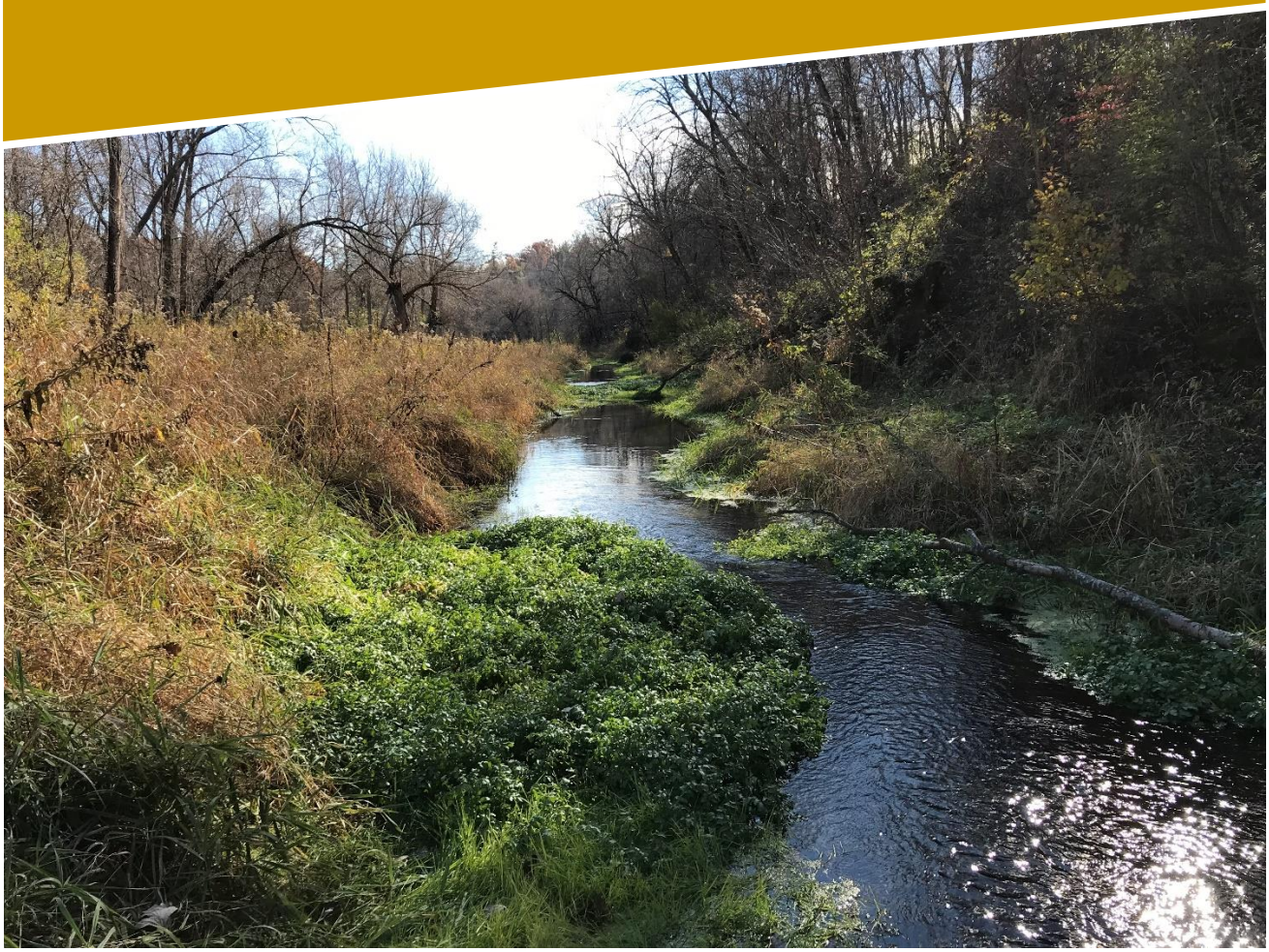
Miesville Ravine Park Reserve

Natural Resource Management Plan

February, 2024



Dakota County forever wild PARKS

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EXECUTIVE SUMMARY

Purpose and Vision

The following Natural Resource Management Plan (NRMP) outlines the historical context, identifies and describes natural resources and communities, and provides a vision and recommendations for addressing issues to conserve, restore, and manage the land of Miesville Ravine Park Reserve (MRPR).

The vision for the park reserve is to be a landscape that:

- Fosters and builds resilient, mature, and high-functioning ecosystems
- Supports natural hydrology and high-quality habitat within Trout Brook
- Provides habitat for native biota, including Species in Greatest Conservation Need (SGCN)
- Allows people to experience the natural heritage of the area via low-impact activities, sensitive to the park reserve's unique resources
- Includes and engages stakeholders, such as public agencies and adjacent landowners, to achieve the best joint management of natural resources in the area
- Mitigates impacts of climate change
- Achieves regionally outstanding ecological quality

The Miesville Ravine Park Reserve NRMP aligns with the Dakota County Natural Resource Management Vision for the Park System:

The water, vegetation, and wildlife of Dakota County parks, greenways, and easements will be managed to conserve biodiversity, restore native habitats, improve public benefits, and achieve resilience and regionally outstanding quality, now and for future generations.

Background

The park reserve consists of 1,847 acres, of which 332 acres represent private inholdings, which means that the publicly owned land is 1,515 acres. The site is located along the southern border of Dakota County, though a small extension of MRPR protrudes into Goodhue County. The park reserve is one of six of the parklands, and one of only two reserves, that constitute the Dakota County park system.

The park reserve is situated along a transition between ecological subsections that includes the level-to-rolling topography of the Rochester Plateau and the heavily dissected landscape of the Blufflands. MRPR is also on the northwestern edge of the Driftless Area, an area that was not covered with glacial drift from the last glaciation event. Trout Brook flows through the central ravine of the parker reserve until its confluence with the Cannon River which flows along the southern boundary of the park reserve. Dozens of steep tributary ravines dissect the park reserve and drain toward Trout Brook, the Cannon River, and several intermittent tributaries.

The unique surface, bedrock, and groundwater geology of MRPR influences many of the existing natural and water resources. Glacial deposits from multiple glaciations combine with a long history of erosion by wind and water to create a rugged topography of bluffs and ravines with variable soil types, including areas of loess (windblown silt and fine sand), outcrops, and shallow depths to bedrock. The dissected topography creates variable slopes and aspect that exerts control on plant communities. The underlying carbonate bedrock is considered karst-prone and characterized by springs and groundwater discharge. This groundwater influence serves as the source water to Trout Brook and provides temperature and clarity requirements that trout depend on. Karst features also facilitate rapid surface-to-groundwater transport of pollutants and are sensitive to groundwater pollution.

Pre-European settlement was a mosaic of prairie, savanna, woodland, and hardwood forest. The park reserve likely hosted outstanding plant community diversity largely driven by topography, soils, and management by indigenous people. Following European settlement, most prairies and savannas, in addition to many wooded areas, were converted to cropland or pasture,. Other wooded areas were thinned or exposed to livestock grazing. Fire suppression caused overgrowth of prairies, savannas, and woodlands. Many historical wildlife populations, including keystone species such as beaver and bison, also generally declined or have been extirpated from the park reserve. Other species like white-tailed deer greatly increased on the landscape. Land use changes also affected the water resources of the park reserve, including ravine erosion, large volumes of sediment deposition along Trout Brook, and channel incision of Trout Brook resulting in a disconnected floodplain.

Modern vegetation exhibits some remnants of the historical vegetation such as bluff prairies and forests that were too steep or rocky to cultivate and dry enough to resist woody encroachment. Twelve land cover types were identified by the NRMP. These land cover types vary in condition from near excellent ecological integrity (remnant bluff prairies) to alterations to the point they no longer resemble native plant communities. The County has restored many formerly cultivated areas and old pastures so that their condition is now on restored trajectory toward resembling a native plant community. Today, the County and partners manage and implement many activities and projects at MRPR and in the surrounding watershed.

Issues

Natural resource issues of MRPR are complex and intertwined. Regional and landscape level issues have impacts across the entire park. More discrete issues affect specific terrestrial and stream habitats. Finally, programmatic issues impact implementation efficiency and effectiveness.

Issues identified for the park reserve include:

- Legacy of post-settlement land use
- Regional landscape degradation and fragmentation
- Loss of key ecological processes
- Habitat fragmentation
- Park access
- Terrestrial habitat degradation, including:
    - Invasive vegetation
    - Invasive earthworms
    - Deer browse
    - Grazing legacy
- Riparian habitat degradation
    - Channel incision and disconnected floodplain
    - Log jams
    - Beaver dams
    - Riparian vegetation
- Erosion
    - Ravine erosion
    - Soil erosion
- Excess nutrients
- Programmatic issues
    - Funding
    - Partnerships
    - Citizen outreach, stewardship, and education
- Climate change

Management Goals and Recommendations

Park-wide goals were established to support the vision, address issues, and determine specific management goals and recommendations for priority features, attributes, and activities. Eighteen priority features, attributes, and activities were identified and assigned goals and recommended strategies for achieving goals. A summary of these goals and strategies are provided in ES Tables 1-18.

ES Table 1. Trout Brook and Tributaries Priority Feature: Goals and Strategies

Goal	Strategies
Goal 1: Improve watershed hydrology and water quality within and beyond the park reserve boundary.	• Work with upstream landowners and partners to implement watershed BMPs and restoration • Restore channels at priority locations
Goal 2: Reconnect the stream with the floodplain	• Restore channels at priority locations
Goal 3: Support channel conditions that provide in-stream habitat	• Work with upstream landowners and partners to implement watershed BMPs and restoration • Restore channels at priority locations • Preserve beaver dams, in general, but consider removal of large beaver dams based on impacts • Integrate vegetation management with adjacent Altered Riparian Area
Goal 4: Restore riparian and upland vegetation	• Restore channels at priority locations • Integrate vegetation management with adjacent Altered Riparian Area

ES Table 2. Mesic Hardwood Forest Priority Feature: Goals and Strategies

Goal	Strategies
Goal 1: Enhance native plant diversity and increase FQI scores	• Control garlic mustard in priority locations, via removal and revegetation • Control invasive woody vegetation in priority locations, via removal and revegetation • Revegetate native species in depauperate soils • Map and prioritize spring ephemeral patches • Monitor plant communities
Goal 2: Reduce invasive vegetation cover to 5%, on average	• Control garlic mustard in priority locations via removal and revegetation • Control invasive woody vegetation in priority locations via removal and revegetation

Goal	Strategies
Goal 3: Regenerate native tree species composition and structure that follows the successional stages, natural history, and complex age structure of the target native plant community for MHs37, MHs38, and MHs39	• Native revegetation of bare soils
Goal 4: Preserve spring ephemeral areas	• Control garlic mustard in priority locations, via removal and revegetation • Map and prioritize spring ephemeral patches
Goal 5: Rebuild healthy soils by significantly increasing vegetation ground cover to 25-100%, typical of Mhs37, MHs38, and MHs39	• Control garlic mustard in priority locations, via removal and revegetation • Control invasive woody vegetation in priority locations, via removal and revegetation • Revegetate native species in depauperate soils •
Goal 6: Enhance native plant diversity and increase FQI scores	• Revegetate native species in depauperate soils • Map and prioritize spring ephemeral patches

ES Table 3. Remnant Prairie/Savanna Priority Feature: Goals and Strategies

Goal	Strategies
Goal 1: Maintain existing restored remnant prairie with less than 5% shrub/tree cover	• Continue and expand use of prescribed fire to maintain prairie and savanna • Suppress woody vegetation with alternatives to fire
Goal 2: Maintain existing restored remnant savanna with less than 50% shrub cover and 50% tree cover	• Continue and expand use of prescribed fire to maintain prairie and savanna • Suppress woody vegetation with alternatives to fire
Goal 3: Prioritize and restore unmanaged and overgrown remnant prairies and savannas to historical open condition	• Assess priority remnant sites for restoration reserve-wide • Continue removal of woody vegetation from historical prairie and savanna
Goal 4: Connect remnant prairie fragments where historical conditions support prairie, savanna, or open woodland communities	• Assess priority remnant sites for restoration reserve-wide • Continue removal of woody vegetation from historical prairie and savanna

Goal	Strategies
Goal 5: Maintain or reduce invasive vegetation cover to less than 5% cover on average	• Assess priority remnant sites for restoration reserve-wide • Continue removal of woody vegetation from historical prairie and savanna • Continue and expand use of prescribed fire to maintain prairie and savanna • Suppress woody vegetation with alternatives to fire • Continue vegetation management and establishment in restored areas
Goal 6: Enhance native plant diversity and increase FQI scores	• Assess priority remnant sites for restoration reserve-wide • Continue removal of woody vegetation from historical prairie and savanna • Continue and expand use of prescribed fire to maintain prairie and savanna • Suppress woody vegetation with alternatives to fire • Continue vegetation management and establishment in restored areas
Goal 7: Conserve dry prairie wildlife specialists	• Assess priority remnant sites for restoration reserve-wide • Continue removal of woody vegetation from historical prairie and savanna • Continue and expand use of prescribed fire to maintain prairie and savanna • Suppress woody vegetation with alternatives to fire • Continue vegetation management and establishment in restored areas

ES Table 4. Reconstructed Prairie Priority Feature: Goals and Strategies

Goal	Strategies
Goal 1: Maintain reconstructed prairie with less than 5% shrub/tree cover	• Continue vegetation management using prescribed fire, mowing, and spot-invasive treatment • Establish burn units with a diversity of management regimes • Consider consistent diversity of management • Introduce/continue grazing, mowing, and haying • Introduce and establish additional native plant species
Goal 2: Maintain or reduce invasive vegetation cover to less than 5% cover on average	• Continue vegetation management using prescribed fire, mowing, and spot-invasive treatment • Establish burn units with a diversity of management regimes • Consider consistent diversity of management • Introduce/continue grazing, mowing, and haying • Introduce and establish additional native plant species

Goal	Strategies
Goal 3: Enhance native plant diversity and increase FQI scores toward a reference condition	• Establish burn units with a diversity of management regimes • Consider consistent diversity of management • Introduce/continue grazing, mowing, and haying • Introduce and establish additional native plant species
Goal 4: Maximize structural heterogeneity	• Establish burn units with a diversity of management regimes • Consider consistent diversity of management • Introduce/continue grazing, mowing, and haying • Introduce and establish additional native plant species
Goal 5: Conserve prairie wildlife specialists	• Establish burn units with a diversity of management regimes • Consider consistent diversity of management • Introduce/continue grazing, mowing, and haying • Introduce and establish additional native plant species

ES Table 5. Overgrown Oak Woodland Savanna Priority Feature: Goals and Strategies

Goal	Strategies
Goal 1: Increase native plant diversity and abundance (significantly increase FQI scores)	• Thin and remove non-oak tree and shrub species • Control common buckthorn and Tartarian honeysuckle, following initial woody removal • Revegetate with native species •
Goal 2: Reduce invasive vegetation cover to 5% cover or less, on average	• Thin and remove non-oak tree and shrub species • Control common buckthorn and Tartarian honeysuckle, following initial woody removal • Revegetate with native species • Native revegetation
Goal 3: Regenerate native tree species composition and structure that follows the successional stages and natural history of the target native plant community (see DNR NPC Field Guide, 2005, for detailed plant community descriptions)	• Thin and remove non-oak tree and shrub species • Revegetate with native species •

Goal	Strategies
Goal 4: Rebuild healthy soils by significantly increasing vegetation cover	• Thin and remove non-oak tree and shrub species • Control common buckthorn and Tartarian honeysuckle, following initial woody removal • Revegetate with native species •
Goal 5: Reduce deer population below 10 deer per square mile	• Thin and remove non-oak tree and shrub species • Revegetate with native species •

ES Table 6. Seepage Meadow Priority Feature: Goals and Strategies

Goal	Strategies
Goal 1: Better understand existing and historical conditions	• Conduct floristic inventory and geomorphic assessment
Goal 2: Increase native plant diversity and abundance to resemble reference remnants and DNR native plant community descriptions	• Control reed canary grass in seepage meadows • Monitor and plan for beaver activity
Goal 3: Reduce invasive vegetation cover to 5% cover on average	• Control reed canary grass in seepage meadows • Monitor and plan for beaver activity

ES Table 7. Altered Riparian Area Priority Feature: Goals and Strategies

Goal	Strategies
Goal 1: Increase native plant diversity and abundance (significantly increase FQI scores)	• Integrate riparian restoration with stream restoration • Prioritize restoration of upstream areas and tributaries • Thin canopy to stage community restoration toward mature forest • Remove dense patches of reed canary grass
Goal 2: Regenerate native tree species composition and structure that follows the successional stages and natural history of the target native plant community (see DNR NPC Field Guide, 2005, for detailed plant community descriptions)	• Integrate riparian restoration with stream restoration • Prioritize restoration of upstream areas and tributaries • Thin canopy to stage community restoration toward mature forest

Goal	Strategies
Goal 3: Reduce invasive vegetation cover to less than 5% cover on average	• Integrate riparian restoration with stream restoration • Prioritize restoration of upstream areas and tributaries • Thin canopy to stage community restoration toward mature forest • Remove dense patches of reed canary grass
Goal 4: Target approximately 75% forest NPC cover	• Integrate riparian restoration with stream restoration • Thin canopy to stage community restoration toward mature forest
Goal 5: Manage and promote beaver to help maintain and benefit the riparian communities	• Integrate riparian restoration with stream restoration

ES Table 8. Altered Upland Forest Priority Feature: Goals and Strategies

Goal	Strategies
Goal 1: Improve native understory diversity and composition toward that described in applicable DNR NPC descriptions	• Thin or clear trees and shrubs to blend with adjacent prairie, savanna, or woodland habitat • Restore target NPCs using strategies described for prairie, savanna, woodland, and mesic hardwood forest priority features
Goal 2: Reduce invasive vegetation cover to less than 5% cover on average	• Thin or clear trees and shrubs to blend with adjacent prairie, savanna, or woodland habitat • Restore target NPCs using strategies described for prairie, savanna, woodland, and mesic hardwood forest priority features
Goal 3: Maintain or reduce shrub and tree cover to less than 5% on average for target prairie NPCs and no more than 50% for target savanna NPCs	• Restore target NPCs using strategies described for prairie, savanna, woodland, and mesic hardwood forest priority features
Goal 4: Maintain or increase oaks and white pine within target woodland NPCs with target canopy cover of at least 50%	• Restore target NPCs using strategies described for prairie, savanna, woodland, and mesic hardwood forest priority features
Goal 5: Maintain or increase oaks and basswood within target mesic hardwood forest NPCs with target canopy cover of at least 50%	• Restore target NPCs using strategies described for prairie, savanna, woodland, and mesic hardwood forest priority features

ES Table 9. Altered Grasslands Priority Feature: Goals and Strategies

Goal	Strategies
Goal 1: Increase native plant diversity and abundance toward target NPC descriptions as described in DNR field guide	• Thin or clear trees and shrubs to restore prairie and savanna habitat • Plant trees suited to target NPCs
Goal 2: Reduce invasive vegetation cover to less than 5% cover on average	• Thin or clear trees and shrubs to restore prairie and savanna habitat
Goal 3: Maintain or reduce shrub and tree cover to less than 5% on average for target prairie NPCs and no more than 50% for target savanna NPCs	• Thin or clear trees and shrubs to restore prairie and savanna habitat • Plant trees suited to target NPCs
Goal 4: Maintain or increase oaks and white pine within target woodland NPCs with target canopy cover of at least 50%	• Thin or clear trees and shrubs to restore prairie and savanna habitat • Plant trees suited to target NPCs
Goal 5: Maintain or increase oaks and basswood within target mesic hardwood forest NPCs with target canopy cover of at least 50%	• Thin or clear trees and shrubs to restore prairie and savanna habitat • Plant trees suited to target NPCs

ES Table 10. Cliff and Rock Outcrops Priority Feature: Goals and Strategies

Goal	Strategies
Goal 1: Understand distribution, extent, and condition of cliff and outcrop communities within the park reserve	• Map distribution, extent, and condition of cliff and rock outcrop communities
Goal 2: Reduce woody vegetation within ROs12c communities to 0-5%	• Remove woody vegetation encroaching on ROs12 communities • Restore and maintain adjacent communities and ecological processes
Goal 3: Maintain or increase FQI scores based on initial condition with composition and structure representative of target native plant communities (see DNR NPC Field Guide, 2005, for detailed plant community descriptions)	• Remove woody vegetation encroaching on ROs12 communities • Restore and maintain adjacent communities and ecological processes

ES Table 11. Cannon River Priority Feature: Goals and Strategies

Goal	Strategies
Goal 1: Support water quality of the Cannon River	• Implement watershed and stream restoration practices within the Trout Brook subwatershed • Assess the recreational tubing launch at Orlando Trail
Goal 2: Support wildlife using the Cannon River	• Implement watershed and stream restoration practices within the Trout Brook subwatershed • Assess the recreational tubing launch at Orlando Trail
Goal 3: Minimize erosion and disturbance along the banks of the Cannon River	• Assess the recreational tubing launch at Orlando Trail

ES Table 12. Ravines Priority Feature: Goals and Strategies

Goal	Strategies
Goal 1: Minimize erosion from ravines to limit the impacts on adjacent and downstream resources	• Inventory and monitor ravines • Develop plans to address concerns, garner funding, and quantify returns
Promote native cover and reduce exotic cover	• Control garlic mustard • Plant a diversity of native understory plants

ES Table 13. Rare Species and Wildlife Priority Feature: Goals and Strategies

Goal	Strategies
Goal 1: Protect and provide habitat for rare species known or likely to occur in the park reserve	• Continue and expand native plant community restoration • Assess rare plant species prior to management actions and park-development activities • Assess Blanding's turtle presence and habitat • Consider reintroductions of dry prairie specialist wildlife • Coordinate with DNR to review fisheries data and if necessary, conduct a fisheries survey and habitat assessment
Goal 2: Provide habitat for a diversity of indigenous wildlife species and SGCN known or likely to occur within the park reserve	• Consider bison reintroduction to reconstructed prairie • Coordinate with DNR to review fisheries data and if necessary, conduct a fisheries survey and habitat assessment
Goal 3: Reduce deer population below 10 deer per square mile	• Manage deer to reduce impact on native plant communities

ES Table 14. Connectivity Goals and Strategies

Goal	Strategies
Goal 1: Reduce edge effects	• Continue native plant community restoration, especially removal in overgrown woody areas • Continue to purchase inholdings, as feasible, to connect and to buffer habitat
Goal 2: Build connectivity and core habitat within and surrounding the park reserve	• Continue native plant community restoration, especially removal in overgrown woody areas • Continue to purchase inholdings, as feasible, to connect and to buffer habitat
Goal 3: Increase core habitat and connectivity	• Continue native plant community restoration, especially removal in overgrown woody areas • Continue to purchase inholdings, as feasible, to connect and to buffer habitat

ES Table 15. Climate Change Resiliency Goals and Strategies

Goal	Strategies
Goal 1: Mitigate harmful changes to natural resources	• Continue native plant community restoration with emphasis on plant and habitat diversity • Monitor for shifts in plant and wildlife populations to inform and adapt management • Manage overgrown woodlands and second growth forest to restore more open woodland and savanna conditions • Selectively and carefully apply assisted migration of plant species or ecotypes that may be climate adaptive • Consider a "regional admixture" approach to seed sourcing • Prioritize surface water and groundwater projects throughout the watershed
Goal 2: Manage for resilient native plant communities	• Continue native plant community restoration with emphasis on plant and habitat diversity • Manage overgrown woodlands and second growth forest to restore more open woodland and savanna conditions • Selectively and carefully apply assisted migration of plant species or ecotypes that may be climate adaptive • Consider a "regional admixture" approach to seed sourcing • Prioritize surface water and groundwater projects throughout the watershed

ES Table 16. Citizen Outreach, Stewardship, and Education Goals and Strategies

Goal	Strategies
Goal 1: Increase public interest, natural resource literacy, and support for parks and open space	• Continue to organize volunteer efforts consistent with current County efforts • Develop volunteer opportunities that combine education, outreach, and stewardship • Continue restoration and management of the native plant communities within the park reserve and educating visitors about its ecology and value
Goal 2: Reduce labor costs and leverage in-kind volunteer match for grants	• Continue to organize volunteer efforts consistent with current County efforts • Develop volunteer opportunities that combine education, outreach, and stewardship • Pilot a site stewardship program and recruit 1-2 volunteer site stewards • Identify MRPR-specific volunteer tasks
Goal 3: Expand site monitoring and data collection capabilities	• Develop volunteer opportunities that combine education, outreach, and stewardship • Pilot a site stewardship program and recruit 1-2 volunteer site stewards • Identify MRPR-specific volunteer tasks
Goal 4: Provide public benefits of natural resources education and stewardship such as knowledge, exercise, and building community	• Continue to organize volunteer efforts consistent with current County efforts • Develop volunteer opportunities that combine education, outreach, and stewardship • Pilot a site stewardship program and recruit 1-2 volunteer site stewards • Continue restoration and management of the native plant communities within the park reserve and educating visitors about its ecology and value

ES Table 17. Partnership Goals and Strategies

Goal	Strategies
Goal 1: Partner with organizations to share resources, leverage funds, and collaborate on funding opportunities	• Continue and expand conservation and restoration project partnership
Goal 2: Partner with organizations to coordinate and implement projects, including education and volunteerism	• Continue and expand conservation and restoration project partnership

Goal	Strategies
Goal 3: Partner with private landowners to implement water quality and habitat management projects	• Continue and expand conservation and restoration project partnership • Pursue partnerships to secure management access to park reserve lands

Implementation

The implementation plan outlines cost and timelines for implementing recommended strategies for priority features. Implementation of native plant community management is based on 46 management units. Implementation is described for native plant community (ES Table 18), water resources (ES Table 19), wildlife management (ES Table 20), and inventory/assessment tasks (ES Table 21-23).

ES Table 18. Cost summary for native plant community management in all units. Baseline management is captured within Maintenance 1 (intensive follow-up management) and Maintenance 2 (long-term, routine management).

Priority Category	Acres	Cost Summary YR 1-5	Cost Summary YR 6-20	Total 20 YR Cost Summary
Maintenance 1	245	$563,143	$112,629	$675,771
Maintenance 2	434	$273,990	$54,798	$328,788
Restoration 1	383	$2,299,751	$459,950	$2,759,701
Restoration 2	783	$3,683,671	$368,367	$4,052,038
Grand Totals	**1846**	**$6,780,025**	**$991,691**	**$7,771,716**

ES Table 19. Estimated costs for remaining Trout Brook stream restorations.

Reach Description	Stream Length (linear feet)	Construction Cost
Tributary (perennial flow north of CR91)	1,100	$49,500
Trout Brook (upstream of CR91 to spring)	2,300	$195,500
Trout Brook (management unit 23)	5,000	$425,000
Trout Brook (management unit 27 downstream to Orlando)	3,650	$310,250
Total Construction Cost		**$980,250**
Engineering Fees (lumped into single project)		**$275,000**
Total	**12,050 linear feet**	**$1,255,250**

ES Table 20. Cost estimates for ongoing wildlife management projects.

Task	Cost YR 1-5	Cost YR 6-20	Total 20 YR Cost
Continued deer management	$25,000	$110,000	$135,000
Beaver conservation	$5,000	$5,000	$10,000
Totals	**$30,000**	**$115,000**	**$145,000**

ES Table 21. Native plant community assessment and inventory tasks identified in the NRMP.

Task	Cost
Map garlic mustard park-reserve wide	$5,000
Map spring ephemerals	$5,000
Assess and map priority prairie remnants	$5,000
Inventory seepage meadow floristic and assess geomorphic assessments	$6,500
Map cliff and rock outcrop plant communities	$5,000
Manage the state-endangered plant species, *Silene nivea*, according to the DNR permit issued September 2023.	TBD
Total	**$26,500**

ES Table 22. Water resources assessment and inventory tasks identified in the NRMP.

Task	Cost
Ravine assessment and catchment delineation	$8,000
Total	**$8,000**

ES Table 23. Wildlife assessment and inventory tasks identified in the NRMP.

Task	Cost
Blanding's turtle habitat assessment	$5,000
Rare species reintroduction assessments	$20,000
Fish habitat assessment	$8,000
Total	**$33,000**

1. INTRODUCTION

Miesville Ravine Park Reserve (MRPR) is a large, 1,847-acre (1,515 acres, not counting in-holdings) park reserve with a diverse range of landscapes and ecosystems. The dramatic and varied topography support a wide array of plant communities from maple-basswood forest to dry bluff prairies, and from cold trout streams and springs to remnant upland bedrock bluff prairies. These natural features provide a valuable opportunity to preserve and restore a unique landscape replete with biodiversity, and which provide a foundation for the public to appreciate, understand, and enjoy the natural heritage of the region.

The following Natural Resource Management Plan (NRMP) outlines the historical context and the existing conditions of MRPR and provides a vision for addressing issues to conserve, restore, and manage the land and the unique features of this special place.

Photograph 1. Overview of the Trout Brook ravine from a remnant bluff prairie.

1.1. Precedent Planning Efforts

Several other County plans precede the NRMP that continue to direct management of MRPR. These plans inform and provide a foundation for the current NRMP.

1.1.1. Dakota County NRMSP

The 2015-2017 Natural Resources Management Systems Plan is a comprehensive, 20-year vision addressing thousands of acres of Dakota County-managed land, including Miesville Ravine Park Reserve. This plan aims to reverse the decline in environmental condition and restore these publicly owned landscapes and waterways through regional and area-specific strategies with the following goals:

- Parks Management:
    - Vegetation Management includes controlling invasive terrestrial species, best management practices for landscapes, strategic seeding, restoring habitats, establishing an adaptive management strategy, and prioritizing natural resources/features.
    - Water Resource Management includes aquatic invasive species control, repairing impaired waterways, best management practices for surface and groundwater quality, monitoring of water systems, and improving water quality and quantity.
    - Wildlife Management includes surveys and monitoring of wildlife habitats and communities and establishing an adaptable management plan.
- Greenways Management includes prioritizing controlling high-risk invasive species as greenways increase spreading of invasive species. Also addresses enhancements to publicly owned areas.
- Conservation Easements Management includes developing a formula for private-public cost sharing, establishing an adaptive management strategy, and addressing landowner responsibility requirements.

1.1.2. Dakota County Parks VSP

The 2017 Visitor Services Plan (VSP), which was developed concurrently with the NRMSP and is its companion document, aims to improve individual and community health, spread environmental awareness and improve ecological quality, maximize park investments, and provide accessible, equitable park services. This plan focuses on visitor engagement and the education to achieve this through outdoor activities, recreational rentals, social and educational events, and volunteer opportunities. The VSP engages and educates the public on various environmental initiatives, including stormwater management, biodiversity and habitat conservation, area clean-ups, and more. These services establish a strong relationship between the environment and the individual, benefiting the community as a whole.

Photograph 2. Parking area and trailhead along 280th St/Orlando Trail.

1.1.3. Dakota County LCP

The 2020 Land Conservation Plan (LCP) is a continuation of the successful 2002 Farmland and Natural Area Protection Plan (FNAPP). The LCP analyses the outcomes of the FNAPP and sets new 10-year operation goals. This plan emphasizes cooperative planning measures with other conservation agencies to restore natural resources and improve biodiversity in Dakota County. Strategies involve establishing conservation and rehabilitation focus areas, restoring natural resources on both public and private lands, expanding and enhancing public areas for improved access and recreational opportunities, and instituting a business plan for services to improve engagement and communication with the public.

1.1.4. Cannon River CRCWMP

The 2020 Cannon River Comprehensive Watershed Management Plan (CRCWMP) under the *One Watershed, One Plan* program is a cooperative plan between local governments and soil and water management districts, including North Cannon River Watershed Management Organization (NCRWMO). This identifies issues, prioritizes solutions, sets budgets, and creates programs on a 10-year implementation timeline for the CRW. The implementation strategies are organized into three tiers:

- Tier 1: Resource Concerns focus on impaired waterways, drinking water quality, and surface and groundwater systems; strategies involve water restoration, water system monitoring, and educating public and natural resource servicers.
- Tier 2: Landscape Alteration Concerns focus on surface water quality and stormwater runoff, drainage systems, and climate related issues; strategies involve BMPs for agriculture and structural practices, runoff and flood control, diligent flood and drainage records, and land conversion tactics.
- Tier 3: Socio-Economic Concerns focus on education for stakeholders and land-use decision makers, public engagement, and planning partnerships; strategies involve volunteer opportunities, training, media and in-person communication, work group and management meetings, and updates, trainings, and workshops.

1.1.5. Miesville Ravine Park Reserve – 2005 Master Plan

The 2005 Miesville Ravine Park Reserve Master Plan was an update of the previous plan that was written twenty years prior, in 1985. Key priorities of the plan included ecosystem restoration, erosion control, waterway and soil management, habitat preservation, and environmental education. Through consideration of historical context, natural resources and water systems, public engagement and feedback, and local jurisdiction and agency input, partners developed a 15-year vision of the park. Recommended design and management strategies included:

- Foster human connection with the environment by addressing user needs through rustic recreational activities, unintrusive facilities, and implemented programs for visitors.
- Analyze ecological quality and natural resources to provide appropriate guidelines for restoration of resources, identify focus areas, and implement sustainable trail design.
- Identify local ordinance requirements and establish regulations for the park visitors and provide guidance for staffing and management of the park reserve.
- Provide budget and phasing schedules and identify funding resources for park improvements and boundary expansion.

Given this planning framework and context, the following sections move onto the current issues at hand for the park reserve.

Photograph 3. Overview of Trout Brook trail with access to channel.

2. EXISTING NATURAL RESOURCE CONDITIONS AND CONTEXT

2.1. Landscape Context

2.1.1. Location

The park reserve consists of 1,847 acres located along the southern border of Dakota County, though a small extension of MRPR protrudes into Goodhue County (Figure 2). The Public Land Survey System location occupies portions of Sections 22, 23, 25, 26, 27, 35, and 36 of Township 113 Range 17; Section 31 of Township 113 Range 16; Section1 of Township 112 Range 17; and Section 6 of Township 112 Range 16.

The park reserve is one of six of the parklands, and one of only two reserves, that constitute the Dakota County park system. The land of MRPR is primarily publicly owned, but 332 acres represent private inholdings. Two parking lots are located in the southern portion of the park reserve along either side of 280th Street. Roadside parking is located along County Road 91/Miesville Trail, in the northern portion of MRPR.

Photograph 4. Park reserve entrance along 280th Street/Orlando Trail.

Because of the importance in preserving the natural resources of this park, recreational usage has been kept to a minimum, which helps protect and conserve the resources from public impacts. Only three% of the park reserve is dedicated to human use, focusing primarily on activities of a rustic nature. Activities include hiking, geocaching, fishing, kayaking/canoeing, hunting, picnicking, hammocking, and snowshoeing. These allow unintrusive engagement in which the public can enjoy the beauty that the reserve offers while being educated about the area's natural features and ecosystems, without compromising the quality of these features. Amenities are kept to a minimum including primitive trails, two picnic shelters, and vault/portable toilets, all located in the Cannon River floodplain (see Figure 3).

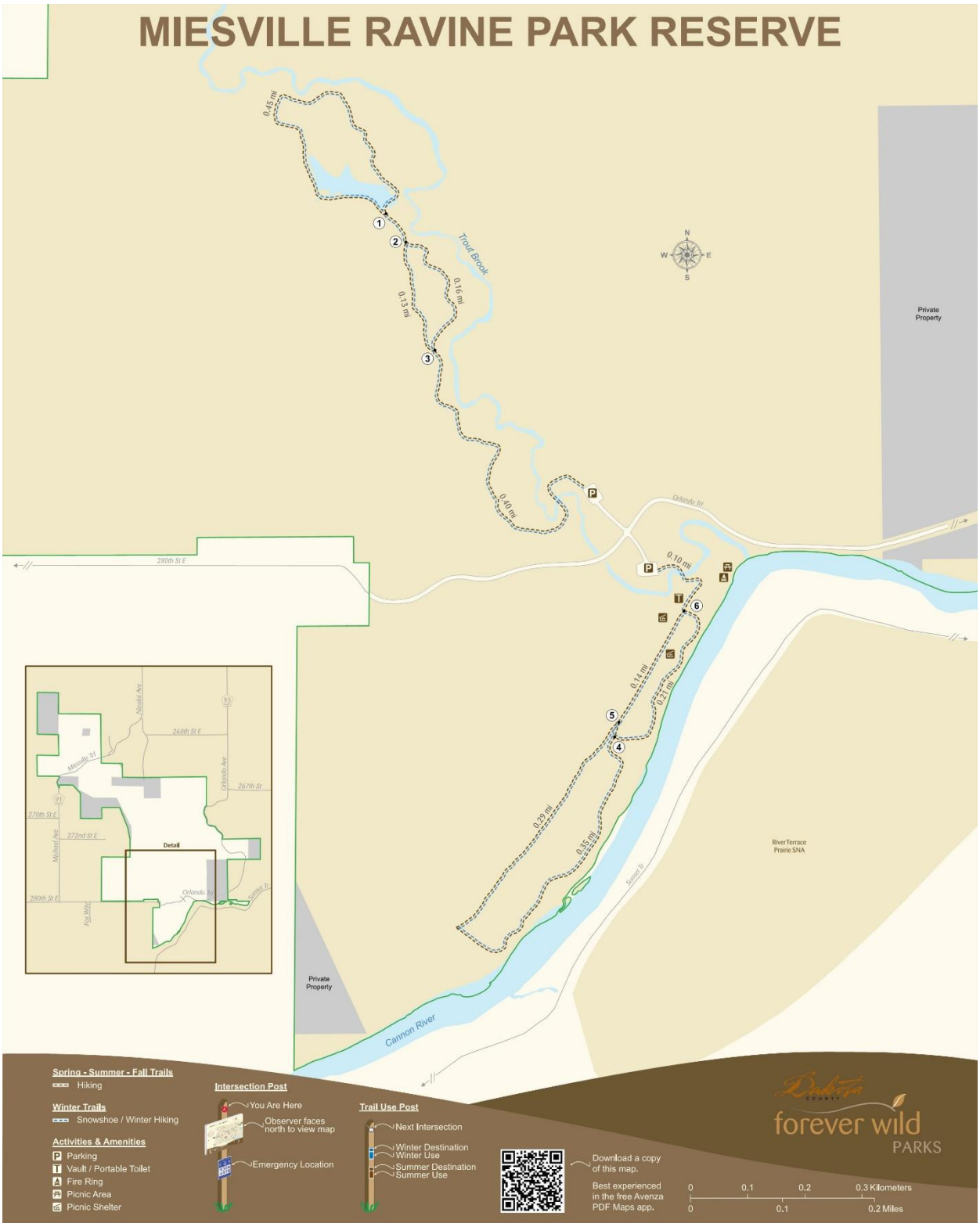


Figure 1: Miesville Ravine Park Reserve – All Seasons Trail Map (Dakota County)

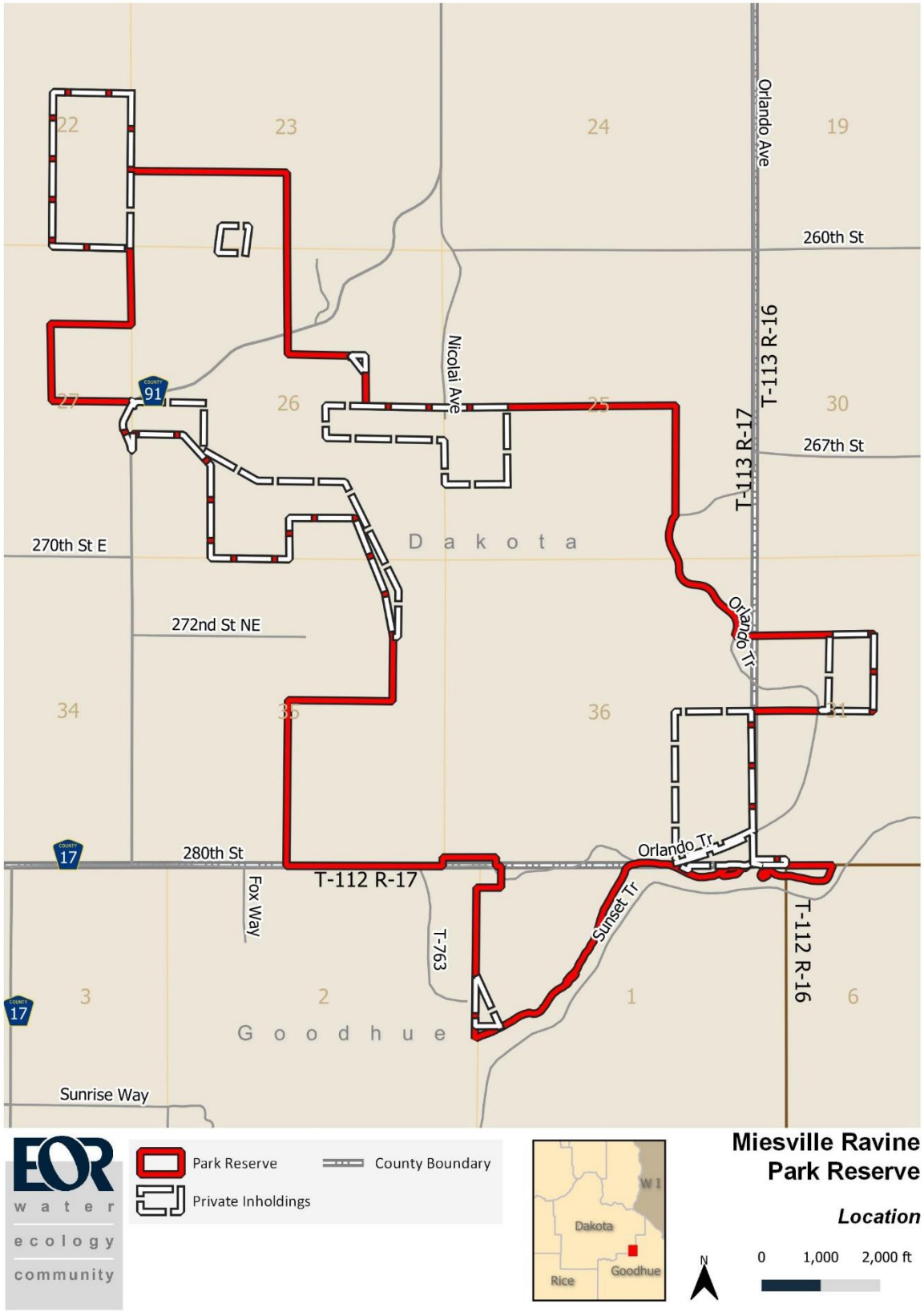


Figure 2. Park Reserve location.

2.1.2. Regional Natural Resources Context

Miesville Ravine Park Reserve is situated within the Eastern Broadleaf Forest province and lies along the boundary of two ecological subsections, the Rochester Plateau and the Blufflands. The boundary of these two subsections is generally a transition area between the level-to-rolling topography of the Rochester Plateau to the heavily dissected landscape of the Blufflands. This transition is encapsulated within MRPR, with relatively flat blufftops located within the Rochester Plateau and steep ravines within the Blufflands. MRPR is also on the northwestern edge of the Driftless Area, an area that was not covered with glacial drift from the last glaciation event, which extends throughout much of southwestern Wisconsin and northeastern Iowa.

Although dominated by agricultural land use, there are other protected lands within Dakota and Goodhue counties in this area (Figure 3). Nearby protected lands include several conservation easements to the west of the park reserve, River Terrace Prairie SNA, and state forest lands and Tangential WMA to the south along the Cannon River. The 2020 LCP identified MRPR as part of the Trout Brook Conservation Focus Area (Figure 4). Because of its Dakota County jurisdiction, the park reserve comprises the vast majority of the Trout Brook CFA, with some adjacent lands and important upstream drainages of the Trout Brook watershed also included.

2.1.3. Adjacent Land Use

Surrounding land use is dominated by row crop agriculture (Figure 5). Exceptions include several wooded ravines extending beyond the park reserve boundary, the roughly 235-acre Gopher Hills Golf Course immediately north of the park reserve, and public natural lands along the Cannon River.

Photograph 5. Overview of reconstructed prairie on blufftop, looking toward farmsteads and agricultural lands in the distance beyond the park reserve boundary.

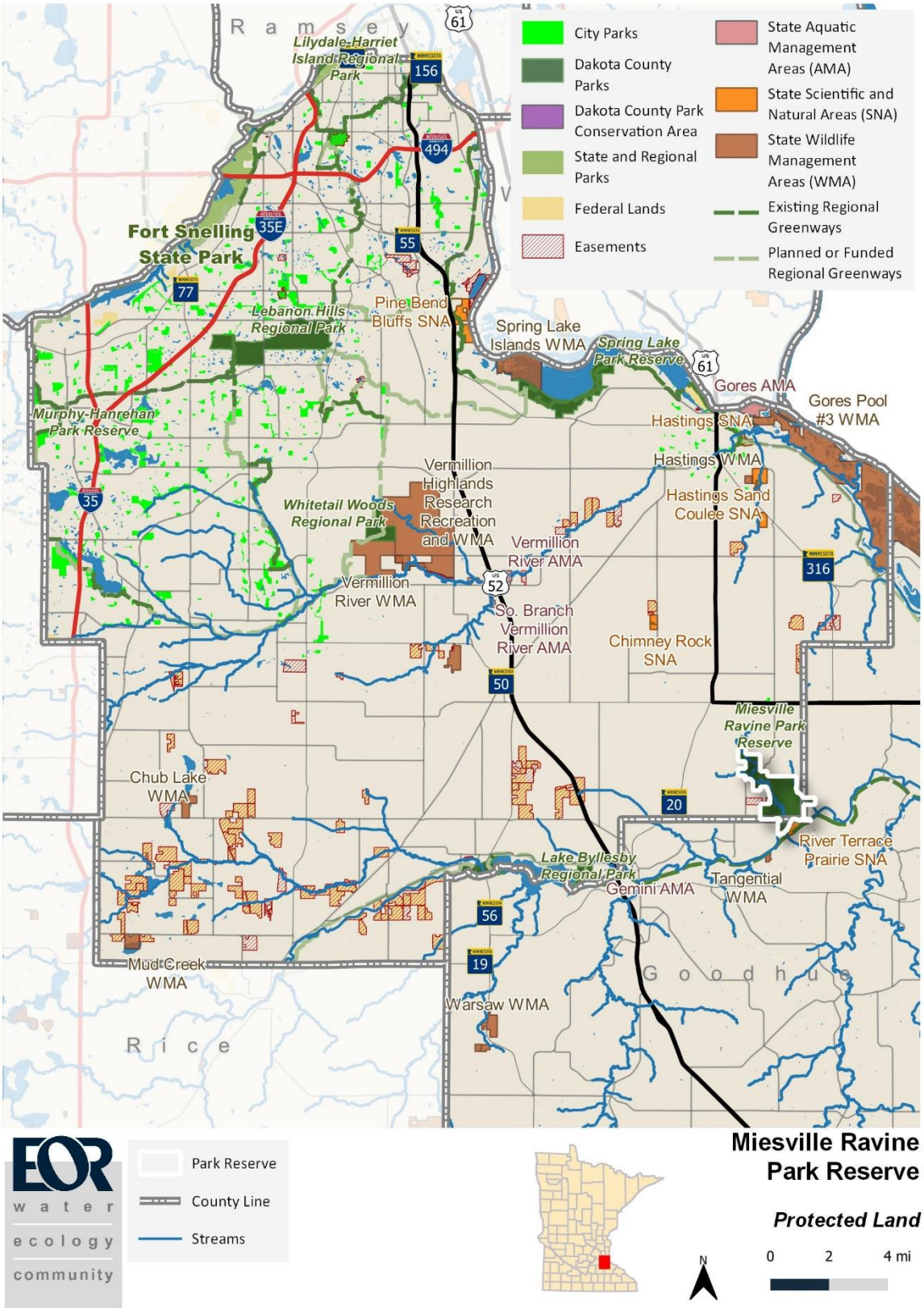


Figure 3. Protected lands in Dakota County and park reserve vicinity.

1. **180th Street Marsh**
2. **Cannon River**
3. **Chimney Rock**
4. **Chub Creek**
5. **Chub Lake**
6. **Darden Creek**
7. **Douglas Township Natural Area**
8. **Dutch Creek**
9. **Etter Creek**
10. **Hampton Woods**
11. **Lake Marion**
12. **Lebanon Hills**
13. **Marcott Lakes**
14. **Minnesota River**
    - A. Black Dog Unit
    - B. Fort Snelling Unit
    - C. Mendota/Lilydale Unit
    - D. Oheyawahe Unit
15. **Mississippi River**
    - A. Pine Bend Unit
    - B. Spring Lake Unit
    - C. River Bluffs Unit
    - D. Vermillion Bottoms Unit
16. **Mud Creek**
17. **Orchard Lake**
18. **Pine Creek**
19. **Sand Coulee**
20. **Spring Creek**
21. **Trout Brook**
22. **Vermillion Highlands**
23. **Vermillion River Main Stem**
24. **Vermillion River Tributaries**

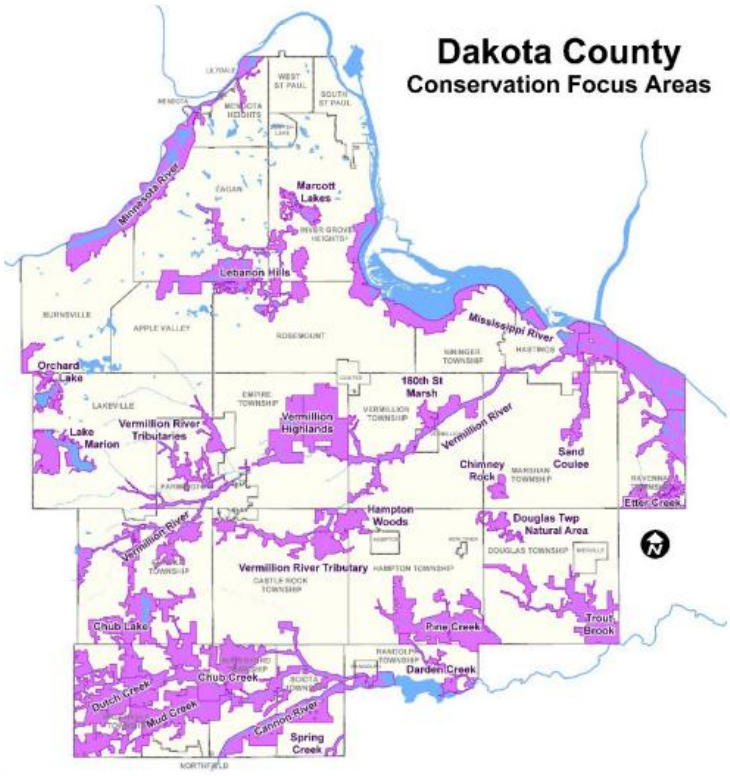


Figure 4. Dakota County Conservation Focus Areas. Miesville Ravine Park Reserve is within the Trout Brook CFA.

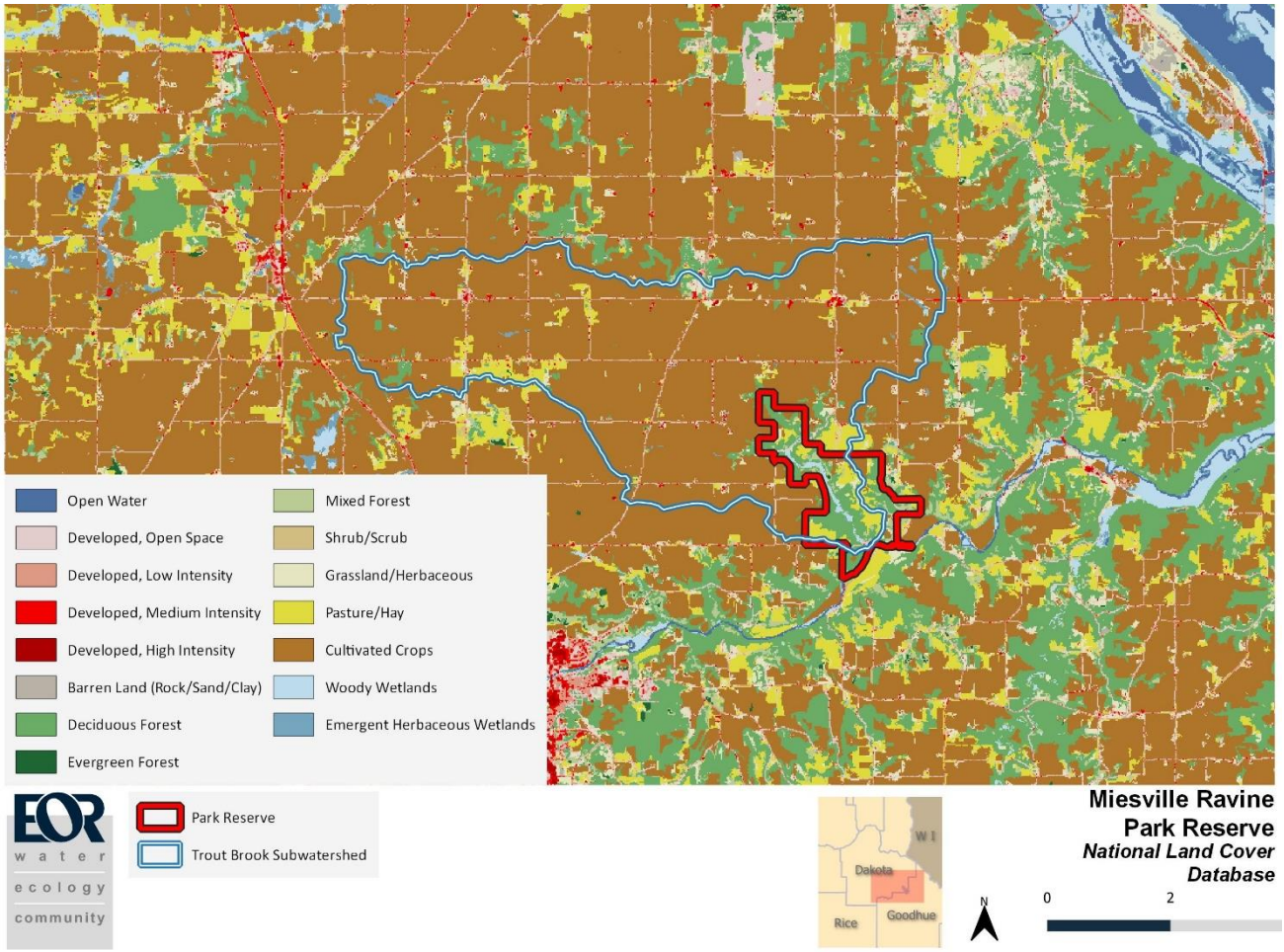


Figure 5. Land use based on National Land Cover Dataset (NLCD).

2.2. Historical and Cultural Context

Humans have occupied the MRPR area and surrounding region since the last glacial retreat 10,000-12,000 years ago. We see traces that they have left in archaeological sites scattered throughout the area. There have been five definitive stages of human occupation since this time, the last pre-European settlers being people of the Dakota Nation. These communities migrated here to take advantage of the abundant natural resources, especially the water systems.

Waterways were especially appreciated for purpose of travel, food, healing, bathing, and general enjoyment. Different bodies of water serve different purposes, and the Cannon River Watershed offered a diverse network of waterway systems. Bdote is a Dakota term that describes the confluence of two water bodies. Specifically, this is in reference to the meeting of the Minnesota and Mississippi rivers, a sacred location to the Dakota culture. The concept of Bdote is an important one to native tribes as they represent waterways from two different origins that become one, such as Trout Brook and Cannon River. These areas were typical locations for native tribes to place their camps for convenience and accessibility to different natural resources. Indigenous people used rivers as sources of transportation, lakes as sources of food (fish and mussels), ponds and wetlands as sources for wild rice, and springs as sources of year-round water. Beyond water, the landscapes offered vital gifts as well. This area specifically was a great resource for the communities that depended on the land's forests for building materials for structures and canoes. They also used the rolling hills for accessibility and mobility, vegetation for foraging, and wildlife for hunting. The prairies and oak savanna of the region were maintained not only by natural fires, but intentionally burned by Native Americans to improve hunting and foraging grounds. The Dakota people, like the groups before them, possessed a deep appreciation for the land and considered its resources gifts to be grateful for. They allowed the land, systems, and seasons to influence their culture and to determine where and when they placed their camps.

The landscape experienced a dramatic transition from prairie, savanna, forest, and wetlands to cropland and pasture following European invasion and settlement. European settlers were also attracted to the MRPR area and surrounding region; the waters and land appealed to them for a different set of purposes. Settlers quickly began taking advantage of Cannon River, setting up mills along the stream banks. They grew wheat in the fields for the mills and dammed the river for hydropower. The park reserve was one of the last areas in the greater region to be occupied by European settlers, but eventually a trail was created from the town of Miesville to Trout Brook to utilize the region's land. By the late 1800's, a plethora of farmsteads occupied the present-day park reserve, and tracks through the park reserve were constructed for the Chicago, Milwaukee, & St. Paul Rail line through the Cannon River Valley.

Decades of overuse and mismanagement of the area's natural resources lead to a sharp decline in the health and quality of the local environment. Hunting extirpated local wildlife, such as bison. Mussel communities were compromised in the height of the "pearl rush" of the late 1800s. Native plant communities were degraded or lost from the landscape along with the two natural disturbances, fire and native grazing, both ecosystem processes essential to maintaining prairie and savanna. Resultant land use changes also influenced the volume and velocity of water moving over the landscape leading to radically increased amounts of surface-water runoff, greatly reduced groundwater recharge, and massive erosion. Landscapes

were also altered through agriculture, transportation infrastructure, stream alteration, dam construction, and deforestation.

Farming within the park reserve gradually declined over the 20th century and with the first acquisition of park reserve parcels by the County in 1985. Since then, the park reserve has expanded through additional acquisitions and been managed with natural resources as the priority. Further context on the historical vegetation and the management activities conducted at MRPR are provided in subsequent sections.

Photograph 6. Film negative of wood sawing crew near Miesville, MN dated 1919. Photo courtesy of Goodhue County Historical Society.

2.3. Geology

2.3.1. Bedrock and Groundwater Geology

Bedrock underlying the surficial sediments consists of the lower Ordovician Shakopee Formation of the Prairie du Chien Group. The Shakopee Formation is a mix of limestone and dolomite, both of which are carbonate minerals. Underlying the Shakopee Formation is the Oneota Dolomite, another carbonate unit. Together, these two units form the Prairie du Chien aquifer, a heavily used aquifer within Dakota County, as well as the greater Twin Cities Metro Area. The carbonate bedrock is considered karst-prone, a

common geology in southeast Minnesota (Figure 6). Karst geology results in karst features such as springs, cracks and fissures in bedrock, and sinkholes created from water dissolving the carbonate in soluble bedrock. Karst springs and groundwater discharge serve as the source water to Trout Brook and provide the temperature and clarity requirements that trout depend upon. At least 24 springs are located within MRPR (Figure 17). However, karst features also facilitate rapid surface-to-groundwater transport of pollutants and cause the area to be very sensitive to groundwater pollution (Figure 7; sensitivity rating descriptions provided in

Table 1). More information regarding karst features and springs can be obtained here: [Karst Feature Inventory (state.mn.us)](#) (Figure 5A).

Figure 5A. Karst Feature Inventory from MN DNR.
Karst features are marked on an interactive map.

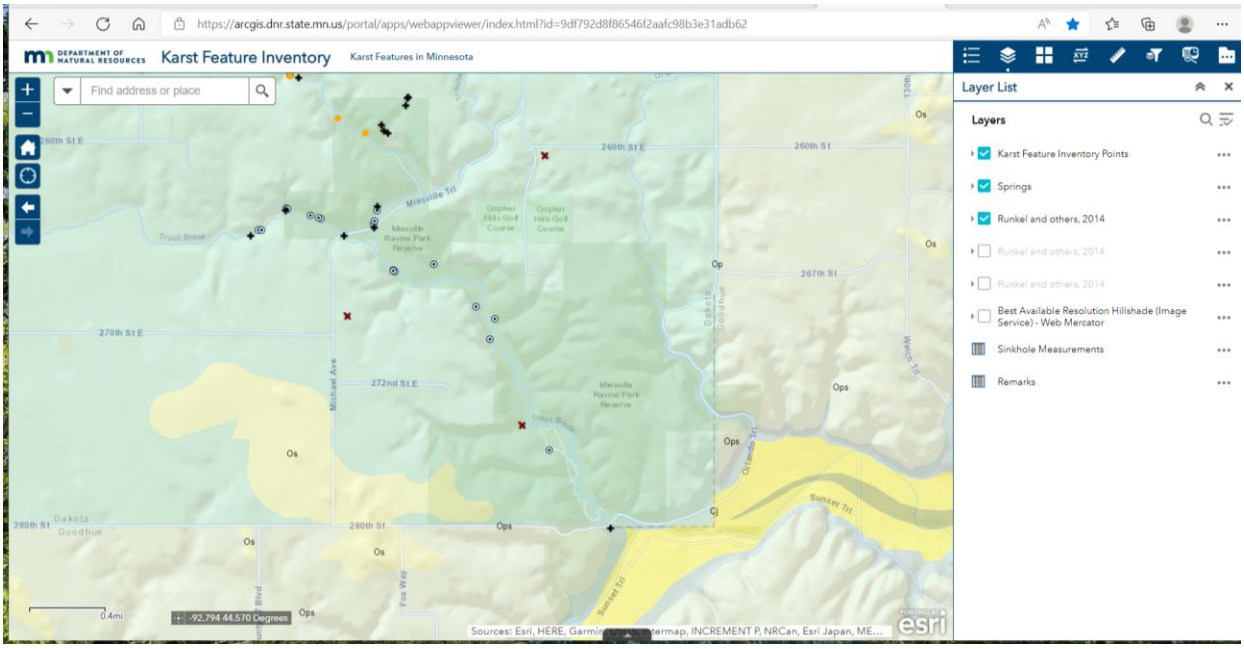


Table 1. Groundwater sensitivity ratings within and near MRPR (Balaban and Hobbs 1990; Berg 2003).

Sensitivity Rating	Estimated travel time for water-borne surface contaminants to reach the aquifer
Very High	Hours to months
High	Weeks to years
High-Moderate	Years to a decade
Moderate	Several years to decades

2.3.2. Surficial Geology and Soils

Like everywhere in Minnesota, the surficial geology of the park reserve area is largely shaped by glacial history. Over the last 2 million years, glaciers have advanced and retreated across Minnesota, each time moving, scouring, and re-working the landscape, and depositing sediment as they retreat. The most recent glaciation occurred about 12,000 to 10,500 years ago, but several other periods occurred before that. The park reserve is located in a unique area of the state where glacial deposits from multiple glaciations combine with a long history of erosion by wind and water to create a rugged topography of bluffs and ravines with variable soil types (Figure 8 and Figure 9). Blufftops within the park reserve were not covered during the most recent glaciation (hence the "driftless" features) and generally consist of loess (windblown silt and fine sand) that was deposited by glaciers from the last and earlier glacial events, over 120,000 years ago (Figure 10). The ravine slopes consist of colluvial soils formed by downward creep of loess and fractured bedrock from upslope. Ravine bottoms are dominated by sandy floodplain alluvium deposited by modern, post-glacial streams. Depth-to-bedrock is relatively shallow and less than 50 feet, with many outcrops along slopes (Photograph 7).

Soil textures on blufftops are dominated by loam and silt loam, with rocky loams and silt loams along ravine slopes and sandy loams in the ravine bottoms. Hydrologic soil groups along blufftops and slopes are dominated by soils with moderately low runoff potential ()Figure 14, group B). Consequently, precipitation infiltrates fairly rapidly to the groundwater, which may carry pollutants such as nitrate

Table 2. Hydrologic soil group descriptions as defined by NRCS.

Hydrologic Soil Group	Description
A	Lowest Runoff Potential
B	Moderately Low Runoff Potential
C	Moderately High Runoff Potential
D	Highest Runoff Potential

Soils along blufftops and steep slopes are largely categorized as moderately to highly erodible to water, with lower slopes and ravine bottoms less erodible as defined by the soil K factor (i.e., the erodibility to surface water flow and splash from rainfall) (Figure 12). The vast majority of soils are considered highly susceptible to wind erosion, with exception of ravine bottoms that are well-sheltered (Figure 13). A composite soil erosion hazard index from NRCS that combines K factor, slope, and content of rock fragments indicates that much of the park reserve is classified as severe or moderate erosion hazard (

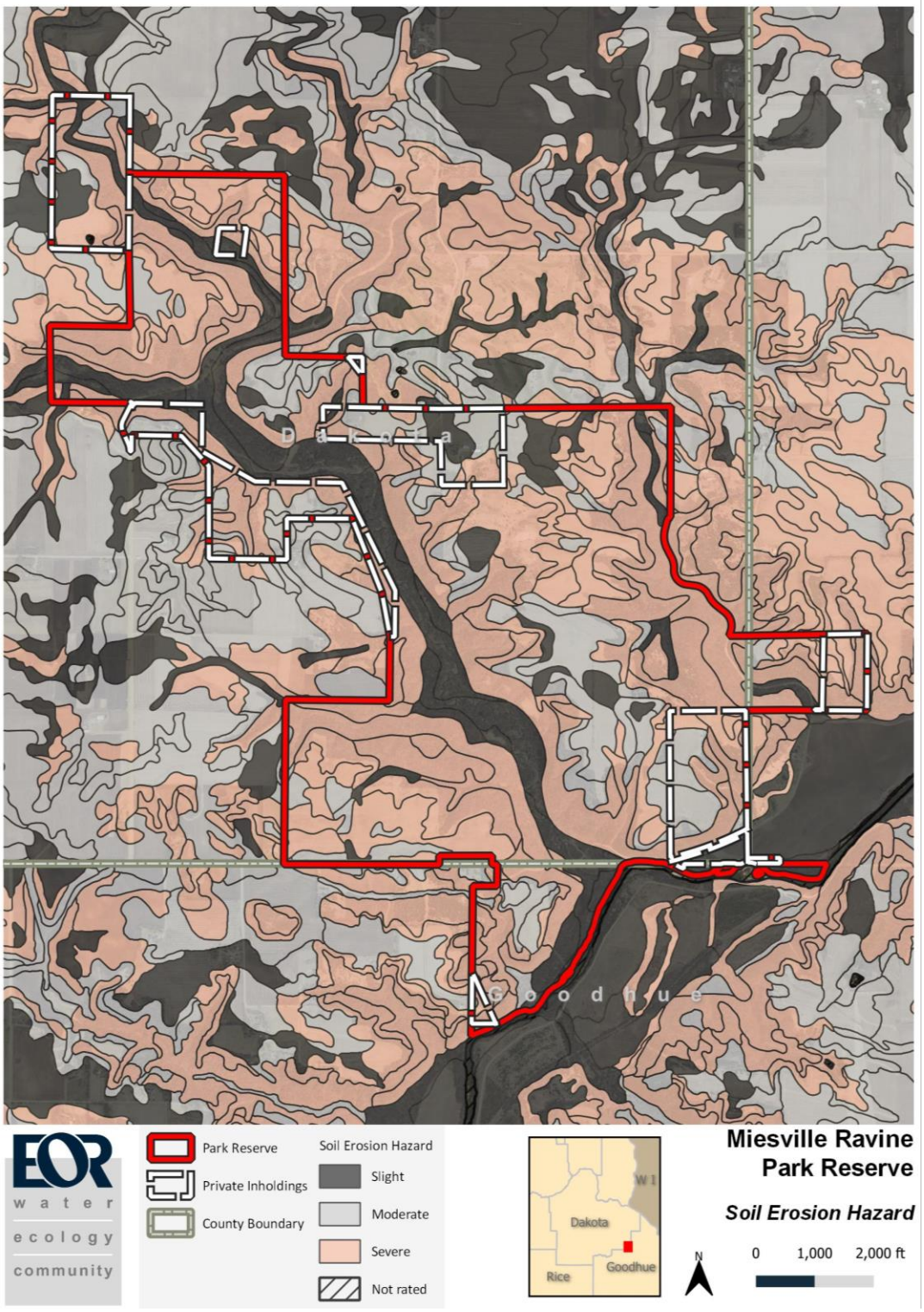
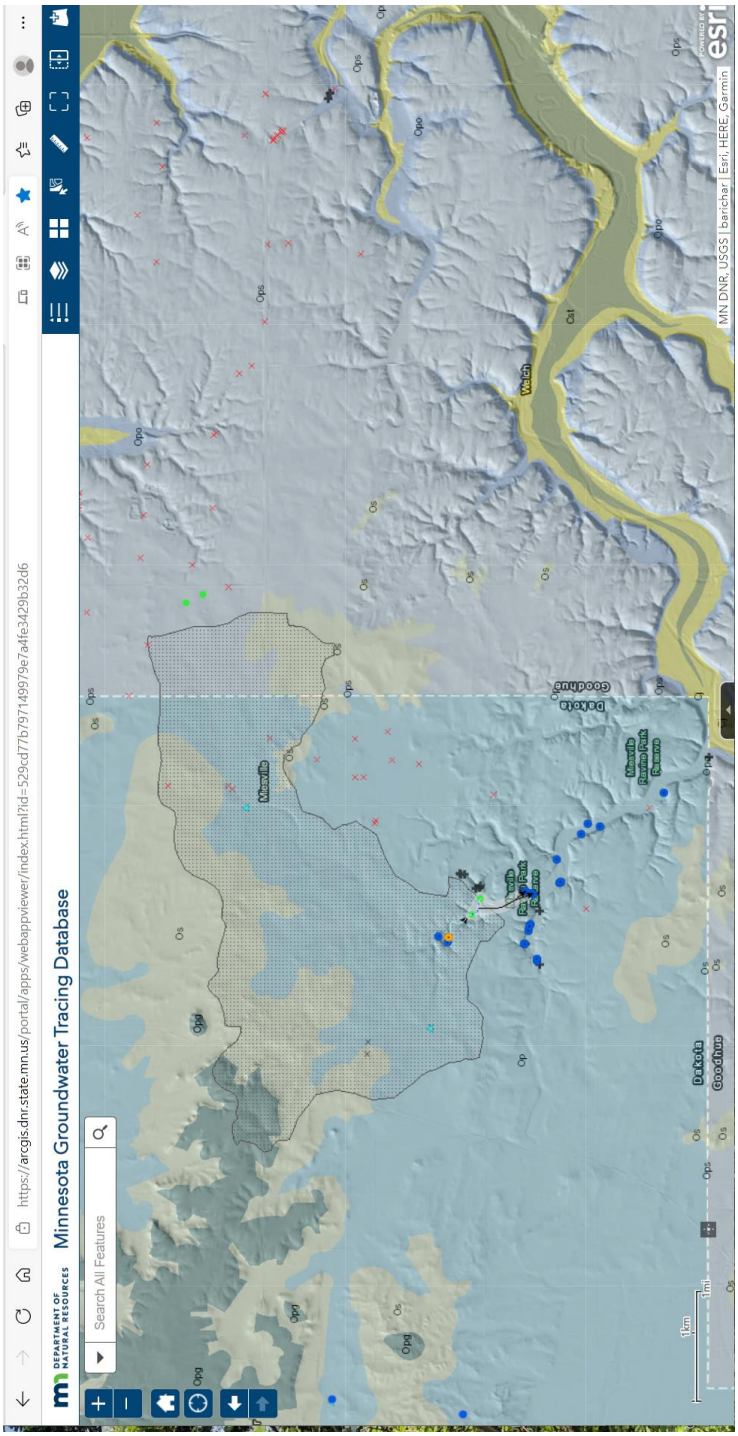


Figure 14)

Another good source of information and a map of springs and groundwater tracing is Minnesota Groundwater Tracing Database (state.mn.us) (Figure 5B)

Figure 5B. Map showing groundwater dye tracing.

Dye-tracing reveals upland areas that contribute to springs down-watershed (hashed polygon on the map).



Photograph 7. Exposed limestone outcrop within mesic hardwood forest.

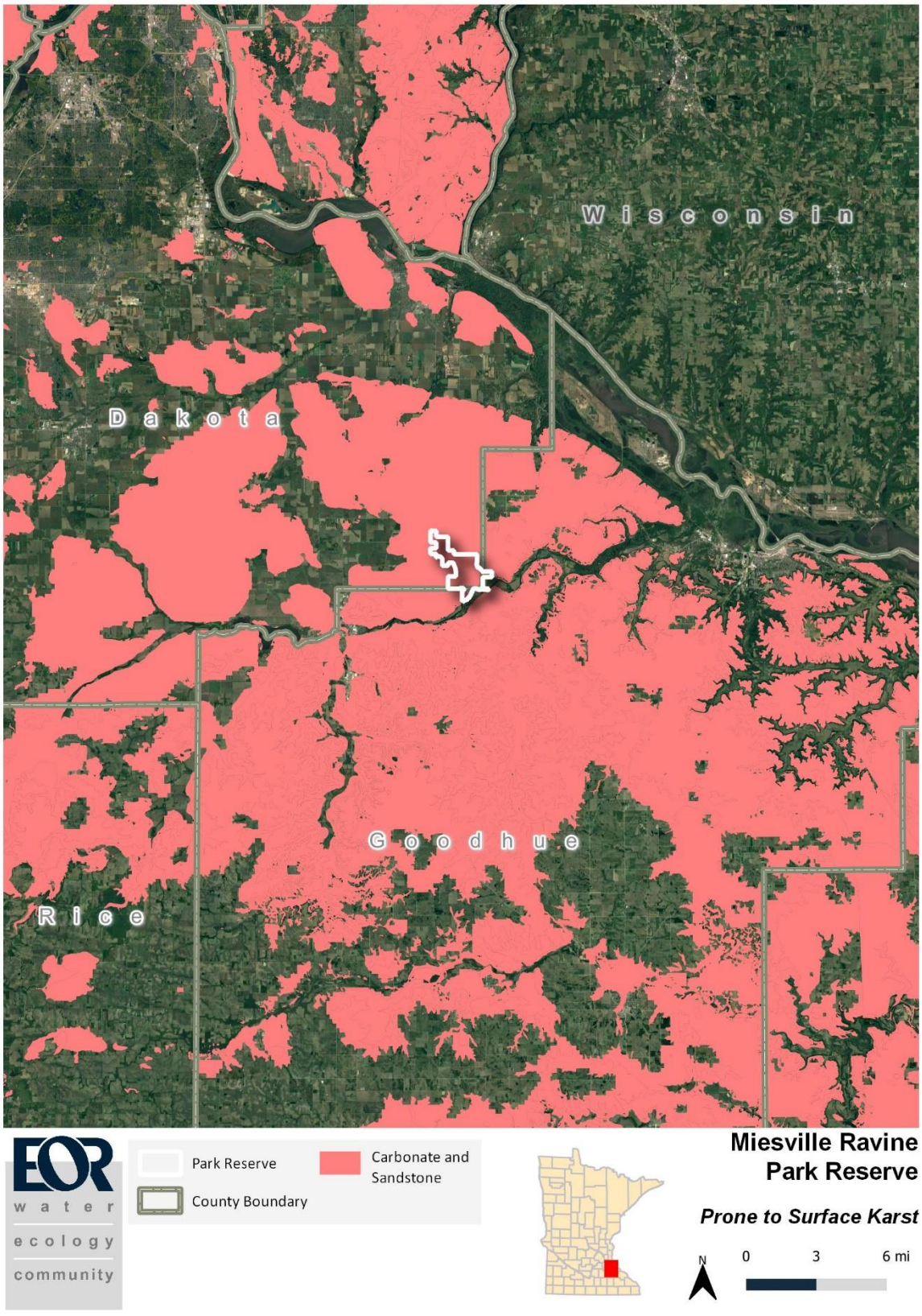


Figure 6. Karst-prone regional geology.

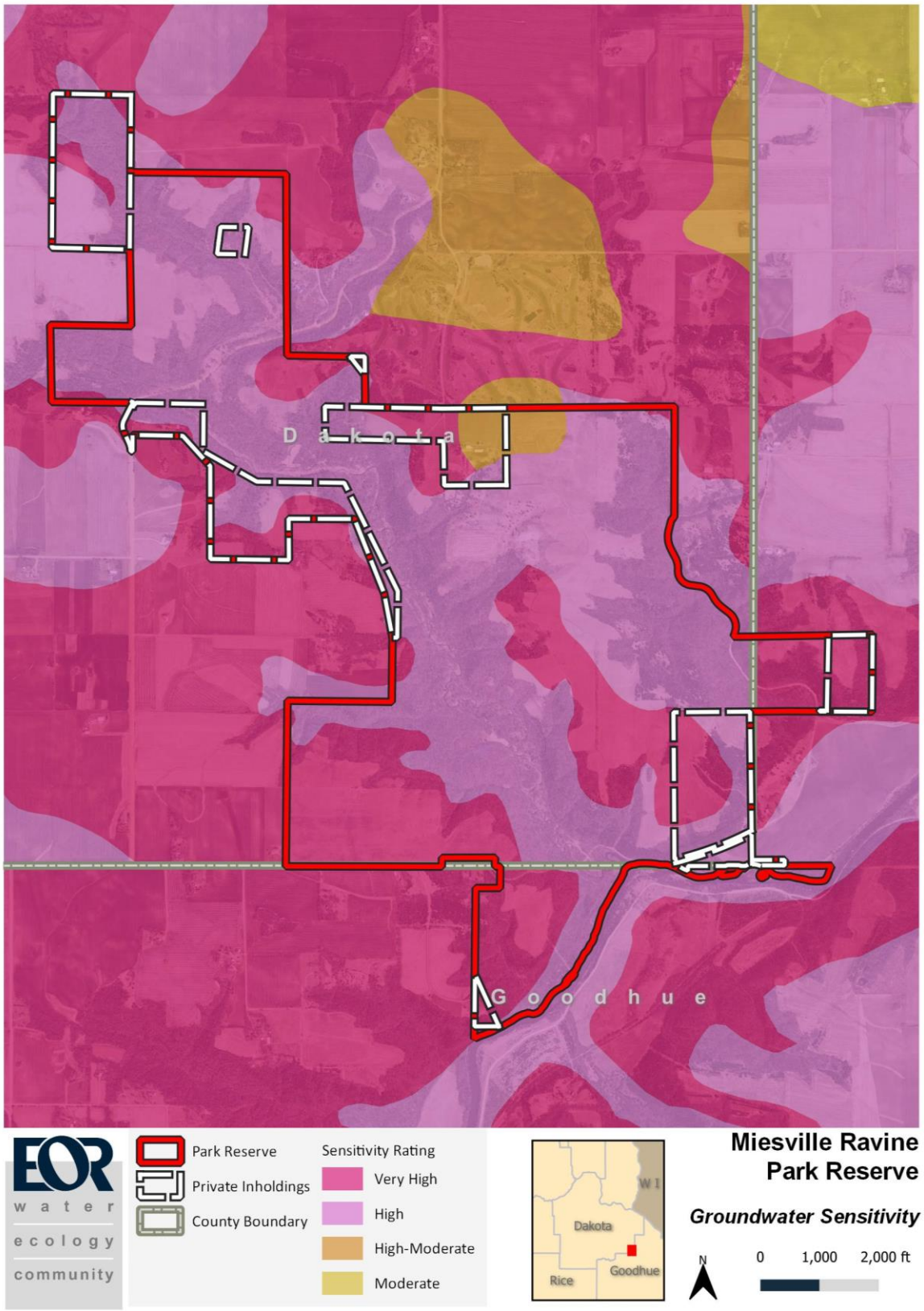


Figure 7. Groundwater sensitivity for Dakota and Goodhue Counties.

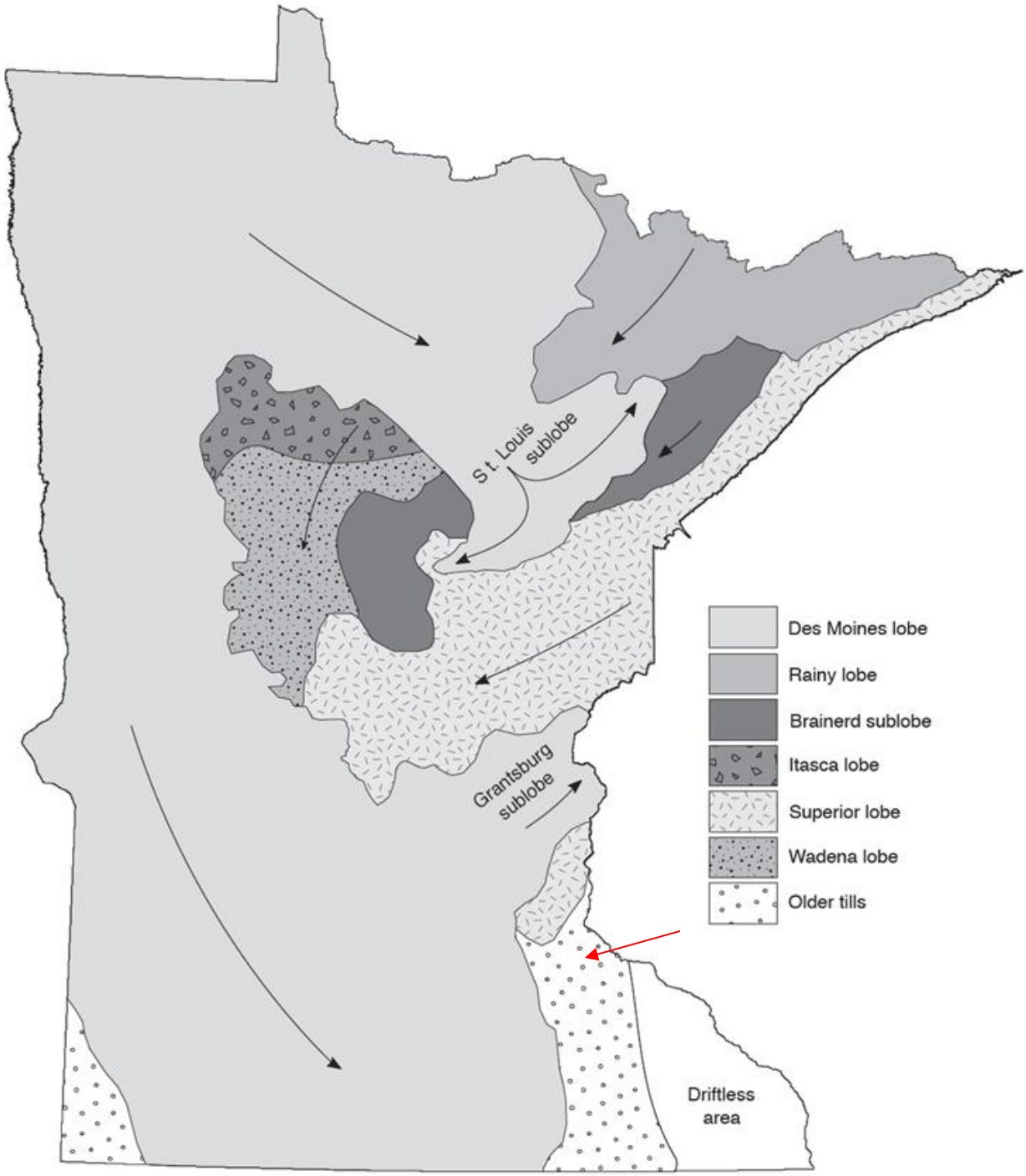


Figure 8: Map of Minnesota ice lobes of glaciations (Lusardi, 1994). Arrow indicates approximate location of MRPR.

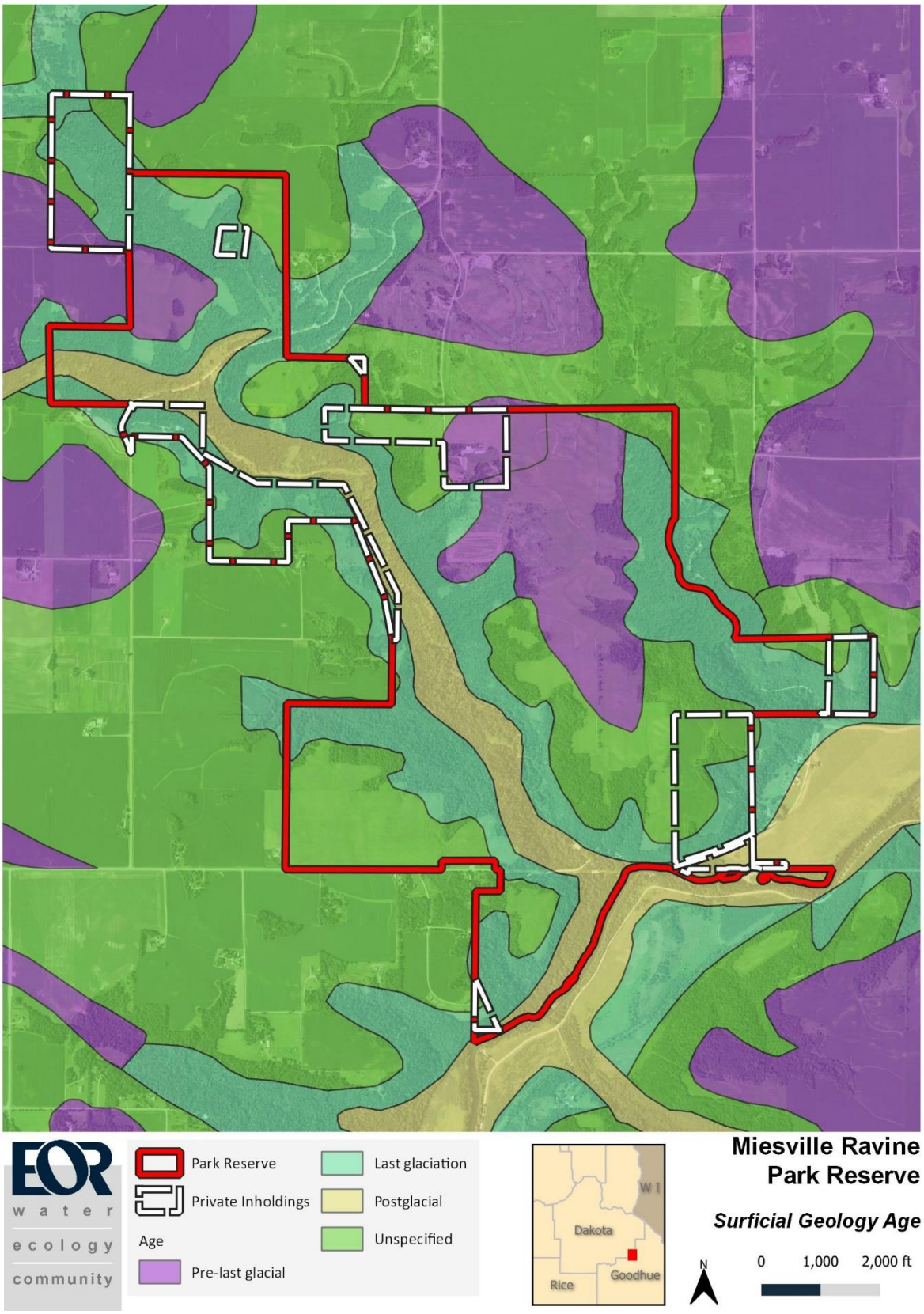


Figure 9. Age of surficial deposits.

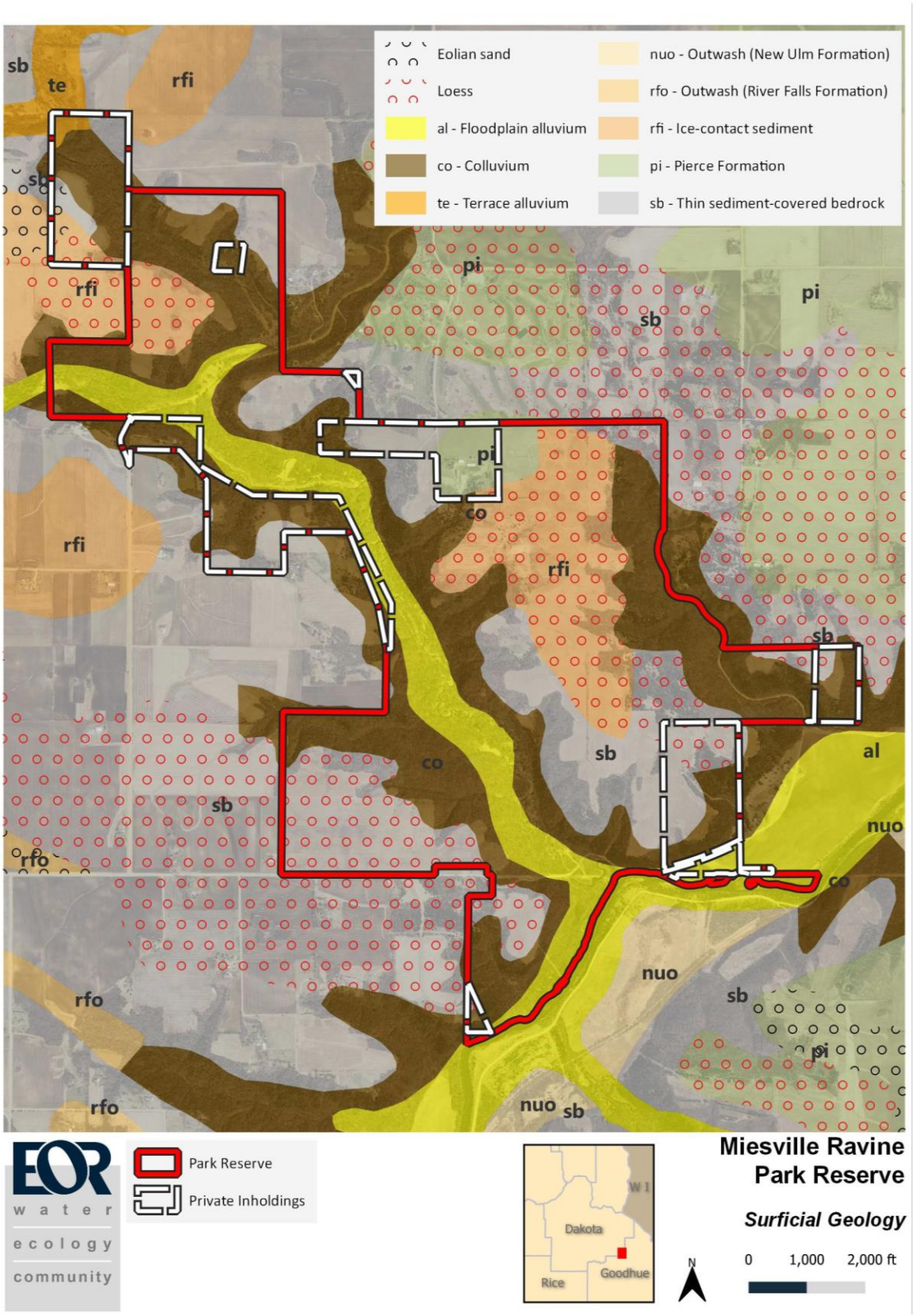


Figure 10. Surficial geology units and loess/eolian sand overlays.

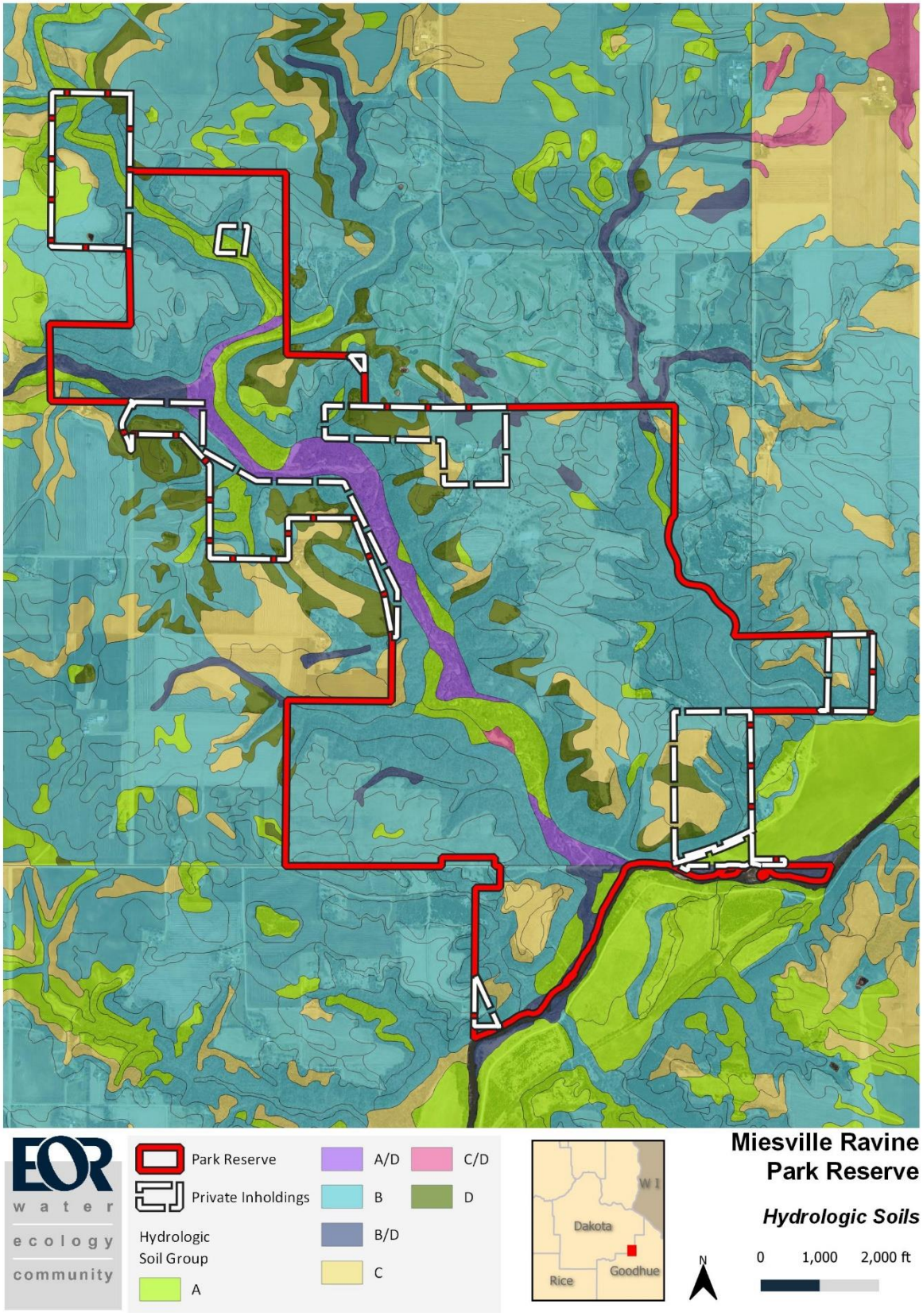


Figure 11. Hydrologic soil groups (see for code descriptions).

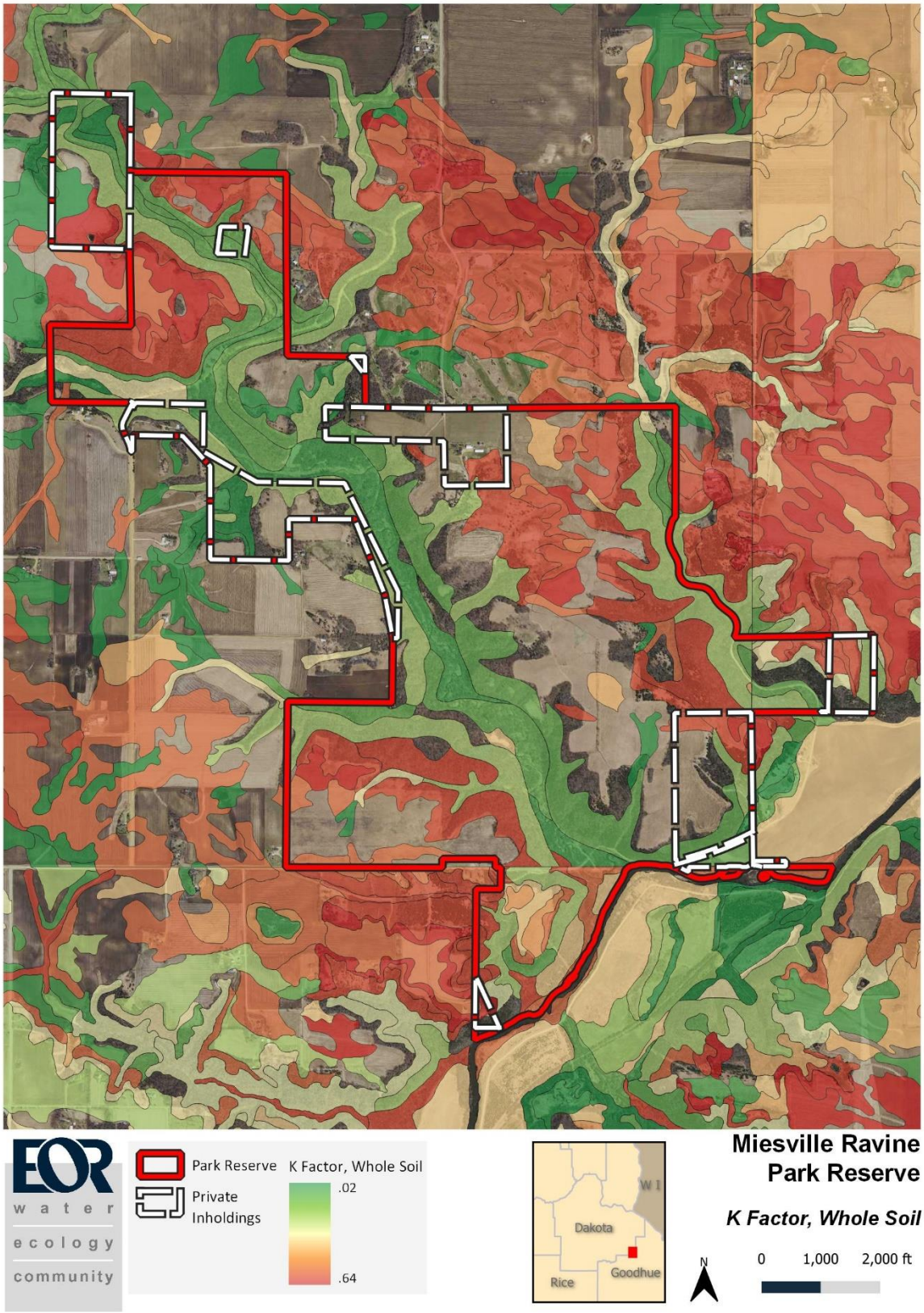


Figure 12. Soil K factor (erodibility to surface water flow and splash from rainfall).

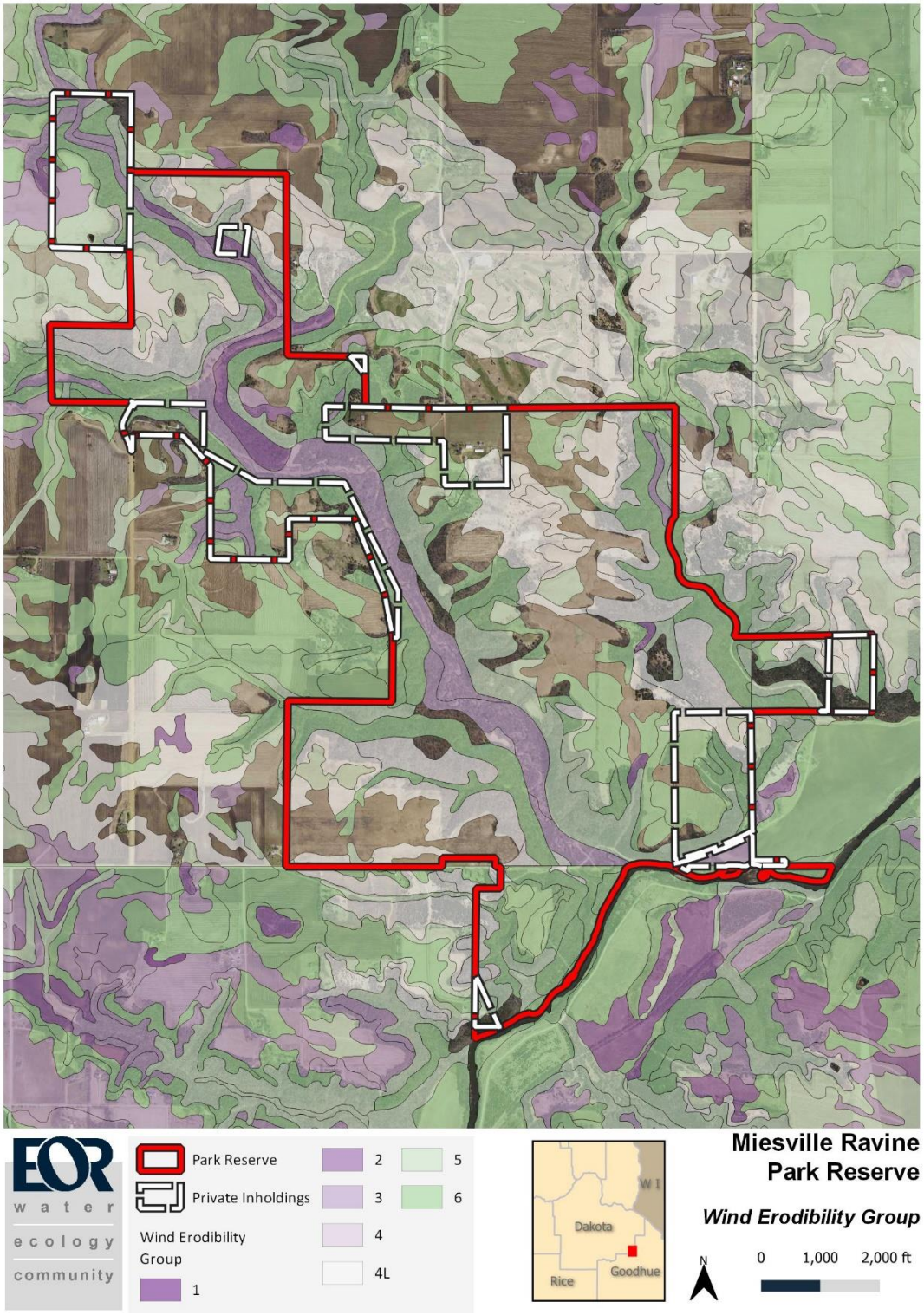


Figure 13. Soil wind erodibility, a measure of the susceptibility of soils to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion; soils assigned to group 8 are the least susceptible. The highest value mapped in or near the park reserve is 6.

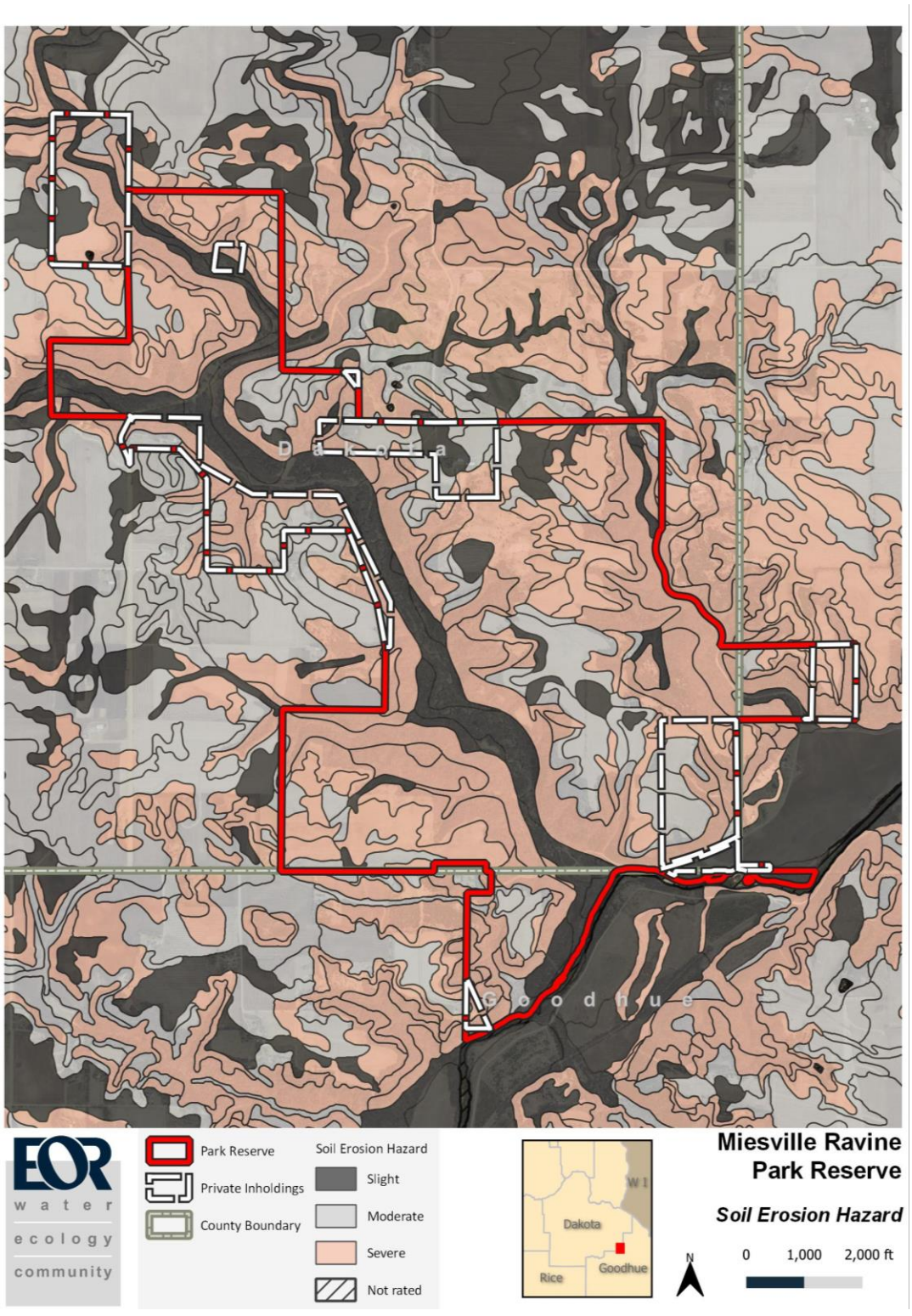


Figure 14. Soil erosion hazard classifications that integrate K factor, slope, and content of rock fragments.

2.3.3. Bluffs, Slopes, and Ravines

The topography of the park reserve is characterized by the central valleys of Trout Brook and the Cannon River (Figure 15). Steep slopes flank the valley bottoms, with relatively flat blufftops dissected by ravines that drain to the central watercourses. The diversity of slope, aspect, and soil conditions provided by these landforms contributes immensely to the park reserve's biotic diversity. Blufftops provide a relatively well-drained environment with generally deeper soils. North- and east-facing slopes result in cooler soil temperatures and moister conditions that facilitate forest communities, with south and west facing slopes being warmer and drier and hosting prairie, savanna, and woodland communities. The central ravine of Trout Brook consists primarily of southwest- and northeast-facing slopes, but the dissected ravines branching from the main valley create high diversity of aspect over relatively small spatial scales. The flat valley bottoms of Trout Brook and the Cannon River consist of well-drained soils that would have historically been exposed to seasonal flooding.

Photograph 8. Two ravines dissecting white pine-oak woodland (FDs27b).

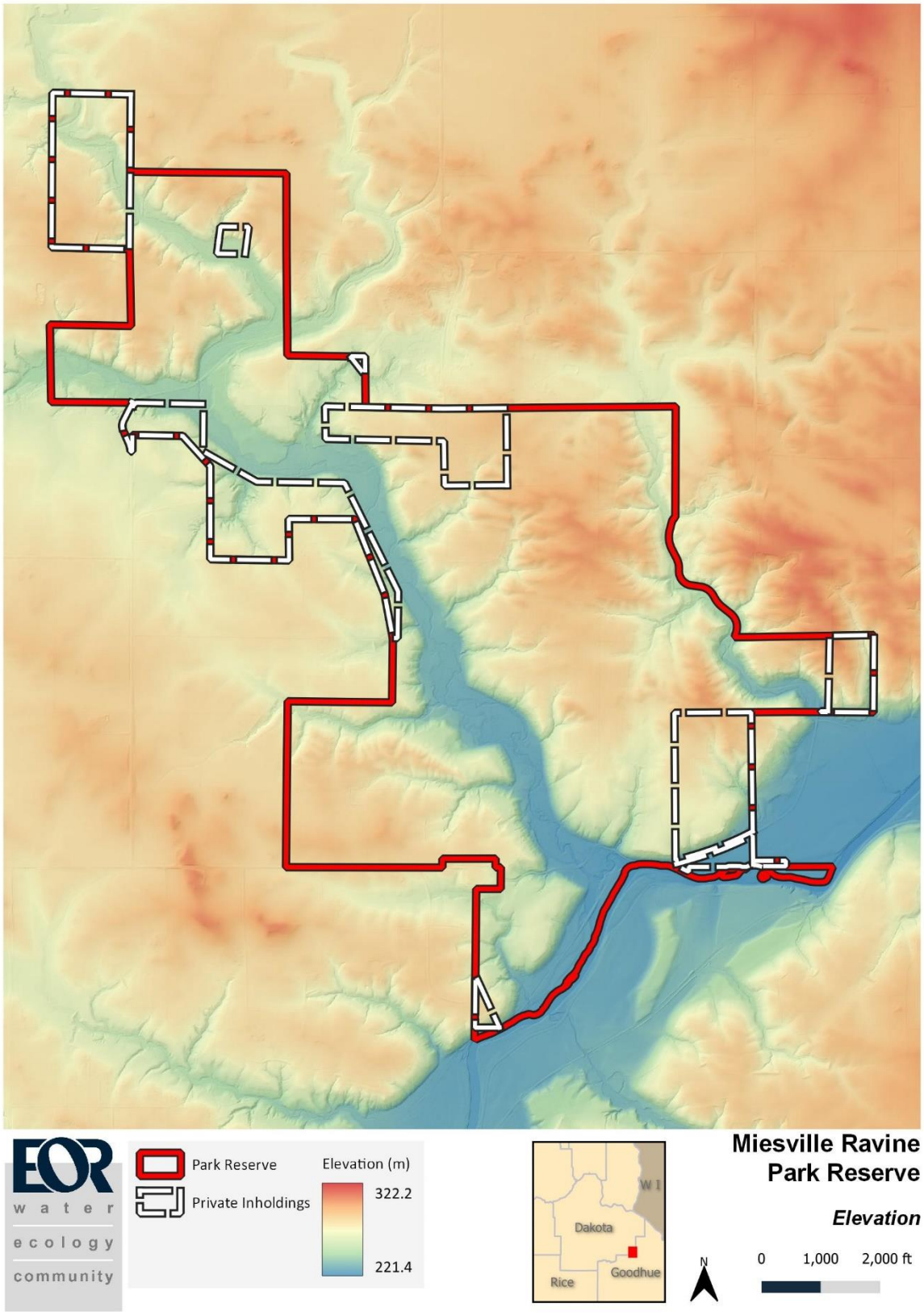


Figure 15. Digital elevation model derived from 2-foot Lidar contours.

2.4. Surface Water Resources

2.4.1. Cannon River

The Cannon River flows along the southern boundary of the park reserve and is a defining feature of the park (Figure 18). The Cannon River is one of only two river systems in the Cannon River Watershed, (the other is the Straight River) and drains to the Mississippi River. The watershed network connects the driftless terrain to the glaciated lands of southeastern Minnesota, draining 946,440 acres. The park reserve is located within the Lower Cannon River watershed (HUC 10). Beyond being a vital connection for the regional water network, it is a home and passageway to a diverse aquatic ecosystem.

The Cannon River is also highly valued by the human community for its recreational and aesthetic value. Cannon River is designated as one of only six "Wild and Scenic Rivers" in the state of MN. The Cannon riverfront is an important feature of the Miesville Ravine Park Reserve, south of Orlando Avenue, at the confluence of Trout Brook to Cannon River. Most recreation and visitor amenities within the park exist here because of accessibility to the river and scenic views.

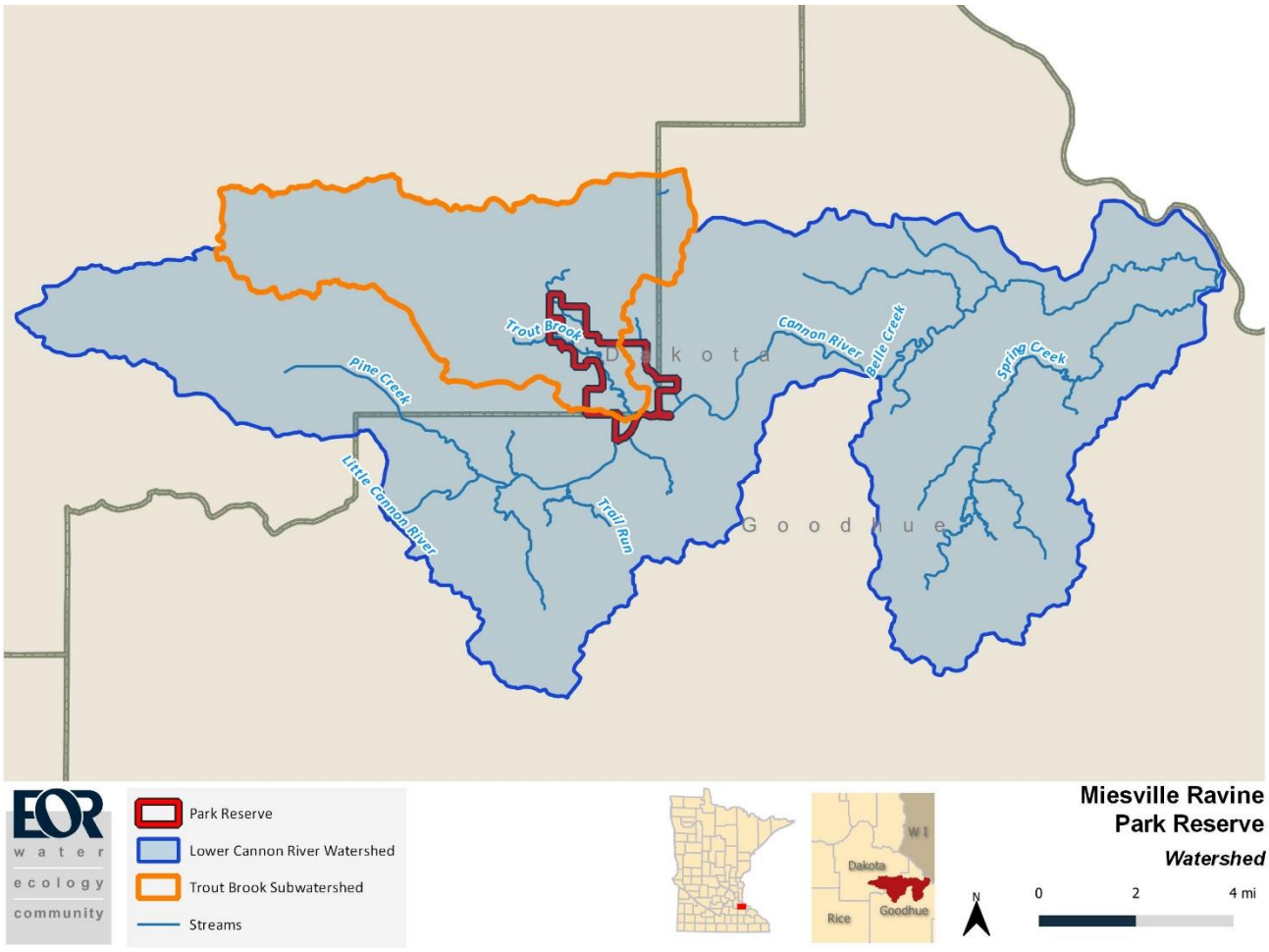


Figure 16. Lower Cannon River Watershed and Trout Brook Subwatershed.

2.4.2. Trout Brook

Trout Brook is one of a handful of trout streams in Dakota County, located almost entirely within MRPR. Trout Brook is comprised of a main stem and two tributaries, east and west, approximately 3.3 miles in length, all of which is designated trout stream. The headwaters of Trout Brook extend approximately 0.5 miles upstream of County Road 91 (south branch), where seeps and springs along the base of the bluffs provide a continuous supply of groundwater flow. Upstream of the seeps and springs, water within the channel quickly diminishes and transitions to a dry waterway that carries intermittent flow during snowmelt and large rain events. As groundwater discharge increases downstream of County Road 91, the stream begins to increase in depth and velocity and receives additional groundwater flow from the north tributary. The north tributary is approximately 0.25 miles in length from the source of its groundwater flow just upstream of County Road 91 to the confluence with the south branch of Trout Brook. Trout Brook has very clean substrates in areas with swift flow, such as in riffles and runs, but significant deposits of silt and sand occur in low gradient reaches and within pools. As the brook progresses towards the Cannon River, stream gradient diminishes and results in substrates comprised mostly of sand and silt. Backwater conditions occur near the confluence during flood events in the Cannon River.

Trout Brook courses through a floodplain comprised primarily of box elder, Eastern cottonwood, American elm, and black willow with an understory of native and invasive grasses and shrubs (Photograph 9). Much of the corridor is shaded; however, numerous trees were removed as part of a trout habitat improvement project near the upper end of the brook. The trout habitat improvement project occurred in a reach approximately 3,100 feet in length and was completed in 2019 (Photograph 10, Figure 26). The project involved significant bank sloping and reconnection of the floodplain, addition of woody structures and grade control, and restoration of native riparian vegetation.

Photograph 9. A picture of a typical wooded riparian area adjacent to Trout Brook.

Photograph 10. Restored reach of Trout Brook with planted prairie vegetation along lefthand bank.

2.4.3. Ravines and Intermittent Drainages

Steep ravine tributaries also carry intermittent runoff from the surrounding uplands. Ravines are a source of both fine and coarse sediment to Trout Brook, dependent on duration and intensity of seasonal intermittent flow events (snow and rain). Steep ravines contribute a greater load of coarse gravel and cobble, while lower gradient agricultural drainages such as those to the west of Trout Brook contributed more fine silt and sand.

2.4.4. Wetlands

The rugged topography and well-drained soils of MRPR generally do not support abundant wetlands and nearly all wetlands within the park reserve boundary are located within the ravine floor (Figure 17). Most of these wetlands are associated with the Trout Brook and Cannon River floodplains, though larger wetlands are influenced by geomorphology, groundwater seepage, and potentially beaver activity. The vast majority of the floodplain wetlands likely lack wetland hydrology due to channel incision causing a disconnected floodplain. Two relatively large sedge seepage meadows are located along the ravine floor. These sedge meadows support ecosystem functions necessary for the trout stream and provide valuable habitat for generalist wildlife as well as specialist birds and invertebrates.

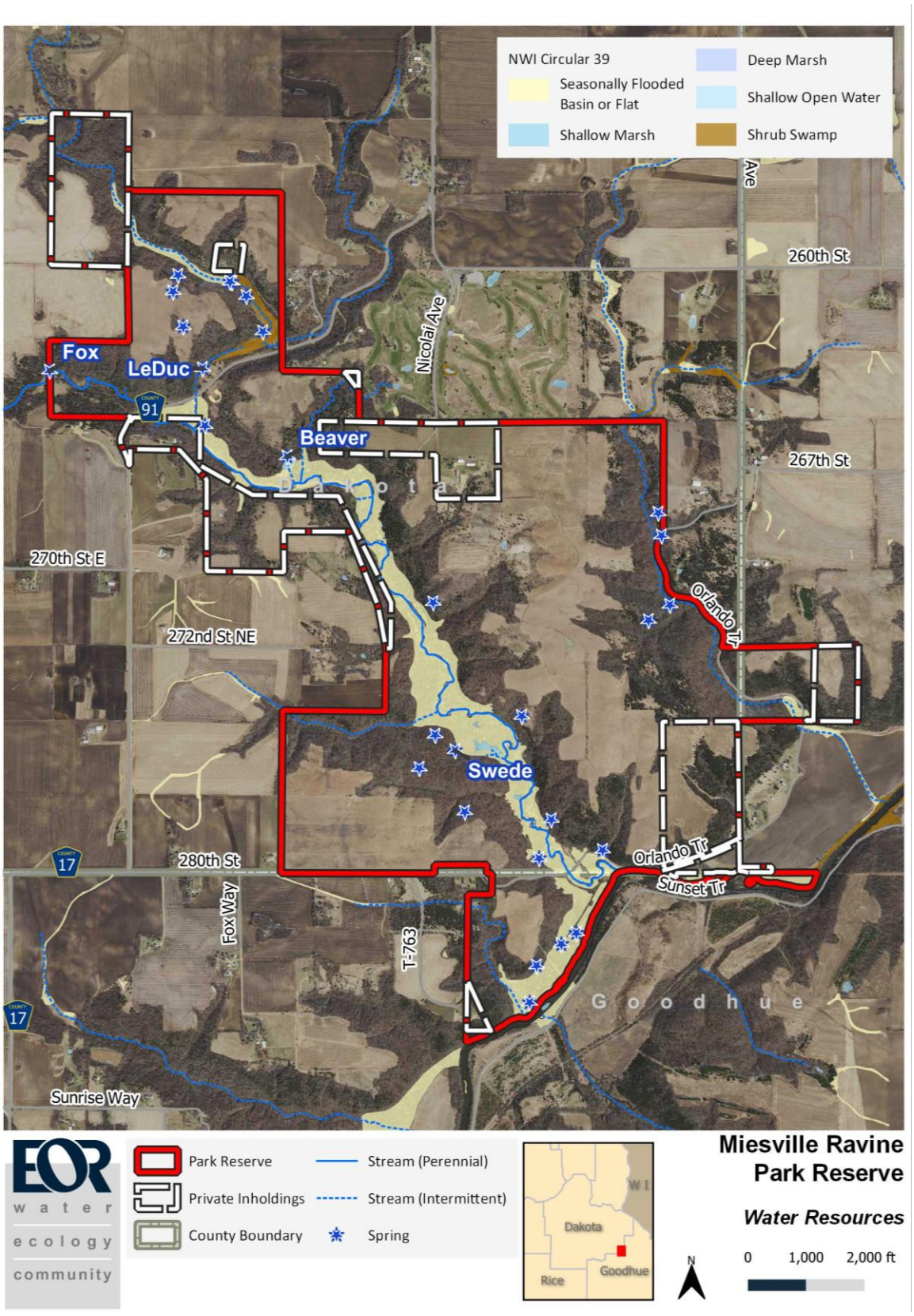


Figure 17. Water resources including DNR public watercourses, NWI wetlands, and surveyed springs.

2.5. Vegetation

2.5.1. Historical Vegetation

Vegetation prior to European settlement was a mosaic of prairie, oak savanna, oak woodland, and hardwood forest, largely driven by topography and soils. Public land survey records suggest the landscape was dominated by prairie and savanna (Figure 18). In reality, the resolution of survey data did not capture the outstanding plant community diversity of the park reserve. This can be seen from a land cover model based on soil, geomorphology, geology, vegetation, and climate, which identified twelve different DNR native plant community classes that could potentially occur within MRPR (NRRI 2019; Figure 21). While this model is based on modern data, it illustrates the likely landscape diversity present prior to European settlement.

As is well known, widespread land conversion occurred following European settlement, and this was no exception at the MRPR site. Most prairies and savannas were converted to cropland or pasture, in addition to many wooded areas. Other wooded areas were thinned or exposed to livestock grazing.

At MRPR, evidence of both human-caused disruption as well as small remnant plant communities that have still persisted, are visible in historical aerial imagery. Aerial photographs from 1937 to 2021 were reviewed and are provided in Appendix A. Key observations from these aerial photographs include a clear legacy of agriculture (widespread occurrence of row crops and farm fields) and a substantial increase in woody vegetation over time, with recent restoration efforts at MRPR visible in newer imagery.

A snapshot of these changes is provided in a comparison of photographs centered along the main ravine near the large southern remnant bluff prairie (Figure 20-Figure 23). Land cover is much more open in the 1937 image, particularly along the southwest-facing slopes and along the ravine bottom. The open character of the steep slopes is likely remnant, as this area would have been difficult to access and possesses the environmental conditions typical of bluff prairie. Thinning or logging may have occurred along the ravine bottom, as this area would generally be expected to be less open based on historical reports of typical valley floor vegetation (Trimble 2012).. By 1970, many areas not in cropland have visibly filled in with woody vegetation, in the absence of fire and grazing, with nearly all non-cropland dominated by woody vegetation by 2010. Interestingly, field evaluation of this area, on the ground, corroborates these observations, showing an abundance of buckthorn, red cedar, prickly ash, and other woody shrubs and trees, but also showing tiny patches of native grasses and forbs scattered all throughout the area—remnants of a former time when the canopy was much more open. The 2021 image reflects recent management at the park reserve—the removal and thinning of woody vegetation from the historically more open remnants and overgrown areas along the southwestern-facing slopes.

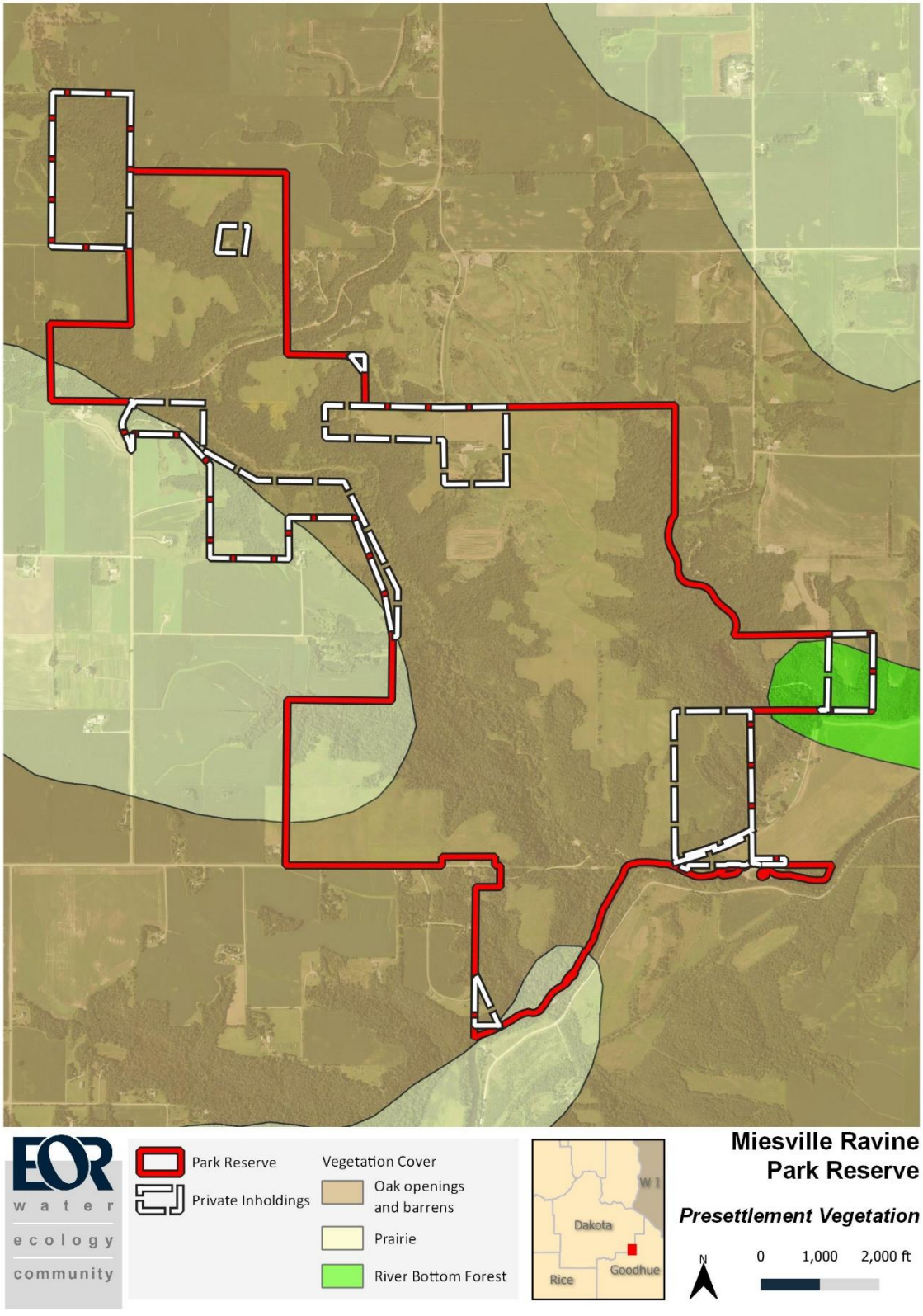


Figure 18: Pre-settlement vegetation based on Public Land Survey notes (Marschner).

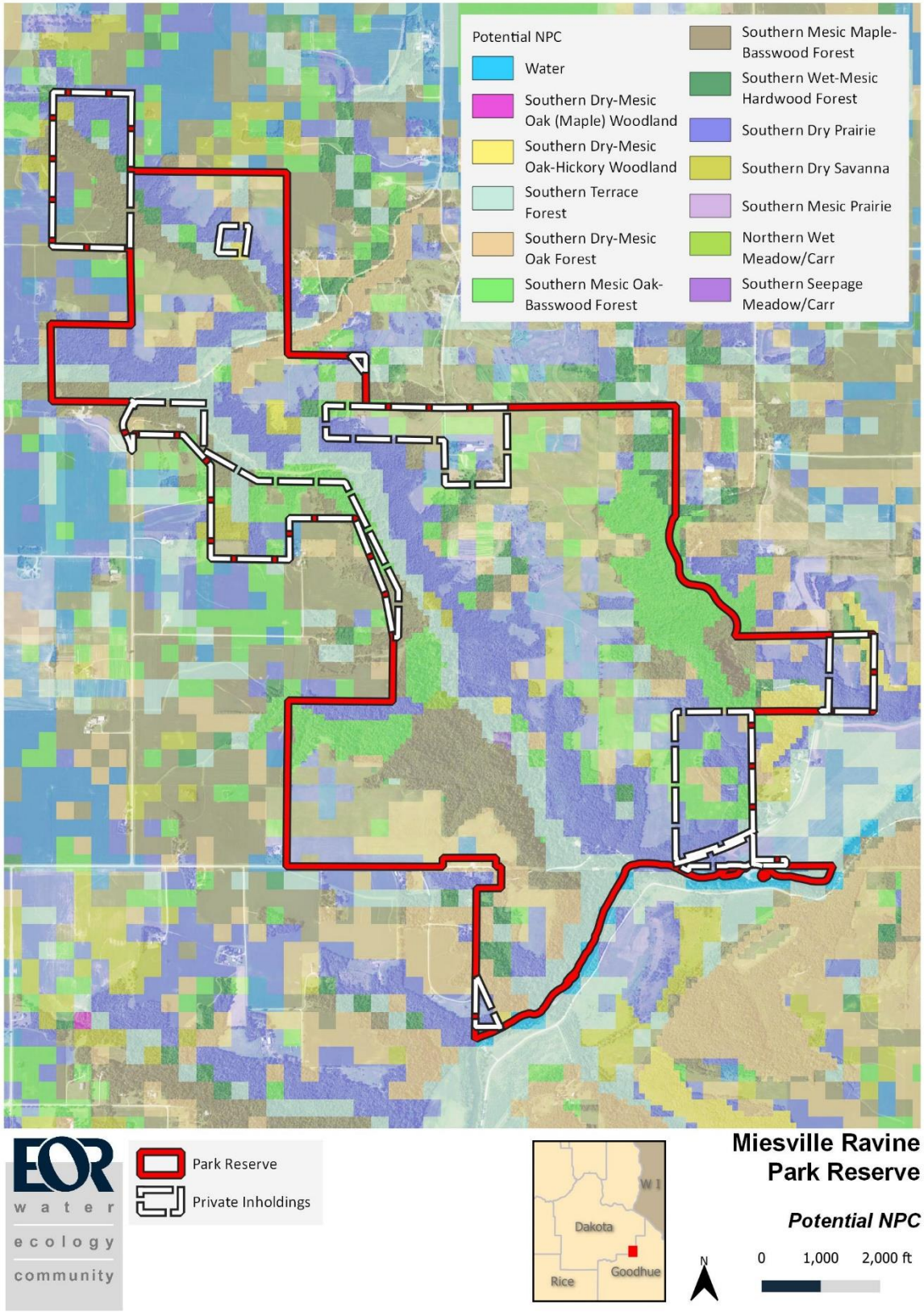


Figure 19. Potential NPC model for the Eastern Broadleaf Forest province (NRRI 2019).

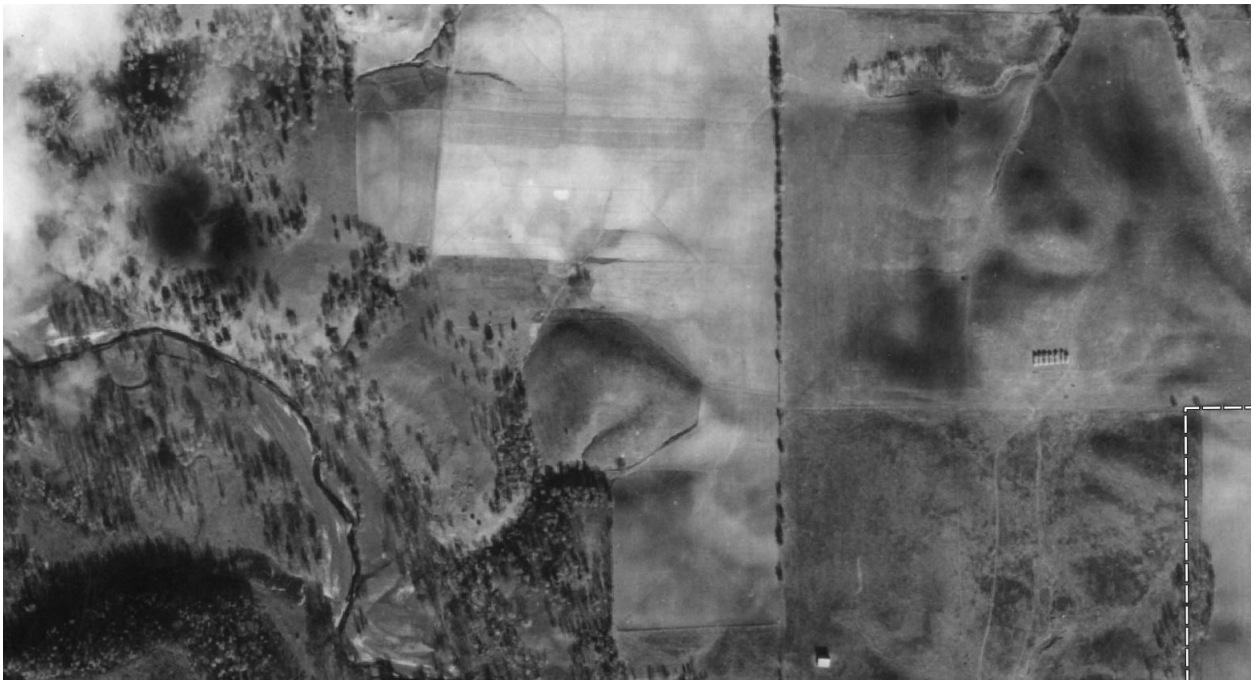


Figure 20. 1937 aerial image. Notice how open the woodlands were on the bluffs.

Figure 21. 1970 aerial image. Canopy has filled in significantly, but there are still a few open patches.

Figure 22. 2010 aerial image. Canopy has almost entirely filled in, with the exception of three or four larger, open spots.

Figure 23. 2021 aerial image. Some canopy thinning has occurred near the largest bluff prairie remnants.

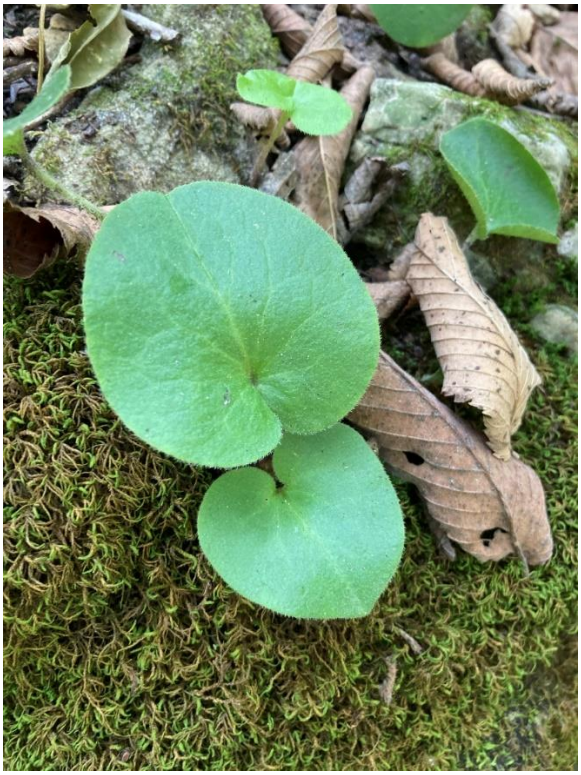
2.5.2. Existing Vegetation

Current plant communities were assessed and classified based on 2021 field visits and desktop data. Desktop data included Minnesota Land Cover Classification System (MLCCS) data, DNR Native Plant Community (NPC) mapping, historical aerial imagery, and two-foot elevation contours. An existing vegetation layer was created in GIS using the MLCCS layer and manually revising geometry and attribute data according to the other data sources. Land cover was classified based on a simplified version of MLCCS and NPC classifications to provide meaningful and legible mapping at a reserve-wide scale (Table 1).

Rare Plant Species

Two state-listed rare plants are present within MRPR, including several populations of kitten-tails (*Besseya bullii*), a threatened species, and a plethora of Snowy Campion, *Silene nivea*. Kitten-tails are primarily found in oak savanna, oak woodland, and dry prairie communities on bluffs of east-central Minnesota. Populations are scattered throughout the park reserve, sometimes consisting of only a handful of plants under an overgrown canopy of remnant woodland.

Snowy campion was recently found (September 2023) by Dakota County Vegetation Technicians, located along Trout Brook. Snowy campion is a state-endangered species and is only found in a handful of sites in the state. It is being closely monitored by Trout Unlimited and Dakota County Natural Resources staff. For more information on this species and its management, see the Implementation Section, page 167-68.



Photograph 11. Kittentails growing within a rock outcrop in an overgrown oak woodland/savanna of the park reserve.

Table 3. Land cover classes of existing vegetation developed for the NRMP.

NRMP Land Cover Class	DNR Native Plant Communities (if applicable)	Description	Acres
Reconstructed Prairie	• Southern Dry Prairie (UPs13) • Southern Mesic Prairie (UPs23)	Former cropland, old field, and Trout Brook floodplain reconstructed to mesic and dry prairie.	494
Remnant Prairie/Savanna	• Dry Bedrock Bluff Prairie, Southern (UPs13c) • Dry Sand-Gravel Prairie, Southern (UPs13b) • Dry Savanna, Southern (UPs14) • Mesic Savanna, Southern (UPs24)	Small pockets of remnant prairie and savanna primarily on south and west facing slopes, but sometimes found on east-facing slopes if soils are dry enough. Mesic savanna is located on sand and loamy sand along the Cannon River.	99
Overgrown Oak Woodland/Savanna	• Southern Dry-Mesic Pine-Oak Woodland (FDs27) • Southern Dry-Mesic Oak-Hickory Woodland (FDs38)	Overgrown woodland with remnant open-grown oaks.	364
Mesic Hardwood Forest	• Red Oak – White Oak Forest, Southern (MHs37a) • Red Oak – White Oak – (Sugar Maple) Forest, Southern (MHs37b)* • White Pine – Oak – Sugar Maple Forest, Southern (MHs38a) • Red Oak – Sugar Maple – Basswood – (Bitternut Hickory) Forest, Southern (MHs38c) • Sugar Maple – Basswood – (Bitternut Hickory) Forest, Southern (MHs39a) • Sugar Maple-Basswood-Red Oak (Blue Beech) Forest—(MHs39c)	Mesic hardwood forests along north and east facing slopes that were not extensively cut over.	367
Floodplain Forest	• Southern Terrace Forest (FFs59)	Floodplain forest terrace along the Cannon River.	12

NRMP Land Cover Class	DNR Native Plant Communities (if applicable)	Description	Acres
Cliff Talus and/or Rock Outcrop System	• Southern Dry Cliff (CTs12) • Southern Mesic Cliff (CTs33) • Southern Wet Cliff (CTs53) • Southern Bedrock Outcrop (ROs12)	Cliff and outcrop communities are generally small, scattered, and occur as inclusions within other communities along steep ravine slopes. A notably large exception occurs along the north and northeast facing slopes of Trout Brook south of County Road 91.	-
Altered Riparian Area	• Southern Wet-Mesic Hardwood Forest (MHs49) • Northern Wet Meadow/Carr (WMn82) • Sand/Gravel/Cobble River Shore (RVx32) • Southern Terrace Forest (FFs59)	A mosaic of wet to mesic wooded and open communities along the ravine bottom and low terraces. Primarily second growth forest recovering from thinning and flood scour. Inclusions of river shore, floodplain forest, and wet meadow communities.	150
Altered Upland Forest	Not applicable	Mesic to dry-mesic forest second growth forest recovering from significant thinning or clear cutting.	99
Emergent Wetland/Seasonally Flooded Basins	• Seepage Meadow/Carr (WMs83) • Northern Wet Meadow/Carr (WMn82)	Large tracts of wet meadow are located along portions of Trout Brook. Two seepage meadows occur along the Trout Brook ravine bottom, with some groundwater contribution. Two artificially impounded seasonally flooded basins are located on the blufftops.	17

NRMP Land Cover Class	DNR Native Plant Communities (if applicable)	Description	Acres
Altered Grassland	Not applicable	Old fields/pastures dominated by cool-season non-native grasses and goldenrod. Variable levels of woody encroachment, primarily by eastern red cedar.	97
Agricultural	Not applicable	Active pasture, hay, or row crop; limited to inholdings.	109
Cultural	Not applicable	Roads; structures, lawns, woodlots associated with inholdings.	37

*Not directly observed but likely present

Photograph 12. Maidenhair fern growing among other forbs and ferns in mesic hardwood forest.

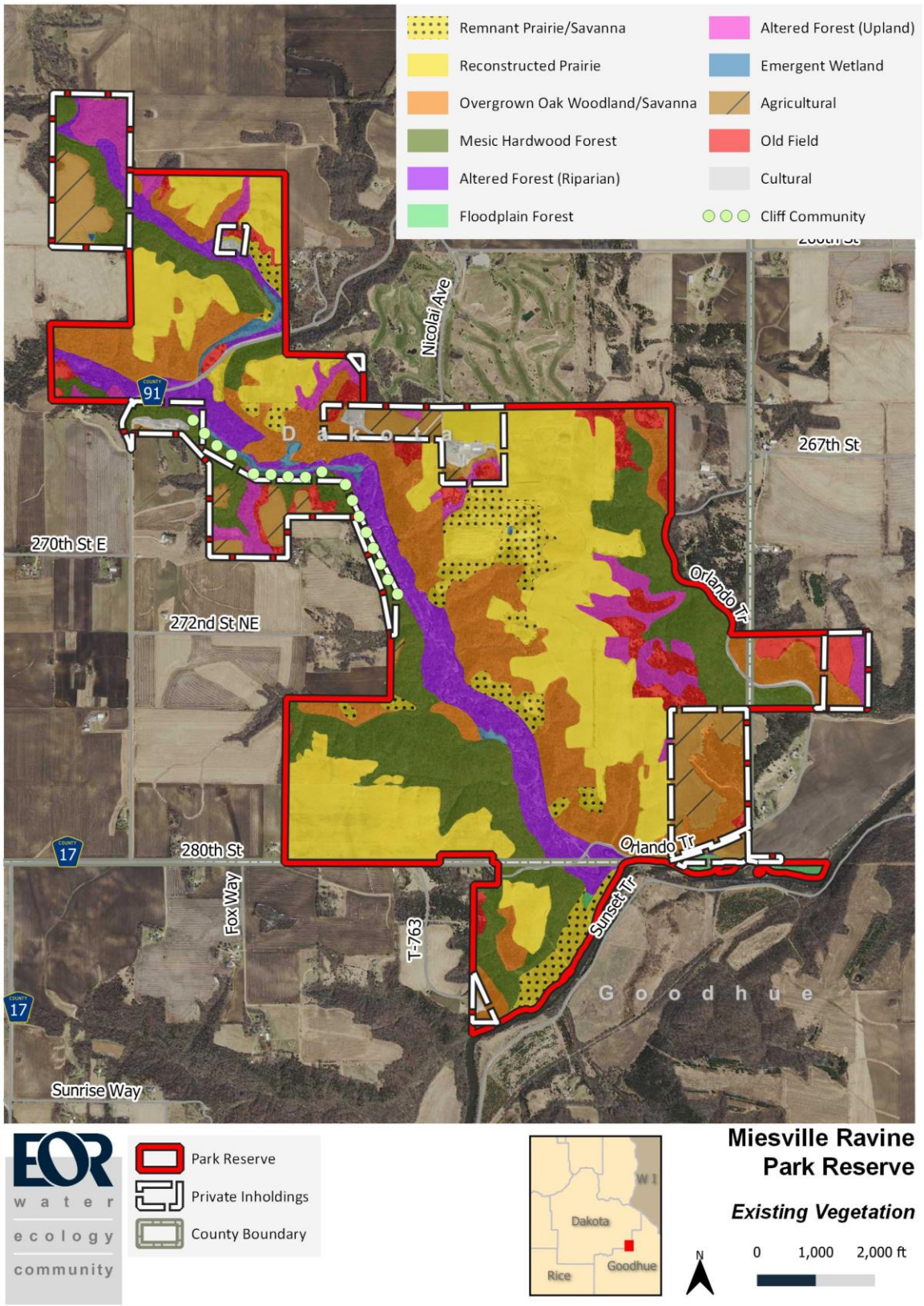


Figure 24. Existing vegetation at MRPR.

2.5.3. Ecological Condition

- The ecological condition of land cover classes within the park reserve was assessed based on guidelines provided by the DNR for evaluating NPCs A-rank communities have excellent ecological integrity. They have species composition, structure, and ecological processes typical of the natural or historic range of the community and have been little disturbed by recent human activity or invasive species. Because of widespread and often irreversible human impacts at both site and landscape scales, true A-rank communities are extremely rare statewide, with only a handful of documented occurrences. However, remnant communities may approach A-rank with appropriate management and be classified as A/B-rank.
- B-rank communities have good ecological integrity. They include lightly disturbed plant communities and communities that were disturbed in the past but have recovered and now have relatively natural composition and structure. B-rank occurrences can approach A-rank condition with protection or appropriate management.
- C-rank communities have fair ecological integrity. They show strong evidence of human disturbance but retain some characteristic species and have some potential for recovery with protection and management.
- D-rank communities have poor ecological integrity. The original composition and structure of the community have been severely altered by human disturbances or invasion by exotic species. They have little chance of recovery to their natural or historic condition, but likely have potential for recovery to C-rank or B-rank.
- R-rank communities have been restored or reconstructed from a degraded condition and may resemble a target NPC. Ongoing maintenance and enhancement are necessary to maintain and improve condition toward that representing a true NPC. Quality of restoration sites varies widely based on prior condition, target NPC, and time and activities conducted since initial restoration. Site-specific metrics should be applied to for assessment of restored condition.
- Z-rank communities have been altered by human disturbance to the point they no longer represent or resemble an NPC and have significantly reduced ecological value and function. These communities are characterized by dominance of non-native species with no identifiable remnant native vegetation, or human development such as roadways and structures. Intensive restoration is required to restore native cover and ecological integrity.

Table 4). The conditions ranks are a continuum of "A" through "D", where "A" rank indicates an excellent quality natural community and "D" indicates a poor-quality natural community. Maps of condition ranks for priority feature land cover classes are provided in Section 4.2.

Ranks according to these guidelines are typically only assigned to communities meeting specific NPC criteria. Some land cover classes within the park reserve (e.g., reconstructed prairies and altered grasslands) do not meet specific NPC criteria. However, it remains important to assess their condition. Therefore, condition ranks of "R" for restored and "Z" for degraded were assigned to these land cover classes.

Criteria according to these guidelines is described below:

- A-rank communities have excellent ecological integrity. They have species composition, structure, and ecological processes typical of the natural or historic range of the community and have been little disturbed by recent human activity or invasive species. Because of widespread and often irreversible human impacts at both site and landscape scales, true A-rank communities are extremely rare statewide, with only a handful of documented occurrences. However, remnant communities may approach A-rank with appropriate management and be classified as A/B-rank.
- B-rank communities have good ecological integrity. They include lightly disturbed plant communities and communities that were disturbed in the past but have recovered and now have relatively natural composition and structure. B-rank occurrences can approach A-rank condition with protection or appropriate management.
- C-rank communities have fair ecological integrity. They show strong evidence of human disturbance but retain some characteristic species and have some potential for recovery with protection and management.
- D-rank communities have poor ecological integrity. The original composition and structure of the community have been severely altered by human disturbances or invasion by exotic species. They have little chance of recovery to their natural or historic condition, but likely have potential for recovery to C-rank or B-rank.
- R-rank communities have been restored or reconstructed from a degraded condition and may resemble a target NPC. Ongoing maintenance and enhancement are necessary to maintain and improve condition toward that representing a true NPC. Quality of restoration sites varies widely based on prior condition, target NPC, and time and activities conducted since initial restoration. Site-specific metrics should be applied to for assessment of restored condition.
- Z-rank communities have been altered by human disturbance to the point they no longer represent or resemble an NPC and have significantly reduced ecological value and function. These communities are characterized by dominance of non-native species with no identifiable remnant native vegetation, or human development such as roadways and structures. Intensive restoration is required to restore native cover and ecological integrity.

Table 4. Ecological quality of MRPR land cover classes.

NRMP Land Cover Class	Condition Rank	Description
Reconstructed Prairie	R	Established prairies are generally in good condition and dominated by native prairie vegetation.
Remnant Prairie/Savanna	A/B	Larger remnants with limited woody encroachment are in excellent condition. Woody encroachment in smaller remnants has resulted in loss of diversity loss and higher density of invasive species.
Overgrown Oak Woodland/Savanna	C/D	Remnant canopy of open-grown oak. Understory is severely impacted by grazing legacy, woody encroachment, intense deer browsing, invasive/exotic earthworms, and invasive/exotic vegetation.
Mesic Hardwood Forest	B/C/D	Generally, a canopy that is characteristic of NPCs. Diverse ground layer including spring ephemerals present in some areas. Understory is impacted by grazing legacy, deer browse, invasive earthworms, and invasive vegetation.
Floodplain Forest	C	Floodplain forest along Cannon River. Not directly observed during field surveys
Altered Riparian Forest	Z	Historically more open. Current community reflects early-successional forest dominated by invasive vegetation and early successional native trees. Hydrology impacted by disconnection from Trout Brook floodplain.
Altered Upland Forest	D	Historically cleared or thinned and current community is dominated by invasive vegetation and early successional native trees.
Emergent Wetland	C/D	Sedge meadow components include areas dominated by sedges, but also large monotypic stands of reed canary grass. Watercress present in spring channels. Seasonally flooded basins on blufftops not observed.
Altered Grassland	Z	Some scattered remnants or colonial native prairie species, but generally dominated by cool-season non-native grasses and native grazing increasers. Variable levels of woody encroachment, primarily by eastern red cedar.
Agricultural	Z	Cultivated areas dominated by row crops or pasture grasses.
Cultural	Not applicable	Developed; no condition assigned.

2.6. Wildlife

2.6.1. Historical Wildlife

The upland habitats within the park reserve and ecological sub-sections were historically dominated by oak savanna, prairie, oak woodland, and hardwood forest. These habitats were once rich with elk, bison, bear, and, to a lesser extent, white-tailed deer. Small mammal species such as beavers, otters, muskrats, fishers, and mink were abundant throughout the region. Predatory species such as wolf and mountain lion existed in healthy populations throughout the county in the 18th and 19th centuries. The prairies and savannas were teeming with insects and filled with a diverse array of bird species including red-headed woodpeckers, bobolinks, loggerhead shrike, and lark sparrows. Snakes would have been abundant within the prairie, including the now state-threatened timber rattlesnake.

Bison in particular were a keystone species of prairie and savanna habitat. Bison grazing and behavior such as trampling and wallowing provided key ecological processes that influenced species and structural diversity. For example, grazing favors species according to palatability, and creates variable vegetation heights and densities across the landscape. Mob grazing also contributed to inhibiting succession of savanna to woodland and forest. Similarly, beaver were a keystone species of riparian habitat, building dams that held back water, moderated flows, and created wetland habitat. In the upper Midwest, about 10 percent of the beaver population present prior to European settlement remains (Johnson-Bice et al. 2022).

Photograph 13. A beaver chewing woody vegetation. Beavers are keystone species that have declined significantly since European settlement (photo not taken at MRPR).

Populations of many species declined with the onset of Euro-American invasion and settlement, primarily due to widespread habitat loss and direct mortality. Loss of oak savanna and prairie were particularly dramatic, declining from over half of all land cover to less than one percent. While non-forested wetlands only comprised a small percentage, historically, this land cover declined by over 50 percent within both ecological sub-sections.

Direct mortality also caused major declines for specific taxa. Fur markets were a driving factor in the decline in furbearer populations. Species such as beaver, mink, otter, and muskrat decreased markedly. The decline of large ungulates was due in large part to market hunting in the 19th century, which included elk and bison, extirpating them from the locality.

2.6.2. Wildlife Today

Trout Brook, and the landscape-level plant community diversity present at MRPR, support habitat for many wildlife species. Key wildlife habitats, according to the DNR Wildlife Action Plan for the Rochester Plateau and Blufflands subsections within the park reserve, include Trout Brook, oak savanna, prairie, emergent wetlands, and altered grassland. These habitats are particularly important rare and/or important to Species in Greatest Conservation Need (SGCN), wildlife that are rare, declining, or vulnerable to decline. Key habitats warrant emphasis for management.

The quality of wildlife habitat depends on the condition of habitat (e.g., stream and plant community condition) as well as habitat size, connectivity, and amount of "edge" (sharp boundary intersection of two distinct land cover types). The park reserve represents a large patch of natural habitat ("core habitat") within an otherwise agricultural landscape. Therefore, it represents an extremely valuable but relatively isolated resource, with exception to its connection to the natural lands along the Cannon River. Of note is the large amount of edge present within the park reserve due to past land use, creating sharp boundaries between blufftop and slope communities, which reduces the amount of valuable core habitat and favors certain wildlife that tend to thrive within the anthropogenic, "high-edge", landscape such as white-tailed deer.

Key taxonomic groups are discussed below; they include fish, birds, mammals, amphibians, reptiles, and insects.

Fish and Mussels

Trout Brook supports naturally reproducing populations of brook and brown trout. Brown trout were introduced from Europe in the late 1800s and are naturalized in many cold-water streams and lakes of Minnesota. Brook trout are native to southeastern Minnesota but introduced to Trout Brook in the late 1970s and early 1980s and have successfully established (DNR 2022). No additional information is available regarding this introduction of brook trout, but it seems likely that brook trout historically occupied Trout Brook and were extirpated or that DNR deemed stocking necessary. Brown trout are more tolerant of higher turbidity and temperature than brook trout. Typical of these species, brown trout are found in higher densities in lower reaches of the stream while brook trout are at higher density closer to the headwaters. Brown trout typically prefer deeper water with overhead cover from undercut banks and large wood, where brook trout typically do better in shallower water with abundant woody debris in the channel (such as upstream of County Road 91). Non-headwaters areas in lower reaches with spring discharges likely provide good spawning habitat for brook trout. Nitrate pollution in groundwater may negatively impact brook trout habitat along Trout Brook, but the actual effect on populations is unknown (Johnson 2002). According to the DNR, large brown trout forage in the Cannon River, near its confluence with Trout Brook, when water temperatures are cool enough. Reports suggest trophy-sized brown trout present in this area and lower reaches. Electrofishing surveys conducted by the DNR in 2019 captured brook trout ranged in size from four to nine inches, with an estimated adult population density of approximately 450 adults per mile.

American brook lamprey have also been observed within Trout Brook. Other species that prefer cold, clear water may also be present such as the brook stickleback or sculpin, though no fisheries surveys have observed these species. Mottled and slimy sculpin have been reintroduced to some southeastern Minnesota streams where previously extirpated (DNR 2003). DNR surveys of the Cannon River near Trout

Brook have detected smallmouth bass, walleye, channel catfish, flathead catfish, freshwater drum, suckers, redhorse, and common carp. At least three rare mussel species are present in the vicinity of the park reserve within the Cannon River. Records indicate that several additional species were at least historically present.

Photograph 14. American brook lamprey (photo not taken at MRPR).

Birds

The habitat value created by the landscape diversity of the park reserve is exemplified by the wealth of bird species observed at MRPR. A total of 202 bird species have been recorded at the park reserve, including 50 SGCN. There are 92 birds designated as SGCN state-wide; the MRPR species list includes over half of these species. The robust number of SGCN that have used MRPR highlights the importance of the park reserve's habitat quality, diversity, and abundance. Anecdotally, there are several SGCN rarely observed in the park reserve that were likely more common historically (and area also experiencing regional declines), including the red-headed woodpecker, bobolink, Henslow's sparrow, and grasshopper sparrow. Red-headed woodpeckers prefer savanna habitat that was historically more abundant at MRPR, but woody invasion has led to less of this habitat. Prairie favored by bobolinks, grasshopper sparrow, and Henslow's sparrow has only been restored from cropland at MRPR in the recent past. Site fidelity could play a role in declines if birds were locally extirpated when the park reserve was dominated by row crop agriculture. More detailed analysis of species-specific survey data and habitat assessment would be required to draw conclusions.

Mammals

A variety of mammals likely use the habitat of MRPR and include rodents, bats, raccoons, opossum, mustelids, coyote, foxes, black bear, and white-tailed deer. Some of these have been observed or detected on trail cameras within the park reserve (Table 5).

White-tailed deer and beaver are two species that significantly influence habitat of the park reserve. White-tailed deer are abundant throughout the region and are frequently present at very high densities within the park reserve, capable of and responsible for over-browsing forest communities. The County holds an annual controlled deer hunt to help reduce the deer population and alleviate the pressure they put on the landscape. Results of deer hunts and surveys conducted since 1994 are provided in Appendix D. Deer per square mile has ranged from 12 in 2004 to 60 in 2018. Issues associated with deer population are discussed in detail in Section 3.6.3.

Beaver and beaver dams are present throughout the Trout Brook corridor along with evidence of activity such as chewed and felled trees, sometimes far up ravine slopes. Beavers are ecosystem engineers and keystone species that are a natural part of stream systems. Beaver dams hold back water, moderate flows, and create wetland habitat that all help create a more resilient ecosystem and provide habitat. Recent research has shown just how beneficial beavers can be on the landscape, especially in regard to improving wetland and riparian habitat, increasing wetland quality and quantity, and increasing base flows for surface waters. Management needs to consider the dynamic nature of beaver dams and ponds, and monitor changes in plant composition so that degradation does not occur. Very large beaver dams can function like low head dams and cause sediment aggradation in the channel, loss of riffle habitat, and channel widening. Within a well-functioning hydrologic and ecological landscape, large beaver dams would not be an issue. However, like all changes to the ecosystem, their impacts should be carefully assessed. The topic of beavers is addressed further within Sections 3 and 4 of the NRMP.

Table 5. Mammals observed at MRPR by Dakota County Parks staff.

Scientific Name	Common Name
Canis latrans	Coyote
Castor canadensis	American beaver
Didelphis virginiana	Virginia opossum
Eptesicus fuscus	Big brown bat
Geomys bursarius	Pocket gopher
Glaucomus sabrinus or *volans*	Flying squirrel (northern or southern)
Lasiurus cinereus	Hoary bat
Lontra canadensis	River otter
Lynx rufus	Bobcat
Marmota monax	Groundhog, woodchuck
Mephitis mephitis	Striped skunk
Microtus pensylvanicus	Meadow vole
Myotis spetentrionalis	Northern long-eared bat
Neogale vison	American mink
Odocoileus virginianus	White-tailed deer

Pekania pennanti	Fisher
Peromyscus leucopus	White-footed mouse
Peromyscus maniculatus	Eastern deer mouse
Procyon lotor	Raccoon
Sciurus carolinensis	Eastern gray squirrel
Sciurus niger	Fox squirrel
Sorex hoyi	Pygmy shrew
Spermophilus tridecemlineatus	Thirteen-lined ground squirrel
Sylvilagus floridanus	Eastern cottontail
Tamiasciurus hudsonicus	American red squirrel
Taxidea taxis	American badger
Ursus americanus	Black bear
Vulpes vulpes	Red fox
Zapus hudsonius	Meadow jumping mouse

Amphibians and Reptiles

Bluff prairies and savanna are among the most important type of habitat for reptiles in the state and provide suitable nesting and hibernacula substrate for a variety of snakes and lizards. Remnants of these habitats are present within the park reserve and provide potential habitat for several SGCN and rare species, though only the gopher snake (special concern) has been observed in the vicinity. Suitable habitat for timber rattlesnake has and does continue to exist in the park reserve, however no records are available. Within the park reserve, western fox snakes, eastern hognose snakes, and common garter snakes have been observed (Table 6).

Table 6. Snakes observed at MRPR by Dakota County Parks staff.

Common Name	Scientific Name
Eastern hognose snake	*Heterodon platirhinos*
Milk snake	*Lampropeltis triangulum*
Western fox snake	*Pantherophis vulpina*
Common garter snake	*Thamnophis sirtalis*
Red-sided garter snake	*Thamnophis sirtalis infernalis*

The Blanding's turtle (threatened) was observed in the park reserve in 1991. Blanding's turtles rely on calm shallow waters such as backwater pools and abandoned meanders with nearby sandy uplands. Historic photos and other evidence suggest critical habitat for this species has practically disappeared since the last sighting in 1991. They are not believed to use the park reserve any longer, though suitable habitat is likely present along the greater Cannon River. The modern absence of Blanding's turtles could be due to a variety of reasons, though all are speculative. Overgrown woody bluffs may inhibit travel to nesting suitable nesting sites. Denuded ground layer vegetation along bluffs may make turtles more vulnerable to vegetation while traveling to nesting sites. Pools that form suitable overwintering habitat may be ephemeral and created by beaver activity, and now many beavers have been driven away from the surrounding agricultural-dominated fields, and base flow has dropped due to reduced stormwater infiltration. For example, aerial images from

1991 indicate the Swede Spring tributary/seepage meadow was dammed by beavers, which resulted in a large pond and a smaller pond just to the north (see summary of aerial photos in Section 4.2.6 description of the Seepage Meadow priority feature). Although not confirmed, both ponds appear to have been groundwater-fed providing the possiblility of overwintering habitat in what is also known as "lost pond". Today, only the small pond to the north remains along with small tributary channel flowing through the seepage meadow to Trout Brook. Conversely, beavers create abundant wetlands as a result of their activities, which would have provided excellent habitat for Blanding's, but is no longer present, or greatly reduced. Finally, suitable nesting habitat within the riparian zone may be a relic of mid-1800s to early 1900s agricultural land conversion and associated erosion. Based on review of historical aerial imagery (e.g., 1964, Appendix A: Figure 52), large sand deposits along Trout Brook appear to be a result of stream erosion associated and not a natural component of Trout Brook's fluvial geomorphology. The floodplain just downstream of lost pond outlet along Trout Brook remained sparsely vegetated in 1991 aerial imagery, potentially providing nesting habitat on sandy depositions. This entire area is now much more wooded and thereby limits nesting habitat in this portion of the park reserve.

Common species of frogs and toads exist in the park; a lack of fishless ephemeral ponds may somewhat limit populations of these taxa, as well as salamanders. Suitable habitat is present for the SGCN pickerel frog, and the park reserve is situated within its northwestern range extent. The SGCN mudpuppy may inhabit sections of the Cannon River. While not dependent on specific habitat within the park reserve, the park reserve is part of the greater landscape that supports this species.

Insects

Insects are integral to food webs, primary herbivores in some systems, and often serve as important pollinators. Diversity data on fine spatial scales is typically sparse. Baseline biodiversity surveys of butterflies and moths at the park reserve were completed in 2021 (Birkey 2021; Johnson 2021), see **Appendix C** for complete list. Over 185 species of moth were detected at MRPR, including several noteworthy prairie and one sedge meadow affiliates. The prairie specialist *Euoxa niveilinea* is a notably rare prairie specialist encountered in a remnant bluff prairie. Thirty-four species of butterfly were identified, including a new Dakota County record for Compton tortoiseshell. County surveys have also recorded bees at MRPR (Table 7).

Table 7. Bees observed during County surveys at MRPR in 2017.

Common name/group	Family	Scientific name
Striped sweat bees	*Halictidae*	
Tiny dark bees	*Halictidae, Apidae, Colletidae*	*Lasioglossum spp.*
Medium dark bees	*Andrenidae, Colletidae*	
Brown-belted bumblebee	*Apidae*	*Bombus griseocollis*
Two-spotted bumblebee	*Apidae*	*Bombus bimaculatus*

Photograph 15. Blanding's turtle (photo not taken at MRPR).

2.7. Record of Resource Restoration & Manipulation

2.7.1. Completed and Ongoing

Numerous projects have been implemented by various entities at MRPR and the surrounding watershed. Ecological restoration projects have been completed and ongoing by Dakota County Parks since 1999, with all of the row crop agriculture reconstructed to prairie (Figure 25). Most recently, bluff prairie, savanna, and woodland restoration has been conducted along the east side of the Trout Brook Ravine, with work continuing into 2022. In total, the County has restored approximately 677 acres of native plant community.

Dakota Soil and Water Conservation District (SWCD) completed three streambank stabilization projects near the southern portion of the park reserve in addition to several erosion control and water quality projects on surrounding lands (Figure 26). Trout Unlimited completed a 3000 lineal foot stream restoration project in 2019, south of County Road 91.

2.7.2. Planned and Contracted

Trout Unlimited plans to conduct a stream restoration directly downstream of the 2019 restoration beginning in 2023 (Figure 26).

Photograph 16. Overview taken from a cropland to prairie restoration completed in 2008-10 looking toward a ravine cleared and restored to oak savanna as part of Bluff Prairies of Miesville Restoration.

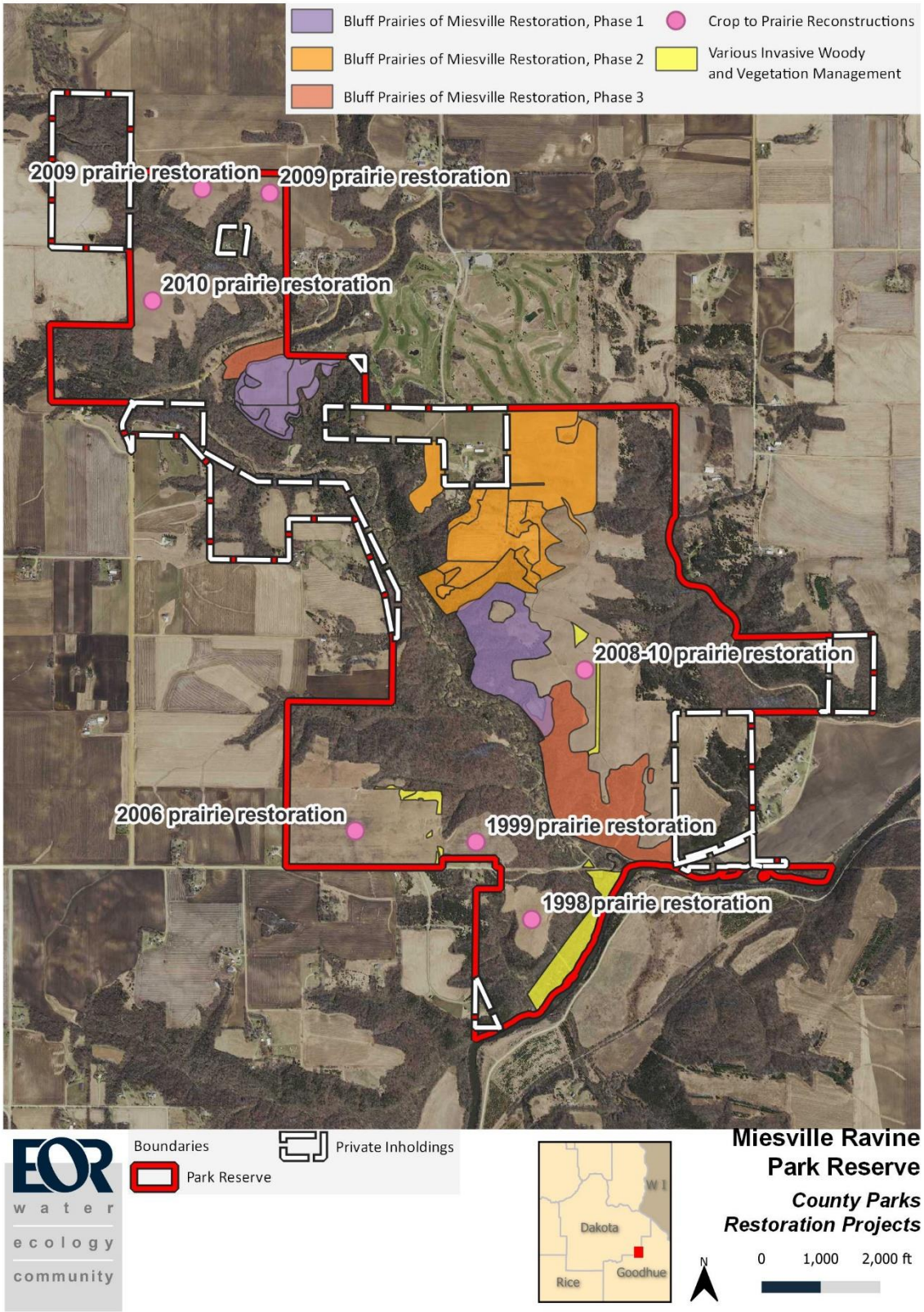


Figure 25. Restoration projects completed by Dakota County Parks.

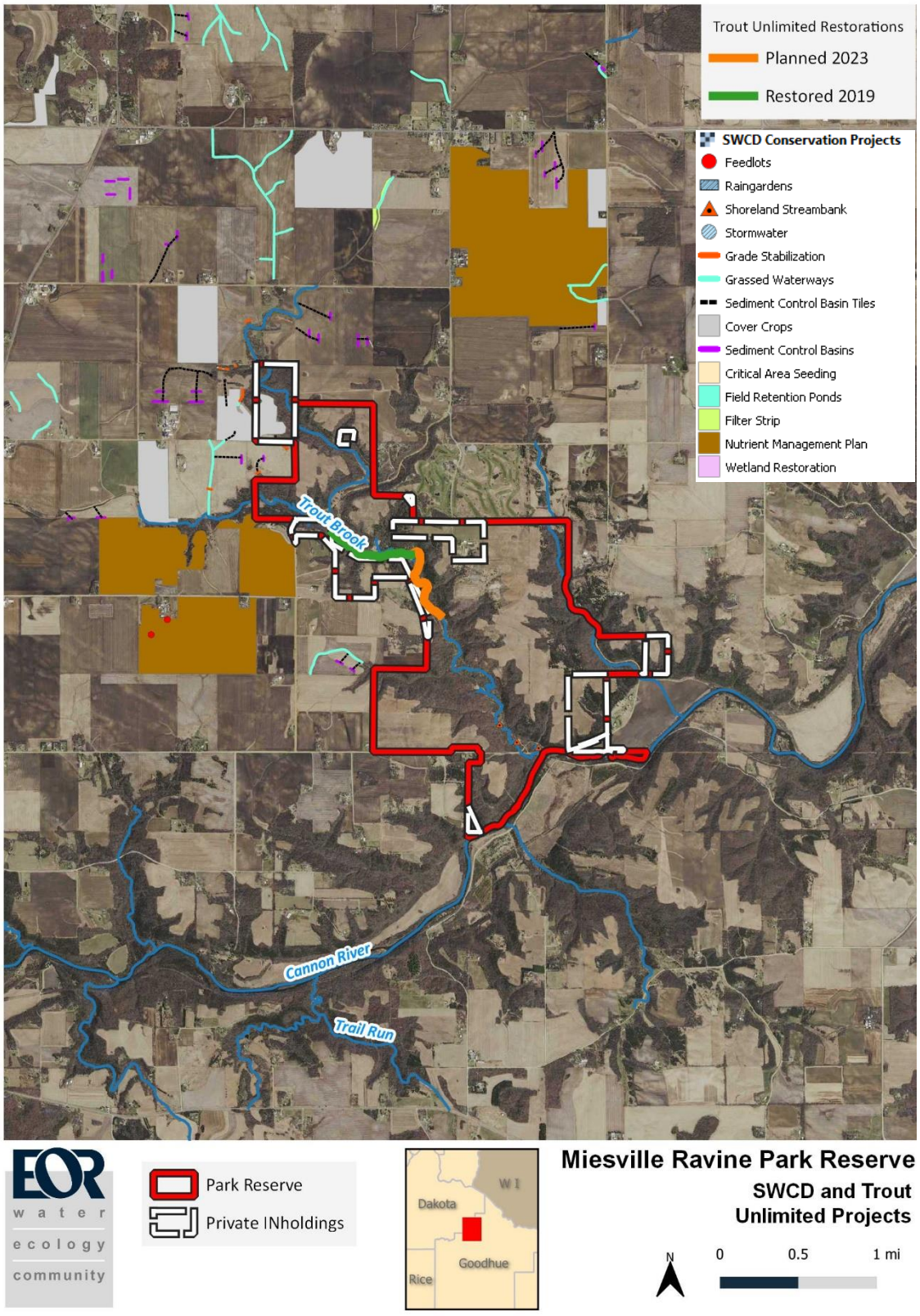


Figure 26. SWCD and Trout Unlimited projects

3. ISSUES

Natural resource issues of MRPR are complex and intertwined. Regional- and landscape-level issues have impacts across the entire park. More discrete issues specifically affect terrestrial and stream habitats. Finally, programmatic issues impact implementation efficiency and effectiveness.

3.1. Legacy of Post-Settlement Land Use

Human disturbance following European settlement created a legacy of habitat loss and degradation with cascading effects that caused many of the park reserve's ecological issues today. Existing natural communities present prior to settlement experienced widespread land conversion to cropland and pasture, while many wooded areas were thinned or cut for timber and exposed to livestock grazing. Many of today's most destructive invasive species were intentionally introduced to the agricultural landscape, such as cool season pasture grasses (e.g., smooth brome, reed canary grass), wind break woody plants (e.g., common buckthorn, Siberian elm), and plants used for erosion control (e.g., crown vetch, birdsfoot trefoil, reed canary grass).

Direct loss of prairie and savanna communities was especially catastrophic, with only about one percent of native prairie remaining on the modern landscape of Minnesota. Tilling and intensive grazing greatly impacted the native soils in both open and wooded communities by reducing soil organic matter content and destroying soil biota that sustains vegetation. The legacy of these soil impacts has resulted in poor soil quality (structure and chemistry) and a much greater vulnerability to erosion.

Habitat fragmentation, or the isolation of smaller pieces of habitat that were once an integrated whole, is another major ecological issue today. Examples of habitat fragmentation abound at MRPR, most notably for prairie. Many of the remnant prairies are confined to steep slopes or thin soils that were unsuitable for agriculture, such as the south and western facing slopes of MRPR. Although remnant pockets persist, being a fire-dependent system, prairie and savanna require periodic burning to prevent woody encroachment. Following Euro-American settlement, wildfires were aggressively suppressed resulting in the loss of this key, natural ecological disturbance/process which led to the subsequent succession of grasslands and savannas to woodlands and forest. Loss of fire and other key ecological disturbance such as grazing (by bison and elk) are discussed further in Issue 3.3.

Today, the vast majority of lands within MRPR are no longer farmed, grazed, or logged. However, the legacies of these practices persist and are not easily reversed. Former cropland required complete prairie reconstruction due to the destruction of the historical community, and the soils beneath them will take years to rebuild lost organic matter and biota. Old pasture remains dominated to this day by non-native pasture grasses and weedy successional vegetation. Grazed forests have lost dense ground cover capable of withstanding herbivory pressure from native deer. This legacy of degradation is intertwined in nearly all of the subsequent issues discussed below.

Photograph 17. Remnant open-grown oak amid overgrowth of woody vegetation caused by fire suppression.

3.2. Regional Landscape Degradation and Fragmentation

Though MRPR comprises a large tract of contiguous natural lands, it exists as an island within landscape dominated by row crop agriculture. The dominant surrounding agricultural land use impacts hydrology, vegetation, and wildlife. Surface water runoff in the surrounding watershed is highest from cropland and contributes to ravine erosion and unnaturally large and flashy flow events in Trout Brook and its tributaries. Surface water runoff from agricultural lands also contributes higher nutrient loading to the aquatic and floodplain systems of MRPR, and also to groundwater that infiltrates through the porous surficial bedrock, which primarily contributes to the high nitrate concentrations of spring seepages and Trout Brook.

The landscape surrounding the park reserve is very low in native plant diversity and abundance and contains large populations of invasive species. Native plant communities within the park reserve are starved for native propagule sources, while being overrun with invasive propagules. For example, seeds of reed canary grass and garlic mustard are transported along upstream drainageways to lowland areas of the park reserve, whereupon they become established and penetrate into vast areas of the site. Similarly, common buckthorn berries are ingested by birds and readily transported throughout the park reserve. Therefore, invasive species management is an ongoing challenge and will require continual management.

Wildlife populations are also affected by the landscape surrounding the park reserve, particularly, fragmented agricultural habitat. Fragmented habitat supports large populations of white-tailed deer and mesopredators (smaller predators serving as apex predators in absence of historical apex predators) such as racoons, skunks, and feral cats (Prugh, et al. 2009). These types of wildlife impact vegetation (e.g., deer overbrowsing) and wildlife (e.g., increased predation of prey such as birds and reptiles).

3.3. Loss of Key Ecological Processes

The native plant communities of MRPR have evolved over thousands of years with ecological processes that maintain their type and condition. Many of these processes have been eliminated or altered due to relatively recent human activity. Fire historically maintained prairie and savanna as open, herbaceous-dominated habitats. Oak woodlands experienced frequent mild surface fires that interrupted forest succession and maintained some open conditions, with larger stand-replacing fires occurring about every 150 years. Even forests relied on light surface fires to create small canopy gaps and understory diversity. Fire suppression following Euro-American settlement profoundly affected these systems, favoring woody communities at the expense of open ones, such as, prairie and savanna, resulting in widespread loss of diversity.

Native grazers such as bison and elk also provided a key ecological process that has been lost due to overhunting and habitat loss: grazing and browsing. Native grazers provided structural diversity within habitats for plants and wildlife. For example, reconstructed prairie in the absence of bison will tend toward uniform plant height and favors a suite of certain vegetation. Bison create variable structure and species diversity, while creating habitat via trampling such as wallows. This structural and compositional diversity results in a more heterogeneous landscape, as well as shifting patches of refugia that are beneficial for a variety of native flora and fauna. Native grazers also historically mediated seed and nutrient transport.

3.4. Habitat Fragmentation

Habitat fragmentation within the park is primarily an issue for the remnant prairie and savanna; on a landscape level, the park forms a relatively contiguous natural corridor. Historically, southern- and western-facing slopes of MRPR likely consisted of prairie, savanna, and woodland that provided a habitat corridor for bluff prairie species (see historical aerial photos in Appendix A). Fire suppression has resulted in tree and shrub encroachment, and bluff prairie and savanna remnants are limited to small pockets fragmented by woodland and forest. Though these small pockets host incredible plant diversity, species are isolated and more vulnerable to catastrophic events. Fragmentation results in increased edge and less interior habitat that is able to support intact communities of certain vulnerable species. At MRPR, the hard forest edge that borders prairies, both restored and remnant, appears to provide sanctuary for herbivores such as rabbits and white-tailed deer that impact sensitive prairie species. For example, the periphery of and sometimes entire populations of prairie violet (*Viola. pedatifida*) were observed to have flowers/fruits nipped by rabbits, preventing seeding, whereas the interior areas were not nipped.

3.5. Park Access

What should be a simple process of accessing areas of the park reserve for management activities, instead is a challenge due to the rugged topography, private inholdings, and surrounding private lands (Figure 27). Ravine bottoms are generally inaccessible by vehicle and heavy equipment, though the 2019 stream restoration required heavy equipment access and established a route along Trout Brook south of County Road 91. The steep slopes of the many ravines make vehicle or heavy equipment access impossible. Blufftops are generally accessible, but where they are dissected by ravines, they may be cut off from vehicle and equipment access. Some blufftops and slope-shoulders, where heavy equipment could be used, are surrounded by inholdings or private lands outside of the park reserve. These inaccessibility issues limit the management tools available for MRPR managers.

Photograph 18. Woody vegetation encroaching on a small pocket of remnant bluff prairie.

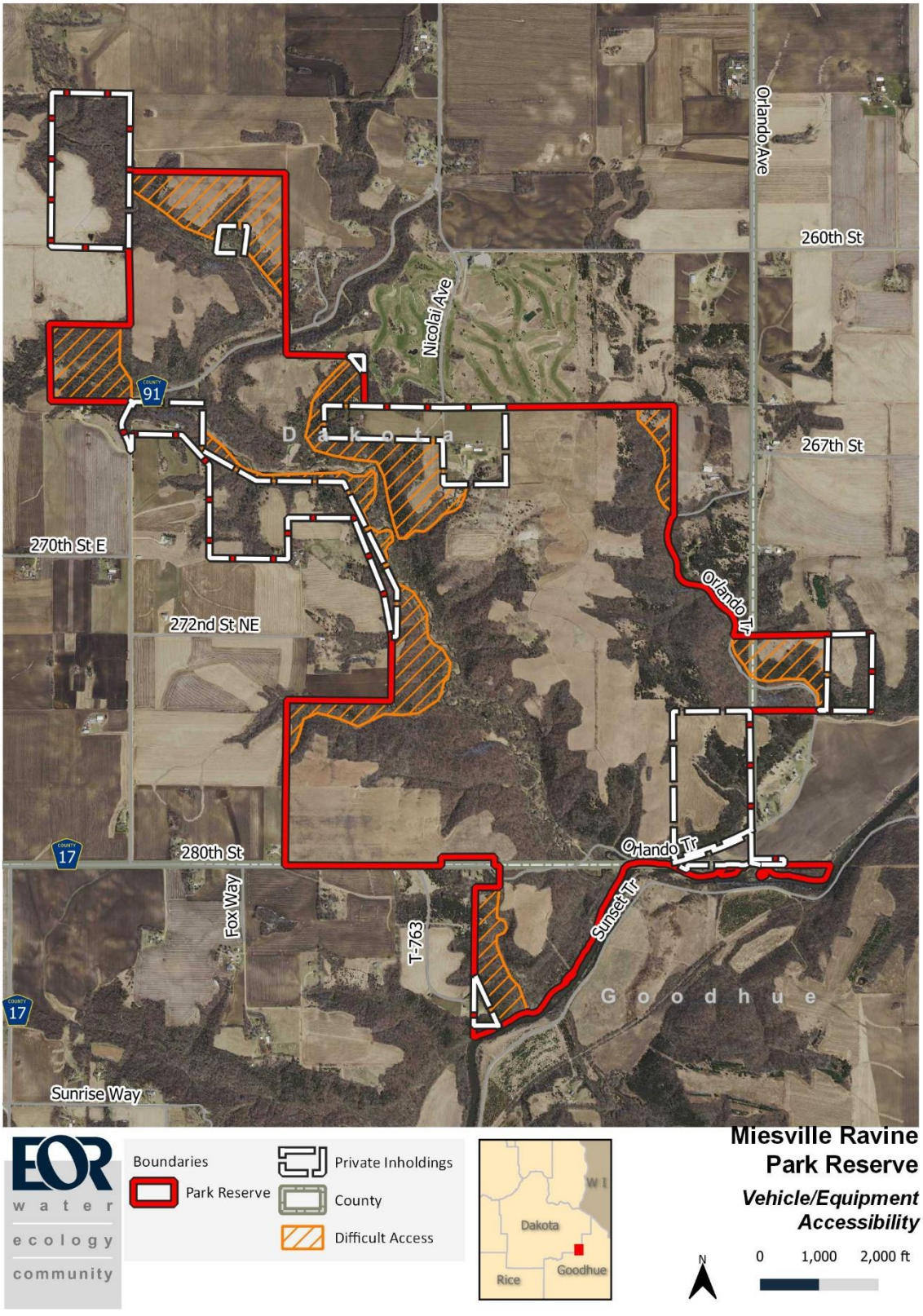


Figure 27. Difficult to access areas of MRPR due to topography, inholdings, and surrounding private lands.

3.6. Terrestrial Habitat Degradation

Many factors have contributed to terrestrial habitat degradation within MRPR. Primary issues, discussed below, include invasive species, effects of overabundant or imbalance wildlife populations, and the legacy of domestic livestock grazing (and contrasting absence of beneficial native grazers). All of these factors are integrated and contribute to ecosystem feedback loops that cause further degradation, along with many of the landscape-level factors discussed above such as fire suppression.

Invasive species discussed below include vegetation and earthworms. The term "invasive species" generally refers to plants or animals that are not native to a region and that have negative effects on the economy, environment, or human health. For the purposes of this management plan, some native species may also be considered invasive due to humans causing changes to the environment that result in an out of balanced or dysfunctional ecological situation whereby native species can cause negative effects. For example, eastern red cedar and white-tailed deer.

3.6.1. Invasive Vegetation

Invasive vegetation is characterized by aggressive, exotic plant species that grow and reproduce rapidly, often displacing native plants and impacting succession of native plant communities. Under some circumstances, native plant species also act as invasive species due to altered ecological conditions (e.g. eastern red cedar). Impacts of invasive plants include reduced biodiversity and wildlife value, negative recreation impacts, and erosion. Invasive plants typically reduce wildlife habitat value significantly by eliminating or displacing native cover and food sources. Wildlife movement, resource management, and recreation can be impacted due to dense monotypic stands of invasive vegetation that cause barrier to movement. Invasive plants like common buckthorn also cause topsoil erosion due to bare soil that forms beneath a very dense buckthorn canopy. Other buckthorn impacts include allelopathic impacts to soils that alter native plant communities and have negative effects on birds that eat berries (Warren et al. 2017; Knight et al. 2007).

Invasive vegetation is common and occasionally dominates much of the land cover within the MRPR. A few particular invasive species are especially problematic and are considered target invasive species for control.

- Common buckthorn is established within forest and woodland areas of MRPR and invades open bluff prairie and savanna habitat. Dense thickets of mature individuals, with little other vegetation, have formed in some highly disturbed areas, especially those with a history of intensive grazing (pasture) or clearing. Other areas are more moderately invaded with only pockets of thick buckthorn and not as mature. Even in high-quality areas, some buckthorn is present even if just an isolated mature individual or scattered young plants. Within forest and woodland communities, buckthorn threatens to shade out herbaceous ground layers and prevent native tree seedling establishment, thereby impacting ground layer diversity and canopy succession. Within savanna and prairie communities, buckthorn is encroaching and threatens to encroach into open habitat and transition the community type. Steep slopes dominated by buckthorn are generally comprised of bare soil and vulnerable to erosion. Buckthorn seeds are dispersed by birds at perch sites throughout the park reserve. This dispersal mechanism makes woodland and savanna habitats

challenging to manage as there will be continual colonization of buckthorn in open areas surrounding perch sites.

- Eastern red cedar, similar to buckthorn, is established in woodland, savanna, and prairie habitat within the park reserve. Despite being native, eastern red cedar was historically controlled by fire in open habitat and in its absence causes similar problems to buckthorn in open habitats. Mature red cedar typically dominates more open bluff slopes throughout MRPR with often bare understories or co-dominates with buckthorn. Like buckthorn, eastern red cedar is bird-dispersed and presents a management challenge due to its continuous colonization near perch sites in open habitats.
- Garlic mustard is present throughout lowland areas and along wooded footslopes, where it is advancing upslope. Dense patches are present in some areas. Seeds of garlic mustard are continually transported along Trout Brook and other drainageways, making it difficult to keep up on control and track new invasions. Garlic mustard is of particular concern where it threatens to overrun populations of spring ephemerals, threatening native plant diversity anywhere it gets established. Large patches of bare ground seem to allow garlic mustard to invade readily, since competition from other plants is minimal. Bare ground is presumably caused by a combination of earth worm activity, over browsing from deer, and disrupted fire regimes.
- Kentucky bluegrass and smooth brome are exotic cool-season pasture grasses present within prairie, savanna, woodland, and old fields of MRPR. These were introduced from being planted as pasture and have persisted in old fields where they can come to dominate. Both grasses threaten restored and remnant open habitats of MRPR and are capable of forming near-monotypic stands in the absence of effective, active management.
- Reed canary grass is the dominant riparian vegetation along most of Trout Brook and also comprises much of the spring-fed wetland community adjacent to Trout Brook. Like garlic mustard, reed canary grass propagules are continually transported along Trout Brook and other drainageways, so reed canary grass can continue to re-invade areas that may have been previously cleared of it.
- Tatarian honeysuckle is another invasive woody shrub and one of several exotic invasive honeysuckles in Minnesota. At MRPR, it rarely dominates but is frequent along woodland edges, riparian areas, and prairie openings.
- Wild parsnip is not frequent throughout the park reserve but is locally common in open areas along the Trout Brook floodplain. Once established, wild parsnip is capable of invading most open habitats including native prairies. Beyond impacts to native plant communities, wild parsnip is of particular concern due to its toxic sap, which causes chemical burns on skin in the presence of sunlight.

Other invasive plants occur within the park reserve or are common in the area but are not considered priorities for control. That said, they could occasionally become locally problematic. These species include but are not limited to Japanese hedge parsley, Amur maple, black locust, Siberian elm, Japanese barberry, Canada thistle, creeping charlie, crown vetch, birdsfoot trefoil, leafy spurge, spotted knapweed, yellow rocket, narrowleaf cattail, and non-native *Phragmites australis*.

Potential invasive species in the region to watch for include Asian bittersweet, Japanese knotweed, Japanese hops, and multiflora rose, among others. Staff can keep apprised of early detection species with resources such as the Midwest Invasive Plant Network.

Photograph 19. Buckthorn thicket among a remnant bur oak.

3.6.2. Invasive Earthworms

Earthworms are an invasive species non-native to the Midwest and established throughout MRPR. Prior to introduction in the last century, forests in Minnesota had developed in the absence of earthworms. Typically, native forests had a thick duff layer that slowly decomposed organic material (e.g., fallen leaves, twigs, etc.), which the understory had adapted to over millennia. Today, earthworms degrade Minnesota forests by rapidly consuming the duff layer, leaving a bare ground layer of exposed soil. The duff layer provides requisite nutrients and soil moisture for native wildflowers, ferns, and tree seedlings, which can be lost or significantly reduced. Earthworms also disrupt critical plant-fungi relationships that native vegetation rely on. Also, earthworm activity results in a net compaction of the upper layers of soil, which is very detrimental to germination and plant growth. Finally, the bare soil conditions created by earthworms facilitate erosion, especially along the steep slopes present within MRPR. Unfortunately, there are no effective earthworm management techniques at this time.

Photograph 20. Bare, earthworm-invaded soil without litter layer.

3.6.3. Deer Browse

As discussed in Section 3.2, the regional landscape supports overabundant populations of deer. Deer populations in North America are historically high compared to pre-European settlement due to loss of key predators and land management that generally favors deer. High deer populations can exert pressure on ground layer plant species, including shrub and tree regeneration. Negative impacts on species such as iconic spring ephemerals of maple-basswood forest have been linked to over browsing by deer. Deer selectively browse some species and favor others, contributing (along with earthworms and past land use issues) to a simplified plant community dominated by just a few species (for example, the native Pennsylvania sedge and the invasive common buckthorn). Once native species diversity and abundance is lost, high deer densities make it difficult for these communities to recover or persist. For example, an estimated 2,400 wood nettle plants per acre are necessary to tolerate high deer densities of 30-40 per square mile (Augustine and Frelich 1998).

3.6.4. Grazing Legacy

As discussed in Issue 3.1, the effects of livestock grazing and associated legacy effects contribute to degradation of woodland and forest communities of MRPR. Overgrazing caused direct loss of many native

ground layer species and tree seedlings via consumption and trampling. Furthermore, prolonged grazing depleted the native seed bank. Like deer, cattle favor certain species, and the abundance of species like white snakeroot within MRPR is indicative of past intensive grazing, since cattle find it unpalatable. Once native species are lost within the ground layer, recovery is difficult, especially when combined with impacts from invasive vegetation, earthworms, and deer browse. The legacy of grazing combines with these factors to result in the simplified communities (compositionally and structurally) dominated by few species. Additionally, livestock trampling compacts the soil surface, increasing surface runoff and contributing to soil erosion and poor soil quality.

3.7. Riparian Habitat Degradation

3.7.1. Channel Incision and Disconnected Floodplain

The stream channel is currently in a state of 'active channel evolution' as the stream slowly adjusts to the altered water and sediment supply from the watershed. Both the north and south tributaries and the main stem of Trout Brook have become incised (or down cut), which has resulted in floodplain abandonment and has exacerbated bank erosion along much of the stream corridor. The degree of channel incision varies, but generally bankfull flows (the stage in which flows should begin to dissipate over the floodplain) are contained within the channel. The more flood energy is contained within the channel, the greater the chance for bank erosion to occur. Over time, bank erosion will continue until a new lower floodplain becomes established, at which time the abandoned floodplain becomes a terrace. This process is known as channel evolution and can take decades or longer before a new state of stream equilibrium occurs. Several indications of active stream degradation have been observed in Trout Brook, including accelerated later-bank migration and subsequent bank erosion, stream bed aggradation and incision (varies by reach), stream substrates dominated by silt and sand, lowered floodplain hydrology due to channel incision, and poor instream habitat.

The active channel and stream bank erosion issues observed in Trout Brook have resulted in habitat degradation in both the aquatic and riparian communities. As the stream channel erodes and widens to form a new floodplain, significant deposits of silt and sand have occurred throughout the stream corridor. Subsequently, key aquatic habitat features such as riffles and pools have been impacted by sedimentation. Pool habitat is largely limited to areas where tight stream meanders occur or where log jams and beaver dams exist, and exposed riffle substrates are largely confined to areas with swift current. Channel incision has also lowered the hydrology of the adjacent floodplain, which has resulted in drier floodplain soils and more favorable conditions for transitional and uplands species to dominate the riparian vegetation community. Few wetlands occur along Trout Brook and are mostly associated with old meander cutoffs and discharge swales from springs and seepages.

Degradation of the stream channel can be mitigated in part by improved land use within the drainage area through implementation of watershed projects such as increasing flood storage and partial conversion of land from agricultural use to grassland (or perennial cover crops), particularly along the north and south drainage ways that transition to the north and south tributaries at the far west side of the park reserve. To speed up the process of channel evolution, stream restoration should be considered and prioritized in areas that would yield the greatest improvement to the resource.

Photograph 21. Example of bank erosion, channel incision, and disconnected floodplain along Trout Brook.

3.7.2. Log Jams

Log jams are frequent along the main stem of Trout Brook and are the result of both lateral bank migration and wood "racking" during flood events. As lateral bank migration advances across the floodplain, trees along the stream banks eventually become undercut and fall into the channel. If the tree is large enough or remains partially rooted in the stream bank, the tree can function as a snag and accumulate large quantities of woody debris including branches, logs, and other trees that move through the system during flood events. The formation of a log jam typically results in varying degrees of bank erosion through deflection of flow. Partial, or side-channel log jams, typically result in bank erosion on the opposite bank from the log jam through deflection of flow. Log jams that span the width of the channel can cause bank erosion on both sides of the channel and result in the formation of a mid-channel bar (sediment island) and a braided channel through sediment aggradation in the channel. In certain situations, large log jams can also cause meander cutoffs to develop or induce significant floodplain erosion. However, not all log jams are problematic and can provide important deep pool habitat and overhead cover for trout and non-game species, and also provide habitat for macroinvertebrates and other species that rely on wood substrates for parts of their life cycles.

3.7.3. Beaver Dams

Although probably much more abundant in the past, beaver dams are infrequent and presently occur along the middle reach of Trout Brook. Three beaver dams were documented in 2021 downstream of the stream restoration project completed in 2019. Beavers are a keystone species in many lotic environments and can significantly influence the hydrology, riparian vegetation, and species composition and distribution in the ecosystem. By nature, beaver dams cause a shift in stream processes that can both benefit certain species and negatively impact others. The beaver dams observed along Trout Brook currently provide deep pool habitat that supports species that utilize both lotic and lentic environments. However, major stream impacts have occurred upstream of one dam that has raised the base flow water surface elevation over two vertical feet. This dam is functioning like a low head dam and has backed up water for over 500 feet upstream. The impacts from the dam include sediment aggradation in the channel, loss of riffle habitat, and channel widening. Thermal impacts are unknown, but the wide and shallow conditions in the channel created by the dam could result in thermal stress and lower oxygen levels during hot weather periods that may impact cold water stenotherms (i.e., brook trout) and macroinvertebrates that require high dissolved oxygen levels (i.e., stoneflies). However, localized thermal impacts are offset, and more, by the regional effects of dams, by, for example, increased infiltration to groundwater and increased base flow to surface water. So, overall, beaver dams are a net benefit to the ecosystem, including salmonids (trout). Furthermore, it has been shown how beaver dams and the result of beaver activity can actually reconnect an incised channel with its floodplain, albeit over a long period of time (6 to 30 years).

3.7.4. Riparian Vegetation

The riparian vegetation along the Trout Brook corridor is dominated by early successional and invasive species including box elder, Siberian elm, common buckthorn, bush honeysuckles, reed canary grass, garlic mustard, creeping charlie, Dame's rocket, and common burdock. Numerous other invasive species exist sporadically over the floodplain and native species are scattered and localized. The dense canopy created by woody invasive species has negatively impacted the herbaceous community along the floodplain forest floor. Bare soils occur in areas where dense stands of woody invasive shrubs exist, with some stream banks with marginal surface protection that are vulnerable to erosion during flood events.

The restored reach along the main stem of Trout Brook completed in 2019 resulted in significant improvements in the density and diversity of native herbaceous grasses and forbs and has increased pollinator habitat along the stream. The lowered stream banks created to narrow the stream and reconnect the floodplain have restored near-surface hydrology near the stream and have resulted in the establishment of deep-rooted grasses and sedges, although ongoing management and monitoring will be necessary for continued success. Future stream restoration activities should emulate the successes from the restored reach and incorporate similar techniques to improve the hydrological connection between the floodplain and the stream that provides suitable conditions that support mesic and wetland obligate species to develop along the riparian corridor.

Riparian vegetation is also greatly influenced by the fauna of a site. For instance, beavers are known to tend and promote stands of willow, cottonwood, and aspen, which keeps these species populations both healthy and in check. Another example is deer populations—overabundant deer can over-browse riparian areas which can lead to denuded stream banks.

Photograph 22. Large beaver dam along Trout Brook.

3.8. Erosion

Erosion is a natural geological process, as is its opposite process, deposition. However, when vegetation gets altered and removed over a large area, especially on steep slopes and in sandy or silty soil types, erosion can become a big problem. Soil erosion across the landscape is a symptom of both regional and site-specific issues across the park reserve. The effects of soil erosion go beyond the loss of fertile land; it leads to increased pollution and sedimentation in streams and rivers, clogging these waterways and causing declines in fish and other species. Degraded lands are also often less able to retain and absorb water, which can worsen flooding and deplete aquifers.

3.8.1. Ravine Erosion

The ravines of MRPR are, in their essence, evidence of past and present erosion. Their formation is the result of water moving from upland areas washing soil away to incise the ravines. There is a continual, natural rate of erosion inherent to all ravines. In MRPR, however, altered land use within the watershed and increased precipitation due to climate change have amplified the volumes of water moving through the drainage system, including the ravines, compared to pre-European levels (though notably, erosion rates were slowed significantly in the mid-1900s due to conservation practices). Additionally, stormwater run off

and water volume goes up with decreasing vegetative cover and concomitant increasing in cover of bare soils within the woodland and forested communities of the park reserve. Ravine erosion contributes sediment deposition to Trout Brook, which disrupts the native plant communities and provides opportunities for invasive vegetation establishment.

Recent management efforts have improved the overall stability of ravines across the park reserve. Much of the adjacent blufftops surrounding the ravines were restored from cropland to prairie. Native prairie vegetation intercepts surface water runoff and reduces water velocity and volume to receiving drainageways. Work conducted by the SWCD has also addressed ravine erosion by identifying BMP locations for water quality improvements with the Trout Brook subwatershed and implemented some of these beyond park boundaries.

Photograph 23. Headcut observed at ravine within overgrown oak woodland.

3.8.2. Soil Erosion

Many of the soils within the park reserve are vulnerable to erosion due to steep slopes and fine texture. Poor vegetation cover in woodlands and forests, due to issues discussed in Section 3.6 (Terrestrial Habitat Degradation), exacerbates the situation. Invasive earthworms in particular contribute to direct soil loss by consuming the organic duff layer present in forested ecosystems. Many of the soils along steep slopes are bare and exposed. Evidence of topsoil erosion is abundant from marks on trees and along fence lines, and

from exposed roots of mature trees. In especially barren ground layers beneath dense canopy cover, hummocks of moss and Pennsylvania sedge have formed mounds surrounded by exposed, eroded soils. Loss of soils results in reduced soil quality of terrestrial habitat while degrading habitat and water quality in downstream drainageways.

Photograph 24. Roots of young sugar maple exposed by soil erosion in mesic hardwood forest.

3.9. Excess Nutrients

Nutrient imbalance is an issue within both terrestrial and aquatic environments. Nitrogen and/or phosphorus are typically limiting nutrients in ecosystems, but exist in excess amounts regionally and locally. Increased nutrient availability typically makes plant communities more susceptible to invasion as many invasive species have a competitive advantage under enriched conditions over native species, and there is a larger surplus of unused resources for invaders (Davis et al. 2000; Shea and Chesson 2002). Within terrestrial habitats, a legacy of agricultural inputs persists, especially in former cropland. Croplands usually have higher nutrient content than pasture or remnant land cover. Increased atmospheric deposition of nitrogen is caused by fossil fuel combustion, and deposition occurs globally across all landscapes. The aquatic resources of MRPR are affected by both surface water and groundwater nutrient excess. Surface water from surrounding watersheds dominated by agricultural land use carry sediment and phosphorus to Trout Brook and tributaries. The karst geology of the region makes groundwater highly susceptible to

nitrate pollution from agricultural inputs, and monitoring of Trout Brook has detected some of the highest measured nitrate levels in southeastern Minnesota (Figure 7; Groten and Alexander Jr. 2015). The main stem of Trout Brook and the south tributary are currently listed by the MPCA as impaired for nitrates (listed in 2010), and both the north and south tributaries are also listed for aquatic life (MPCA 2022).

Consideration of excess nutrients in land management is important because many invasive species thrive within nutrient-enriched habitats. Further, aquatic systems with high phosphorus are susceptible to increased algal blooms and poor clarity, with cascading effects for aquatic biota. Elevated nitrate levels in aquatic systems may harm fish and other aquatic life. At MRPR, nutrient enrichment likely contributes to many of the issues with invasive species, including reed-canary grass along Trout Brook and adjacent floodplain and smooth brome/Kentucky bluegrass in restored prairies.

3.10. Programmatic Issues

Implementation of the MRPR management plan relies on funding, partnerships, and outreach. Addressing the following issues are essential to optimizing natural resource management.

3.10.1. Funding

With 56 regional parks and park reserves totaling more than 54,000 acres in The Twin Cities metropolitan area, funding for parks is competitive, even more so for operations and maintenance.

Conversely, expanding, improving, and maintaining natural resources can be incredibly costly. Substantial dollars will be needed to continue to foster MRPR's ecological quality, considering the compounding issues expressed herein.

3.10.2. Partnerships

Management efforts are most successful when stakeholders develop robust collaborations that develop and leverage efficiencies and synergies with multiple incentives. Many local, regional, and state public and private entities are invested in the natural resources of MRPR. While the source of their interest may differ, many have overlapping or common goals. The County has historically and continues to partner with many organizations, and sustaining and expanding these partnerships is critical.

3.10.3. Citizen Outreach, Stewardship, and Education

Natural resource education, awareness, and stewardship can benefit both park users and the natural resources of MRPR. The diversity and quality of natural resources at MRPR provides ample opportunity for the public to engage with its unique ecology. Promoting public understanding of the role and value of Dakota County Park's natural resources is vital to the mission of Dakota County.

Some management activities are well-suited for volunteers, such as manual removal of garlic mustard and seed harvesting or monitoring of remnant prairie. Garlic mustard occupies areas of the park reserve that are difficult to access with equipment and where hand-pulling may be a suitable method. However, a challenge to public stewardship at MRPR is its distance from the population centers of Dakota County. Finding local volunteers or volunteers willing to travel longer distances has been a challenge for park staff.

Furthermore, the ruggedness of the Park Reserve and degree of difficulty of the tasks can deter volunteers and/or the County from soliciting help, due to safety concerns.

3.11. Climate Change

Like everywhere else, climate change is impacting MRPR, and the situation will only continue to get worse in the near future. In Minnesota, climate change is manifesting with warmer winters (especially higher night-time low temperatures), increasing precipitation and storm intensity (more heavy rains and fewer slow soaking events), and greater snow events. Temperatures have risen more than 2.5°F since the beginning of the 20th century, and warming trends are expected to increase the intensity of droughts such as that experienced in 2021 (NOAA 2022).

Climate change exacerbates the ecological issues discussed above in this section. As the region and the park experience greater swings in temperature and precipitation, insects, birds, trees, wildflowers, and soil microorganisms are forced to tolerate conditions beyond those through which they have evolved. Indirect impacts to natural systems include favorable conditions for invasive plants, pathogens, and pests, including white-tailed deer. Invasive plants are expected to exploit changes in the environment from climate change and colonize disturbed areas faster than native plants can. As forests become stressed from the direct impacts of climate change, pests and pathogens will likely increase due to higher numbers of stressed trees vulnerable to infestation. White-tailed deer populations are expected to rise under climate change, and pressure from deer browsing may limit regeneration of tree species.

Another impact of climate change is the dyssynchronization between plant and animal phenology and key environmental factors. Not all species are able to adjust to the rapid shifts in climate, with subsequent disruptions in species interactions and ecosystem function. For example, plants may flower earlier than pollinators evolved to visit them, or caterpillars may emerge prior to arrival of migratory birds that evolved to feed on them as a primary food source.

Climate change will also likely have a major impact on the stability and subsequent health of streams like Trout Brook. The predicted seasonal variability and storm severity will alter base and peak stream flows, which will likely spawn instability and morphological response disturbance. As the channel is attempting to respond to this ongoing variability, stream health will likely be degraded.

Photograph 25. White pine in mesic hardwood forest communities of the park reserve are expected to decline in response to a warmer climate.

4. VISION, GOALS, & STRATEGIES

4.1. Natural Resources Vision and Goals

4.1.1. Vision

The vision for the park reserve is to be a landscape that:

- Fosters and builds resilient, mature, and high-functioning ecosystems
- Supports natural hydrology and high-quality habitat within Trout Brook
- Provides habitat for native biota, including Species in Greatest Conservation Need (SGCN)
- Allows people to experience the natural heritage of the area via low-impact activities, sensitive to the park reserve's unique resources
- Includes and engages stakeholders, such as public agencies and adjacent landowners, to achieve the best joint management of natural resources in the area
- Mitigates impacts of climate change
- Achieves regionally outstanding ecological quality
- Encourages a diverse and equitable useage of the parks in a safe setting for all

The Miesville Ravine Park Reserve NRMP aligns with the Dakota County Natural Resource Management Vision for the Park System:

The water, vegetation, and wildlife of Dakota County parks, greenways, and easements will be managed to conserve biodiversity, restore native habitats, improve public benefits, and achieve resilience and regionally outstanding quality, now and for future generations.

Photograph 26. Hoary puccoon in remnant bluff prairie.

4.1.2. Park-wide Goals

- **Restore and manage plant communities at a landscape scale** to provide a mosaic of appropriate communities with soft edges/transitions.
- **Increase native plant diversity and abundance within communities** by restoring ecosystem structure and processes, establishing native groundcover, and diligently revegetating depauperate sites.
- **Minimize invasive species' presence and abundance** through prevention of establishment, by prioritizing sensitive habitats, by identifying populations that are likely to spread (e.g., upstream), and by identifying feasible target areas.
- **Provide habitat for rare species and SGCN known or likely to occur in the park reserve** by restoring and managing the native plant communities that provide their critical habitat.
- **Enhance landscape connectivity** through native plant community restoration.
- **Restore natural hydrology and habitat to the Trout Brook channel and floodplain and tributaries,** via landscape-level management practices and partnerships.
- **Restrict recreation to low-impact activities** to preserve sensitive natural resources and highlight the natural heritage of the park reserve to the public.
- **Nurture collaboration and outreach to address landscape-level issues** by working with public and private stakeholders to accomplish shared or overlapping goals.
- **Practice adaptive management** to learn from and apply lessons of management outcomes while exploring alternative means of meeting objectives based on the current state of knowledge.
- **Integrate climate change adaptation into management actions** by managing for diversity, monitoring site-specific and regional responses to climate change, and practicing adaptive management.
- **Work with Visitor Services and Park Patrol to make the park reserve open and safe to all types of people** by periodically checking public surveys, conducting public outreach, working with Parks Director to provide adequate Park Patrol presence at the site.

4.2. Goals and Recommended Strategies

Previous sections provided goals and recommended strategies for priority features of the park reserve. Priority features are attributes of a site that are of particular ecological and management importance and important to account for in management planning. The priority features of MRPR include:

- Trout Brook and Tributaries
- Mesic Hardwood Forest
- Remnant Prairie/Savanna
- Reconstructed Prairie
- Overgrown Oak Woodland/Savanna
- Seepage Meadows
- Altered Riparian Area
- Altered Upland Forest
- Altered Grasslands
- Cliff and Outcrop Communities
- Cannon River
- Ravines
- Rare Plant Species and Wildlife

Goals for land cover priority features are framed within the context of target native plant communities. An overall target native plant community map is shown in Figure 28. Target native plant communities can also be thought of as desired future conditions. In some cases, there are multiple target native plant communities that might be suitable for a given area based on alternative or transitional states. For example, fingers of prairie near ravine crests could also be managed as savanna. In general, transitions between target native plant communities could and often should be blurred or feathered, and not managed as discrete transitions. The GIS attribute data for the target native plant communities includes alternative target communities beyond those displayed in Figure 28.

Goals and strategies are also provided for the broader attributes and activities that support the priority features of the park reserve. These attributes and activities include:

- Connectivity
- Climate Change Resilience
- Citizen Outreach, Stewardship, and Education
- Partnerships
- Sustainable Park Development

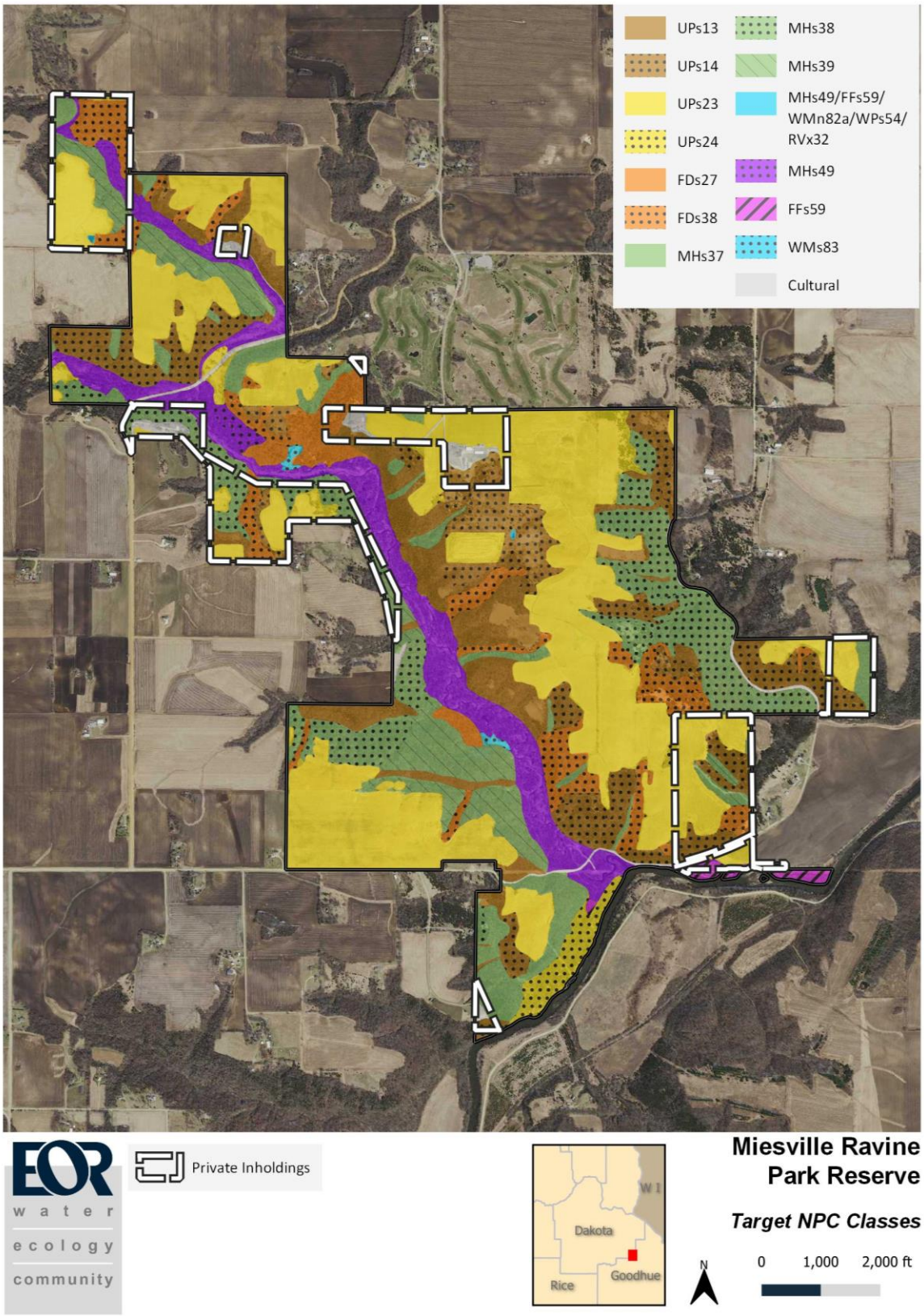


Figure 28. Target native plant community classes for MRPR.

4.2.1. Trout Brook and Tributaries

Primary issues within Trout Brook include:

- Degraded and altered hydrology, stream morphology, and water quality due to existing and historical land use in the broader watershed
- Channel incision and disconnected floodplain
- Stream flow constrictions (log jams and beaver dams that tend to accelerate bank erosion)
- Degraded water quality
- Degraded riparian vegetation
- Maintain habitat and water quality capable of supporting a fishable population of wild Brook Trout

Goals

1. Improve watershed hydrology and water quality within and beyond the park reserve boundary.
2. Reconnect the stream with the floodplain
3. Support channel conditions that provide in-stream habitat
4. Restore riparian and upland vegetation
5. Work with DNR to remove Brown Trout from stream

Strategies

Work with upstream landowners and partners to implement watershed BMPs and restoration

The hydrology and water quality of Trout Brook is primarily controlled on a watershed-scale, which extends beyond park reserve boundaries. A 2016 subwatershed analysis completed by Dakota County SWCD identified and prioritized hundreds of conservation practice locations for water quality treatment and water volume reductions across the landscape (Dakota SWCD 2016). Several of these that were located within the park reserve have been implemented, in partnership with the SWCD. Several more have been completed in the greater Trout Brook watershed by the SWCD and private landowners. In addition to BMP implementation, it will be important to work with inholdings and land adjacent to landowners to restore native plant communities (e.g. conversion from row crops), and consider land or easement acquisitions. Results of an MPCA study indicate that row-crop agriculture in the surface and subsurface drainage basins of Trout Brook is the primary cause of the water's elevated concentrations of nitrate.

Watershed restoration is fundamental to the successful restoration of Trout Brook and must be continued. Continue working with the SWCD and other partners to fund and implement as many additional conservation practices as possible. Refer to section 3.10.2 for a partial list of potential partnership organizations.

Restore channels at priority locations

Three channel restoration reaches are considered priority based on 2021 surveys and are described below.

North Tributary: Implement grade stabilization to restore the stream bed elevation along the north tributary to reconnect the stream with the floodplain. Significant deposits of sand occur within this tributary and are flushed downstream into the main branch of Trout Brook during flood events. Reconnecting the floodplain would allow for dissipation of flood energy and reduce the amount of sand delivered downstream.

South Tributary: Implement a stream restoration project to reconnect the stream with the floodplain and narrow the stream channel in areas that have become over-wide from lateral bank migration. This tributary contains a high concentration of native brook trout, particularly upstream of County Road 91, and should be considered a top priority for restoration. Coordinate work with Dakota County Transportation Department to develop a plan to address the existing fish barrier at the County Road 91 culvert. Ideally, the existing box culvert would be replaced with an open span bridge or bottomless arch culvert that can accommodate floodplain flows during large flood events.

Trout Brook (Main Stem): Implement phased stream restoration and build off existing stream restoration work implemented in 2019 near the upper end of Trout Brook. This reach is planned for restoration by Trout Unlimited in coming years. Design elements should focus on reconnecting the stream with the floodplain using a combination of grade control and bank grading, narrowing the channel to improve sediment transport (particularly sand), increasing appropriate pool habitat that benefits brook trout, increasing large wood habitat, and improving riffle habitat for aquatic invertebrates and fish spawning.

Preserve beaver dams but consider removal of large beaver dams based on impacts

Three beaver dams were documented in 2021 downstream of the stream restoration project completed in 2019. Beavers are a keystone species that greatly benefit stream systems by holding back water, moderating flows, and creating wetland habitat and landscape heterogeneity. Beaver populations within MRPR should be encouraged. Within the larger context of regional ecosystem degradation, local effects of beavers may occasionally be undesirable such as the possible facilitation of reed canary grass invasion in the Swede Spring seepage meadow described in Section 4.2.6 (though it is possible inundation could have also been related to a local trout pond operation). Currently, the beaver dams observed along Trout Brook provide deep pool habitat that supports species that utilize both lotic and lentic environments. However, stream impacts have occurred upstream of one large beaver dam that has raised the base flow water surface elevation over two vertical feet. Specific effects of this dam are described in Section 3.7.3.

In general, beaver activity should be encouraged due to their many positive benefits. Preserve small beaver dams along Trout Brook, particularly dams that are positioned in steep gradient reaches that provide deep pool habitat yet only impact a short stretch of stream. However, consider removal of large beaver dams that impound long stretches of stream, especially in lower gradient reaches along Trout Brook. Dams impounding spring seepage meadows may be beneficial or have negative impacts depending on site-specific effects. Preserve these dams and be prepared to respond to potential negative impacts such as invasive species when the dam eventually washes out.

Integrate vegetation management with adjacent Altered Riparian Area

Plant community restoration of the riparian corridor along Trout Brook is described in 4.2.7. Ideally, efforts would be combined with stream restoration efforts and several pertinent activities are described below.

Conduct tree canopy thinning along Trout Brook, particularly early successional species such as box elder and removal of woody invasive species to promote the establishment of deep-rooted herbaceous vegetation. Incorporate tree harvest plans into stream restoration efforts and utilize harvested woody material for instream habitat. Encouraging beaver activity will also help achieve this goal through their contribution to canopy thinning.

Retain up to 25 percent cover of mature native trees characteristic of MHs49 and FFs59 near the stream to allow for future wood recruitment via deadfall and other benefits such as contributions to instream leaf pack formations (aquatic invertebrate habitat) and neotropic and resident bird nesting habitat. Preserve dead-standing trees in the riparian corridor for future wood recruitment, snag habitat, and opportunities for cavity nesting.

Utilize abandoned terraces and transitional zones for floodplain forest restoration with a focus on creating a closed and contiguous canopy that supports SGCN known to occur in the park reserve, including cerulean warbler, prothonotary warbler, and red-shouldered hawk.

Wild Brook Trout and Introduced Brown Trout

DNR has plans to stock a significant number (approximately 6,500) of the MN Driftless strain of Brook Trout for three consecutive years beginning in 2025. They also want to stock 100 slimy sculpins, to increase forage species, in 3 of 5 years for a total of 300 fish, beginning in 2025. They will also continue to encourage watershed protection measures and best management practices to maintain water quality and quantity capable of supporting a trout fishery.

They will continue to monitor along the stream, to evaluate fish populations and effectiveness of the program.

A potential plan the DNR may implement is to work with the Twin Cities chapter of Trout Unlimited to expand upon the stream habitat project completed in 2018. Also, since brown trout can compete with native Brook Trout, DNR may investigate the possibility of a barrier on the lower reach to prevent Brown Trout emigration from the Cannon River and implement a Brown Trout removal project above the barrier.

Work with Volunteers to Control Invasive Species and Improve Habitat for Game and Non-Game Wildlife

Work with local non-profits, conservation groups, and hunting/fishing organizations to improve habitat for game and non-game wildlife. One organization to consider is the Twin Cities chapter of MN Trout Unlimited (MNTU), who have stated their support for this plan and it's goals.

Photograph 27. Looking upstream along Trout Brook toward a sandy point bar.

4.2.2. Mesic Hardwood Forest

Mesic Hardwood Forest at the park reserve consists of six different DNR NPC types:

- Red Oak – White Oak Forest (MHs37a)
- Red Oak – White Oak – (Sugar Maple) Forest, Southern (MHs37b)*
- White Pine – Oak – Sugar Maple Forest (MHs38a)
- Red Oak – Sugar Maple – Basswood – (Bitternut Hickory) Forest (MHs38c)
- Sugar Maple – Basswood – (Bitternut Hickory) Forest (MHs39a)
- Sugar Maple-Basswood-Red Oak (Blue Beech) Forest (MHs39c)

These forest NPCs are characterized as dry-mesic to mesic forest communities on loess-covered bedrock bluffs. All NPCs are fairly similar and may occur within complexes, but with subtle affinities based on aspect slope position and moisture regimes. They share strong correlations with north-facing slopes, though MHs37 has the driest moisture regime and is therefore sometimes found on west-facing slopes. MHs39 types are more restricted to north and northeasterly aspects due to its wetter moisture regime. MHs38 types fall somewhere in between. Historically, stand-replacing fire was uncommon in all Mesic Hardwood Forest NPCs, while smaller disturbances resulting in patchy tree loss (most likely from light surface fires) varied from intervals of about 20 years for MHs37 to 50 years for MHs39.

Existing condition rank of Mesic Hardwood Forests varies from B/C to D. The hybrid B/C rank applies to areas of generally C-rank forest with small inclusions of B-rank forest. Both B and C-rank forests have canopies and sub-canopies typical of Mesic Hardwood Forest NPCs with varying composition of northern red oak, white oak, basswood, and sugar maple as dominants (dependent on representative NPC type). The understories of both B and C-rank forests have been impacted by invasive vegetation, invasive earthworms, deer browse, and legacy of non-native grazing; however, both still retain characteristic species of respective NPC types, with B-rank areas approaching typical structure and composition more closely. D-rank forests have been most dramatically impacted by invasive vegetation, earthworms, and historic land use. These D-rank areas are typically located along crests that were historically cleared and grazed or steep ravine slopes subject to most severe erosion. Both the canopy and understory of D-rank areas retain only remnant examples of target NPCs and are often dominated by buckthorn, garlic mustard, and eastern red cedar, or characterized by barren or depauperate understories.

Primary issues within Mesic Hardwood Forest include:

- Reduced native plant diversity of both herbaceous and regenerating tree species due to the interaction of invasive vegetation, invasive earthworms, deer browsing, and the legacy of non-native grazing
- Bare soils and soil erosion due to earthworms that eat the duff layer and cause compaction of surface soils resulting in reduced vegetative cover of the understory
- Garlic mustard invasion, as induced by bare soils and propagule conveyance via waterways and dispersal by deer, which is particularly impactful to spring ephemerals
- Uniform canopy age and structure due to fire suppression

Target NPCs within Mesic Hardwood Forest generally consist of the forest types currently present at the park reserve and listed above. However, some ravines and bluff crests may be better suited to the following drier, more open NPCs based on slope and aspect:

- Dry Prairie (UPs13)
- Southern Dry-Mesic Oak-Hickory Woodland (FDs38)

Target NPCs are mapped in Figure 31.

Goals

1. Enhance native plant diversity and increase FQI scores
2. Reduce invasive vegetation cover to 5 percent, on average
3. Regenerate native tree species composition and structure to follow the successional stages, natural history, and complex age structure of the target native plant community for MHs37, MHs38, and MHs39 (see DNR NPC Field Guide, 2005, for detailed plant community descriptions)
4. Preserve spring ephemeral areas
5. Rebuild healthy soils by significantly increasing vegetation ground cover to 25-100 percent, typical of Mhs37, MHs38, and MHs39 NPC Field Guide descriptions
6. Reduce deer population below 10 deer per square mile

Strategies

Control garlic mustard in priority locations, via removal and revegetation

Goals addressed: enhance native plant diversity (1), reduce invasive vegetation cover (2), preserve spring ephemeral areas (4), and rebuild healthy soils (5).

Within Mesic Hardwood Forest at the park reserve, garlic mustard invasion is common along footslopes of the bluffs and ravines (Photograph 28). Areas disturbed by mass wasting along slopes or isolated canopy gaps appear to be especially dense and often dominated by 75-100 percent cover of garlic mustard. From the footslopes, garlic mustard is invading upslope where it is intermixed with native vegetation or present in satellite patches. Satellite patches are further scattered throughout upper slopes and shoulders/terraces of Mesic Hardwood Forest where it has likely been dispersed by wildlife and humans.

Photograph 28. Dense garlic mustard along footslope of bluff along Trout Brook trail. Invasion is creeping upslope into areas dominated by native ground vegetation.

Prioritize garlic mustard populations for control using the Midwest Invasive Plant Network (MIPN) decision tree. The MIPN decision tree prioritizes based on new invasions, patches adjacent to spread pathways, quality of native plant community. and management resource availability. At MRPR, propagule pressure of garlic mustard should also be considered as seeds are transported along Trout Brook and other drainageways, including areas upstream of the park reserve boundary. A consistent seed source of garlic mustard will always be present, and control of some areas may be extremely difficult or not feasible.

Priority areas at MRPR may include:

- Areas with less frequent disturbance
- Upstream areas of the park that export seeds downstream
- Upslope areas that export seeds down slope
- Small, outlier populations
- Populations that threaten spring ephemerals or other high-quality habitat
- Areas where native vegetation could be established as means of competition with garlic mustard

Recognize that there may be areas where garlic mustard control is not worthwhile, particularly areas with a strong garlic mustard seed bank and few indicators of a healthy native plant community capable of recovery.

For example, the toeslope of bluffs near the boundary with the Trout Brook floodplain/Altered Riparian Area priority feature has some patches of nearly 100 percent garlic mustard cover with few native understory species, and are located in areas where Trout Brook flows may continually disperse garlic mustard seed from upstream sources.

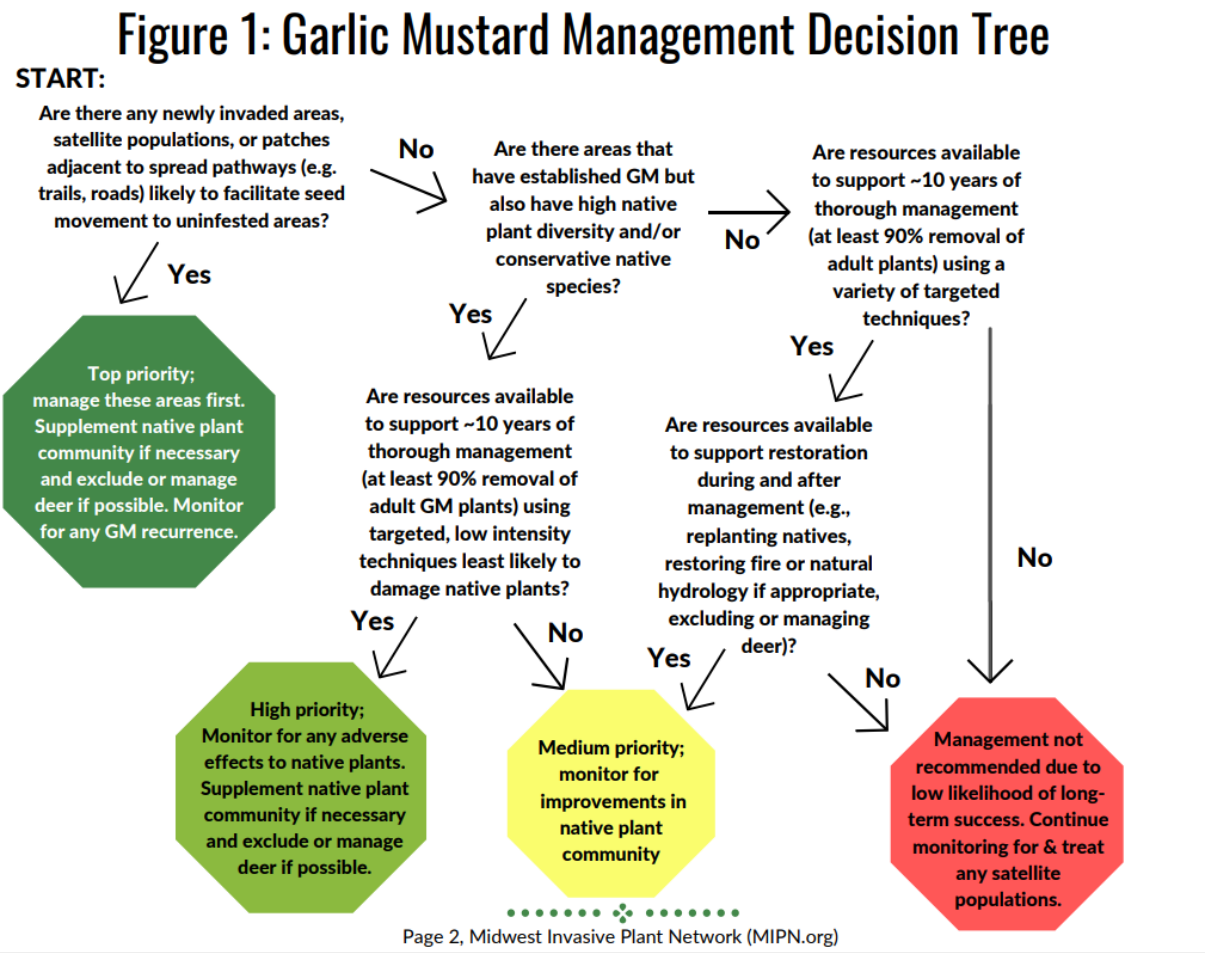


Figure 29. Garlic mustard management decision tree (MIPN 2021).

Hand pull small populations or those intermixed with high-quality native vegetation such as spring ephemerals or certain tree seedlings, leveraging volunteers or service programs as able. For denser infestations with some conservative native species or high native diversity, slightly less selective but more efficient non-chemical methods include weed whips or flame weeding. The goal of these methods is to prevent or remove flowering heads while minimizing damage to desirable natives. Use discretion with cutting height to avoid damage to non-target species. It may be necessary to revisit the site multiple times within the same growing season to prevent flowering on secondary/re-sprouted stems. Gather or pile plants/cuttings for disposal or cover with a tarp; plants left in place are capable of producing seed even after pulled or cut. Keep good records of where garlic mustard control has occurred and what it entailed, which will help organize effective management over the many years that will be required for garlic mustard control.

Glyphosate and triclopyr are effective treatments and can be applied in early spring or late fall when most native plants are dormant. However, avoid use of herbicides in areas of or adjacent to potential spring ephemeral habitat, or where garlic mustard is intermixed with native species. If non-target species are killed, it is likely that garlic mustard will replace them.

Garlic mustard is a biennial and a prolific seed producer. A single plant can produce over a thousand seeds. Recommended control methods are intended to not only remove garlic mustard, but eventually deplete the seed bank. Therefore, repeated and diligent efforts are necessary at treatment areas until control is achieved. Target at least 90 percent removal of a site's flowering plants and rosettes each year and recheck for missed plants during the flowering period. About 10 years of treatment are likely necessary. Following multiple treatments, assess whether native vegetation cover is increasing. If no increase is observed, consider fencing garlic mustard treatment areas to exclude deer and also consider seeding or transplanting native vegetation (methods described in subsequent sections)

Experimental garlic mustard control options are listed below. These methods are unproven or carry additional risk, but could prove more effective than traditional techniques.

- Some declines of garlic mustard populations at long-invaded sites have been observed, but are poorly understood. Monitor garlic mustard populations at the park reserve and be prepared to take advantage of any declines by aggressively revegetating with native species.
- Stay up to date on garlic mustard biocontrol and be prepared to implement if approved by USDA. Two different European weevils are currently being studied for potential impacts to native plants and hold promise for effective biocontrol.
- Goats can be used to control garlic mustard, but effectiveness has not been quantified. Washington County Parks used goats to graze garlic mustard within five to eight acres paddocks for up to one month. Longer duration grazing studies are needed for better conclusions.

Control invasive woody vegetation in priority locations, via removal and revegetation

Goals addressed: increase native plant diversity and abundance (1), reduce invasive vegetation cover (2), and rebuild healthy soils (5).

Common buckthorn is the primary invasive woody species in Mesic Hardwood Forest at MRPR. Exotic honeysuckle is occasional but is rarely, if at all, a dominant. Management of honeysuckle concurrent with buckthorn should suppress honeysuckle sufficiently to achieve goals.

Priority areas for buckthorn control within Mesic Hardwood Forest at MRPR include:

- Areas where restoration efforts are ongoing or have been completed
- Populations that threaten spring ephemerals
- Populations that threaten forest regeneration (e.g., dense thickets below characteristic NPC canopy)
- Upslope areas that export seeds downslope
- Patches of buckthorn with large fruiting individuals
- Small, outlier populations
- Areas where native vegetation could be established as means of competition with common buckthorn

Degree of buckthorn infestation is widely variable throughout Mesic Hardwood Forest and requires custom prescriptions for each management unit.

A general order of operations for control of dense, mature buckthorn populations starts with forestry mowing and hand cut followed by herbicide stump treatment, with follow-up foliar spray. Steep slopes require hand cutting. Increased light availability typically results in a flush of buckthorn from the seed bank and requires two to three years of foliar spray. Then seed with a mix customized to site conditions and target NPC. Resprouts will likely be persistent for years and require spot-treatments and/or integrations with prescribed burns or goat browse. An example timeline is provided in Table 8 but is flexible and adaptive to site conditions and resource availability.

Many buckthorn populations of Mesic Hardwood Forest at the park reserve are scattered and intermixed with native vegetation and consist of many different age classes. Buckthorn may be limited in these areas by dense canopy shade and competition with native ground and shrub layer vegetation. Target these areas with cut/treat methods to avoid non-target damage. Most importantly, maintain the health of these areas by controlling deer populations and minimizing disturbance to native vegetation.

Historically, light surface fire occurred every 20-50 years in Mesic Hardwood Forests. Prescribed fire may be a suitable management technique for integrated buckthorn control. Within MRPR, prescribed fire may be limited by slope and deficient fuel load from loss of understory biomass and fine fuels in the duff layer. It is recommended to plant fuel-building seed mixes to provide adequate fuel loads for burning. Some fuel-building mixes have already been used within the park reserve. Seed mix establishment could be limited by shading from dense canopy cover. Target areas with relatively open canopies (50% cover) or thin canopies to achieve more open conditions. Canopy thinning mimics the small mortality events caused by light-surface fire. Thinning could target species such as sugar maple and ironwood that have become particularly abundant across the landscape due to fire suppression.

Goat grazing has been employed at the park reserve for buckthorn control and is especially useful on steep slopes where equipment and people cannot function. Goats can be used both before and after intensive buckthorn removal. When used before intensive removal, drop large mature buckthorn to create space and allow goats to knock back buckthorn. After heavy removal, use small paddocks and high goat density, grazing each paddock area twice per season.

Revegetation following buckthorn removal is an emerging science. While some native seed banks may respond vigorously to buckthorn removal, other sites may be depleted and vulnerable to reinvasion. Light availability and soil quality are also critical variables. Understand that using suppression species or novel seed mixes could be effective. For example, initial seed mixes may focus heavily on grasses that establish well and provide fuel load for prescribed fire (i.e., fuel-building mixes). Another example includes relying on planting seedlings of sugar maple or elderberry, woody species that compete effectively for light with buckthorn. Using these species is a successional strategy where overseeding would be necessary at later stages of restoration.

Table 8. Example management timeline for dense, mature buckthorn in Mesic Hardwood Forest.

Year	Treatment	Timing
Year 1	Forestry mow; hand cut/treat on steep slopes	Late fall/winter
Year 2	Foliar spray resprouts/flush	Late summer/fall
Year 3	Goat browse	Summer
Year 3 (continued)	Foliar spray spot treatments	Late summer/fall
Year 4*	Prescribed burn	Spring
Year 4 (continued)	Seed diverse woodland/forest mix	Late spring/early summer
Years 5-10	Continued follow up treatments to include spot treatment, prescribed burns, goat browse, supplemental seeding	

*May be limited in deep shade/poorly vegetated areas and require fuel-building/canopy gaps.

Native revegetation of bare soils

Goals addressed: enhance native plant diversity (1), regenerate native tree species (3), rebuild healthy soils (5), and reduce deer population (6).

Many areas of Mesic Hardwood Forest have bare soils related to past land use, earthworm invasion, and deer browse. To improve the barren understories, active management is needed. Where invasive species are not a major issue, existing vegetation composition is primarily dictated by deer browse pressure, existing seed bank, light availability, and soil conditions. Strategies should focus on reducing deer browsing, increasing the number of native propagules, increasing light availability at scales suited to the native plant community type, and rebuilding soil.

Reducing Deer Browse: Most recent deer surveys at MRPR estimated deer density of 40 deer per square mile. Target deer density should aim for 10 deer/square mile. Reducing deer browse is critical to facilitating revegetation. Existing native ground layer vegetation struggles to tolerate current levels of deer browsing, and any revegetation efforts would also experience similar deer browsing. Park management should continue existing aerial assessments and public hunting programs. Consider a sharpshooting program if deer densities remain high.

Park-wide management should also emphasize reducing desirable deer habitat. Deer prefer dense cover adjacent to open fields or meadows, typically with sharp edges, such as boundaries between eastern red cedar/buckthorn thickets and restored prairie. They are edge feeders. These habitats generally are located within other priority features (see other Sections), but their management has profound effects on the vegetation with Mesic Hardwood Forest. The abundance of deer habitat (edge) on the landscape is also an issue as the deer are not subject to park boundaries. Consider partnerships with landowners to collaborate on or subsidize enhancement and preservation of natural areas on surrounding lands.

Use deer protection measures such as fencing and tree cages, tubes, and bud caps. Protection should target existing areas vulnerable to deer browse such as spring ephemeral populations, regenerating or planted tree seedlings/saplings, and vulnerable/high cost revegetation projects such as forest seeding and

herbaceous plantings. Fencing is the most effective method of deer protection, but also the most costly and requires regular maintenance and monitoring to ensure effectiveness. Small areas can employ 16 ft X 16 ft, 50-inch high micro-exclosures that are demonstrably effective and relatively simple to construct, maintain, and move around (Mohr and Lamond 2018). Micro-exclosures are based on the concept that deer avoid entering small spaces. For larger areas, more robust fencing is required that is at least eight feet high. Fencing is only as good as its weakest spot and is prone to damage from fallen trees/branches. Regularly monitor fencing locations, and consider using a volunteer site steward to check in on fence condition.

Environmental Conditions: Seeding and planting of native tree species is necessary to bolster the seed bank, but likely requires manipulation of environmental conditions in order to be successful. Light availability limits plant establishment and growth. While not a fire-dependent ecosystem, Mesic Hardwood Forest historically experienced light surface fire every 20-50 years that created and maintained small canopy gaps. Canopy gaps provide resource availability and also provide for more complex age and structure within a forest. Mimic this disturbance and provide opportunities for establishment of native vegetation by creating small canopy gaps of less than 0.1 acre (approximately 66 ft X 66 ft). Use of existing canopy gaps is also suitable. While canopy gaps may release some native seed bank (as well as invasives), active seeding and planting of canopy gaps is likely necessary. Fence canopy gap plantings to protect from deer, or at the very least, bud cap/cage/tube trees.

Photograph 29. MHs38 with less than 5% cover of ground layer vegetation.

Soils in most bare areas have been degraded by multiple factors, including invasive species (especially earthworms, buckthorn, and Tartarian honeysuckle), and the impacts of recent land use, which have all resulted in loss of soil structure and chemistry and increased erosion. There is a strong need to rebuild soil "health". Forest soil health relies on microbial relationships, soil tilth, and soil organic matter, among other things, that have been degraded at MRPR and are not quickly restored. Consider seeding a native fuel-building cover crop on bare soil north facing slopes to help rebuild the soil. Re-seed with a more diverse mix following establishment of the fuel-building mix. Plant trees characteristic to each Mesic Hardwood Forest Community type.

Active Revegetation: Revegetation of barren understories of mesic hardwood forests is a developing science. That said, revegetation is likely necessary in the face of degradation and improves biotic resistance of forests to buckthorn invasion and potentially other invasives (Schuster et al. 2022). Research indicates trees and shrubs are most effective at shading out buckthorn, particularly in less open canopy conditions. These woody species are likely most effective due to niche overlap, as they are more likely to be competing directly with buckthorn. Target species with the greatest amount of niche overlap, especially those with extended leaf phenology such as elderberry. Seeding herbaceous species is also effective, especially in more open canopies, but research indicated more follow-up buckthorn control was likely necessary (Schuster et al. 2022). A summary of different approaches is provided below.

Trees: In general, canopy gaps should be planted with tree species characteristic of the native plant community. For example, include white pine within MHs38a. For areas within dense shade, sugar maple is a good candidate for most tree plantings in target MHs38 and MHs39 NPCs. Sugar maple is shade-tolerant and may be particularly competitive with buckthorn due to its shade creation and shade tolerance (Schuster et al. 2022). Sugar maple is less suited to MHs37, and red oak, white oak, basswood, and disease-resistant American elm should be higher priority in these target NPCs. Ensure trees are protected from deer browse with bud caps, tubes, cages, or fencing.

Climate change is and will continue to affect canopy composition within Mesic Hardwood Forest. Planting should also consider increased densities of more southerly mesic hardwood species present at MRPR (e.g. white oak) or even climate-adaptive species from areas outside of Dakota County (e.g., black maple, black oak, or shagbark hickory).

Herbaceous Vegetation and Shrubs**:** Many forest herbs rely on complex interactions with soils and specific environmental conditions and germination requirements, and may not be widely available commercially. Several revegetation approaches are outlined below and can be intermixed and customized based on site conditions.

- Cover crop
    - As discussed above, cover crops of rye or oats are useful in erosion prone areas to rapidly establish cover, rebuild soil, and provide fuel for potential prescribed fire. Cover crops will require overseeding with native mix, unless significant change in site conditions (e.g., deer reduction, light availability) allows for native seed bank recovery. Prepare for overseeding with prescribed fire.
- Suppression seed mix
    - A suppression seed mix is weighted toward native species most likely to establish and thrive under degraded site conditions (i.e., most restoration sites) while providing good competition and fuel load for prescribed fires. Examples include wild ryes (*Elymus* spp.) and woodland sedges (e.g. *Carex sprengelii*). This type of mix is best suited for the most degraded Mesic Hardwood Forest sites, such as dense buckthorn removal sites, barren understories, and large canopy gaps that have more open conditions. As cover establishes, introduce more conservative species such as spring ephemerals and wildflowers via overseeding or plugs. As canopies mature, shade-intolerant grasses and sedges may decline.

- Shrubs
    - A diversity of shrubs characteristic of the native plant community can be planted. For degraded sites recovering from invasive removal, a more restoration aggressive planting could be used that might include shrubs like elderberry, gray dogwood, and American hazelnut. Elderberry in particular may be a strong competitor with buckthorn. A concern could be that sites become dominated by these native woody shrubs with little understory development. Integrating with prescribed fire and goat grazing could prepare sites for interseeding or planting with a more diverse vegetation characteristic of hardwood forest pant communities.
- Diverse forest/woodland seed mix
    - Diverse forest and woodland mixes should be used following cover crop or suppression mixes or for sites with favorable environmental conditions and experimental areas. These mixes should include shade-tolerant species and should include grasses, sedges, forbs, ferns, and shrubs. See Appendix C for lists of understory species typical of Mesic Hardwood Forest NPCs. Diverse forest and woodland seed mixes are increasingly available commercially, such as this example seed mix from Minnesota Native Landscapes. Include native forest species that are able to tolerate the presence of earthworms including Pennsylvania sedge, zig-zag goldenrod, columbine, and jack-in-the-pulpit, as well as a variety of other species that are planted at high enough densities or in large enough numbers that might be able to withstand heavy browsing pressure. Also consider including species from more southerly provenance to account for climate change, such as mayapple.
- Experimental moss transplant
    - Within MRPR, forested slopes with moss cover appear to have better soil retention. Moss often forms small "terraces" or hummocks along otherwise denuded slopes. Transplanting moss onto denuded slopes could hold promise for stabilizing soils and facilitating revegetation. Case studies and literature on moss transplant appear fairly limited to wetland and aquatic environments. Horticultural propagation for shade gardens may provide insight into potential methods. Prior to initiating a project, County staff should identify suitable transplant species (see Janssens 2014a and 2014b for identification resources) and potential donor sites.

Photograph 30. MHs38c with densely vegetated herbaceous native understory.

Map and prioritize spring ephemeral patches

Goals addressed: increase native plant diversity and abundance (1), preserve spring ephemeral areas (4), and reduce deer pressure (6).

Map and prioritize existing spring ephemeral patches according to floristic quality indices. High-priority ephemeral areas should be prioritized for monitoring and the surrounding area further assessed for management need to enhance the adjacent buffer. Proximity of patches to garlic mustard can also feed into the prioritization model described above for garlic mustard. Fencing priority spring ephemeral areas to reduce deer pressure is another option, but maintenance of fencing could be a challenge due to falling trees within this forested area.

Monitor plant communities

Goals addressed: Monitors progress toward all goals, effectiveness of strategies, and informs adaptive management. General monitoring recommendations for the park reserve are provided in Section 5.5.

Specific monitoring for Mesic Hardwood Forest might include establishment of monitoring plots to improve understanding of effects of deer browse and invasive earthworms. Currently, these issues (along with others) are intertwined at a site-specific level to the extent it is difficult to understand true impact. Establish

fenced monitoring plots in areas of management action ("treatment") and unmanaged areas ("control"). Monitoring vegetation within these areas over time may reveal insight into impacts of deer and earthworms. For example, if deer browse is the primary limiting factor for native vegetation rather than earthworms, fenced plots would be expected to respond well regardless of management action. Monitoring forest vegetation is a long-term commitment, though observations within the first few years could potentially provide insights into management. Forest recovery from overbrowsing likely will take at least five years and possibly greater than 20. For example, plant community composition exclosure plots in Pennsylvania diverged from control plots after five years, while diversity did not recover even after 11 years (Pendergrast IV et al. 2016). Another study from Pennsylvania determined legacy effects often lasted greater than 20 years (Nuttle et al. 2014). An example from an MHc26a forest in east-central Minnesota documented increased red oak regeneration, but also noted an increase in ruderal woody and herbaceous species that competed with native trees in the short term (Berger et al. 2019). Anecdotal observations of exclosures support the observation of ruderal species colonization, potentially because exclosure sites are degraded/disturbed due to several factors and release from browse initiates early successional colonization from the seed bank.

Photograph 31. Posted sign for MRPR deer hunt.

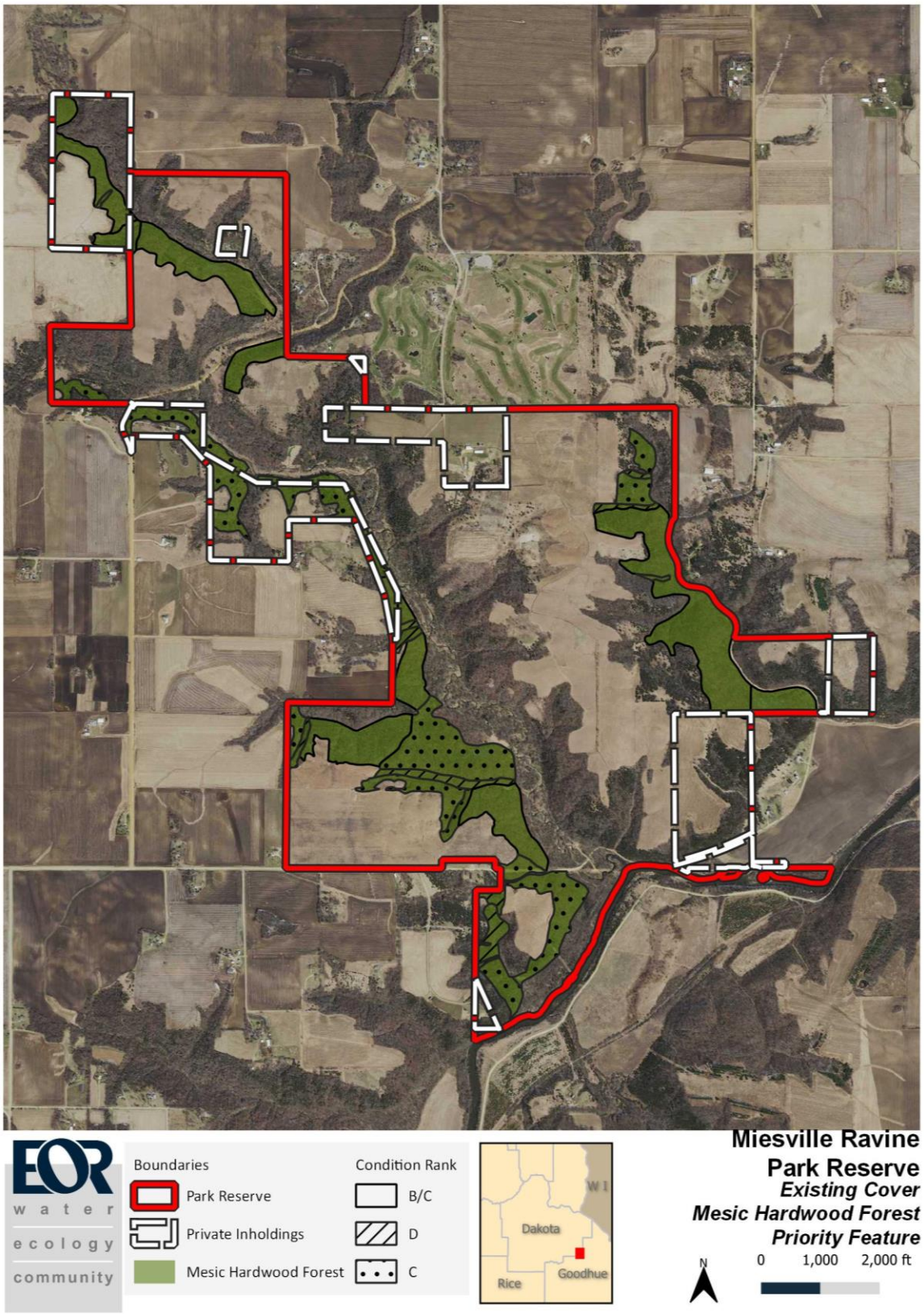


Figure 30. Existing cover and condition rank for Mesic Hardwood Forest priority feature.

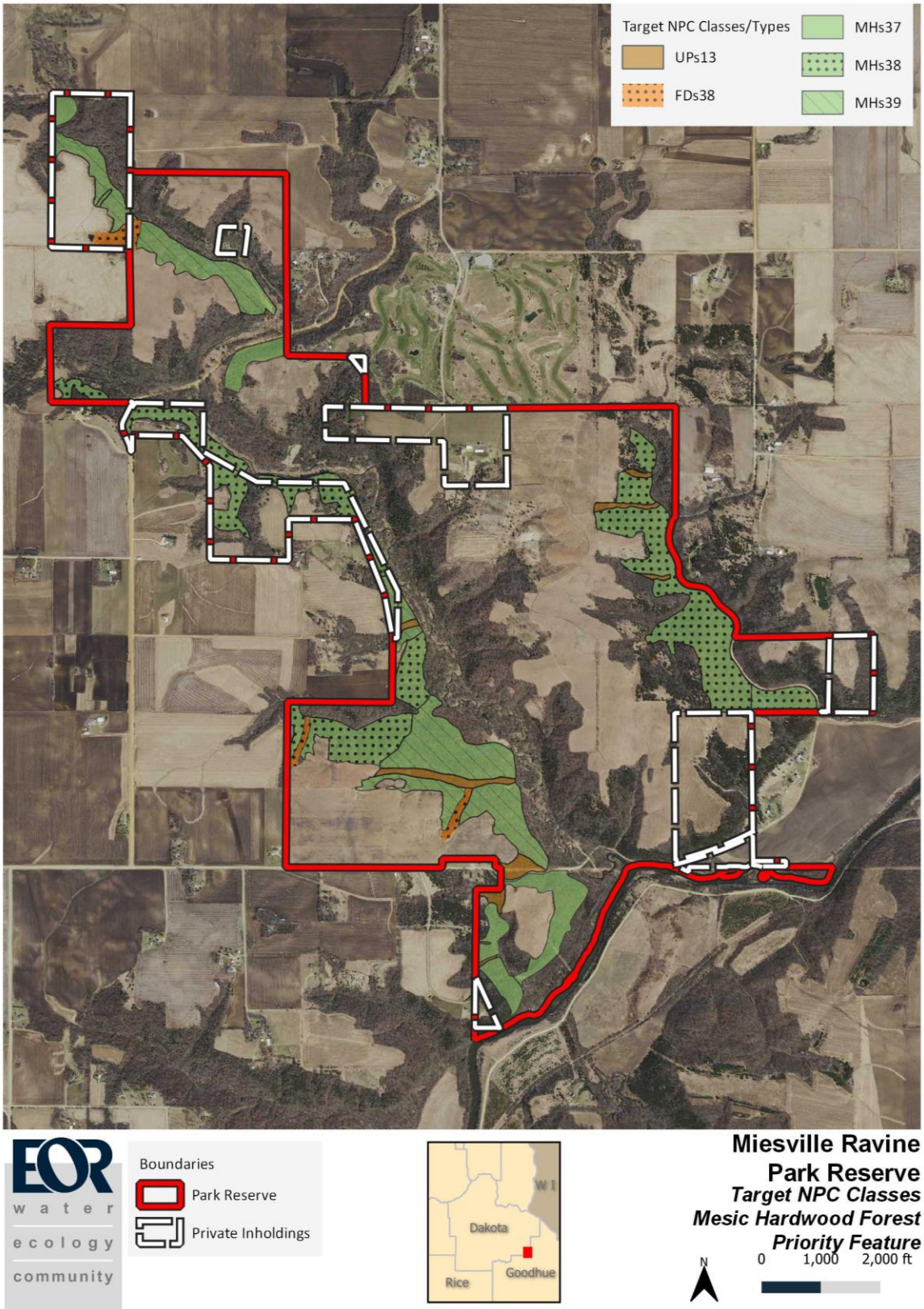


Figure 31. Target NPCs for Mesic Hardwood Forest priority feature.

4.2.3. Remnant Prairie/Savanna

Three different DNR NPC types of remnant Prairie/Savanna occur at the park reserve (Figure 32):

- Dry Bedrock Bluff Prairie (UPs13c)
- Dry Sand-Gravel Prairie (UPs13b)
- Dry Savanna (UPs14)

These NPCs are characterized as dry, grass-dominated open communities present on gently to steeply sloping sites with droughty soils. Moderate to severe moisture deficits are frequent. Historically, fires likely occurred every few years and limited woody encroachment, though the dry conditions of these sites also limit colonization of woody species. The UPs13c type (Dry-Bedrock Bluff Prairie) at the reserve is located along very steep slopes with thin soils overlying frequently outcropping bedrock. Some of these along the east side of the Trout Brook ravine have been restored by the County using woody removal and prescribed fire in recent years, while other scattered instances throughout the park reserve are severely overgrown by woody species. There are likely many very small remnant patches that remain unmapped along steep bluff slopes. UPs13b (Dry-Sand Gravel Prairie) is limited to a single location of coarsely textured soil at a bluff footslope which has likely remained relatively open due to dry soil moisture conditions. UPs14 (Dry Savanna) is limited to restored remnant sites located on upper and shoulder slopes along the east side of the Trout Brook ravine, with a more highly degraded remnant community understory due to a greater degree of woody encroachment. Restoration of the Overgrown Oak Woodland/Savanna feature will likely add areas of UPs14.

Existing condition rank of Remnant Prairie varies from B to D. The B-rank communities consist of the UPs13b site and the restored UPs13c sites. A hybrid C/D rank applies to the restored savanna, where the bur oak cover is representative of the NPC, but degradation resulting from woody encroachment and invasive species has resulted in lower native diversity in the shrub and ground layers, relative to NPC descriptions. D-rank communities are UPs13c sites that are being heavily encroached upon where only small canopy gaps allow for remnant herbaceous flora to persist.

Primary issues within Remnant Prairie/Savanna include:

- Fire suppression that occurred in the past 150 years
- Lack of native browsers
- Woody encroachment
- Introduced exotic species
- Habitat fragmentation
- Equipment access

Target NPCs include UPs13b, UPs13c, and UPs14 and correlate to existing cover. Restoration of overgrown UPs13c could allow for UPs14 as a target NPC, depending on extent and composition of remnant flora such as remnant oaks. Target NPCs are mapped in Figure 33.

Goals

1. Maintain existing restored remnant prairie with less than 5 percent shrub/tree cover

2. Maintain existing restored remnant savanna with less than 50 percent shrub cover and 50 percent tree cover
3. Prioritize and restore unmanaged and overgrown remnant prairies and savannas to historical open condition
4. Connect remnant prairie fragments where historical conditions support prairie, savanna, or open woodland communities
5. Maintain or reduce invasive vegetation cover to less than 5 percent cover on average
6. Enhance native plant diversity and increase FQI scores
7. Conserve dry prairie wildlife specialists

Strategies

Assess priority remnant sites for restoration reserve-wide

Goals addressed: prioritize and restore unmanaged and overgrown remnant prairies (3), connect fragments (4), maintain or reduce invasive vegetation cover (5), enhance native plant diversity (6), and conserve dry prairie specialist wildlife (7).

Review of historical aerial imagery on a landscape-level reveals quite obviously that the park reserve was much more open in the early to mid-20th century. However, much of the open lands were heavily grazed, converted to pasture, or thinned/cut-over by humans. Identifying potentially high-quality remnants requires a more detailed assessment of imagery combined with field assessment. Field surveys and desktop review associated with the NRMP identified several small patches in the far eastern extent of the park reserve (Figure 32). Other small, isolated remnant pockets remain, but are often less than 100 square feet and difficult to locate. These pockets are under grave threat due to their small size. A detailed review of aerial imagery, existing field data, and a field survey should be conducted to identify and prioritize remnant sites. Aerial imagery review should focus on steep areas absent of signatures associated with human land use such as straight lines (e.g., fencelines, mowing) and without uniform vegetation structure. Field data collected should focus on floristic quality and size of remnant.

Photograph 32. Cylindric blazing star (Liatris cylindracea) observed in overgrown remnant along Orlando Trail.

Continue removal of woody vegetation from historical prairie and savanna

Goals addressed: prioritize and restore unmanaged and overgrown remnant prairies (3), connect fragments (4), maintain or reduce invasive vegetation cover (5), enhance native plant diversity (6), and conserve dry prairie specialist wildlife (7).

Ongoing work has removed and thinned woody vegetation from 211 acres of historically more open habitat along the east bluff of Trout Brook. These restorations aimed to restore the bluff to its 1990 condition based on canopy clearing, with eventual goals of restoring to 1930s, and even pre-settlement conditions. Management should continue woody removal both outward from existing areas and clear new areas of the park reserve where remnants remain. For example, priority areas to target include heavily overgrown areas such as the two southwestern UPs13c remnants, the far eastern extent of the park reserve along Orlando Trail, and some kittentails locations. These actions will connect fragments and ensure preservation of high-quality remnants. The two southwestern UPs13c remnants may require coordination of machinery access through private lands, while the remnants in the far eastern extent could be cleared via hand crews mobilizing from Orlando Trail.

Methods of woody removal at MRPR have focused on the following techniques with success. Continue implementation of these methods at new restoration sites.

- Selective thin canopy to preserve bur oaks but remove other woody vegetation, with exception of ravines where native woodies have been left in place.
- Forestry mow on flat bluff tops and flatter, accessible areas of slopes
- Use goats to browse (control) exotic brush on steeper slopes (especially medium to small stems)
    - Browse goats twice a year, for three or four years in a row
- Anything goats do not browse, control via spot treatment with herbicides

- Use fire as a tool to stimulate native plant growth and to curtail exotic and woody plant growth via prescribed burning
    - Burn each year, if possible.
    - After initial effort (first two years), form burn units and set up a burning rotation of every four to nine years.
- Monitor for ground species recovery over the first two years,using supplemental seeding in areas that are depauperate or that need help establishing vegetation; this will provide fine fuels that can carry a running ground fire

Continue and expand use of prescribed fire to maintain prairie and savanna

Goals addressed: maintain restored remnant prairie and savanna as open (1, 2), maintain invasive vegetation cover as less than five percent cover (5), enhance native plant diversity (6), and conserve dry prairie specialist wildlife (7).

County staff has been using prescribed fire to manage areas of remnant prairie and savanna following initial removal of woody vegetation as described above. Use of prescribed fire should be continued to control woody encroachment, promote native vegetation, and reduce invasive species. Timing, frequency, intensity, and spatial scale of prescribed fire can be manipulated to achieve different goals. The primary goal of prescribed fire use for the remnant prairies of MRPR are to control woody vegetation (including buckthorn). Secondary goals include enhancing native vegetation by exposing and warming soil and releasing nutrients to promote seed germination and flower production.

Prescribed fire provides immense benefit to the native plant and wildlife community as a whole and is critical to maintaining remnant prairie and savanna. However, fire is also capable of killing or even extirpating some wildlife species, particularly some fire intolerant insects (though reptiles and nesting birds are also vulnerable). Because the remnant prairies of MRPR are small, there is an inherent risk that burning will cause species loss. For example, the 2021 Lepidoptera survey of MRPR cited *Euoxa niveilinea* as an uncommon species that may be unique to the park reserve and vulnerable to fire. Prescribed fire within the remnants could observe the following guidelines to conserve invertebrates and other wildlife within the established rotation of burning units every four to nine years:

- Burn based on need rather than schedule
    - Burn if woody cover within a remnant prairie exceeds five percent on average.
    - Burn if shrub and non-bur oak tree cover within a remnant savanna exceeds 25 percent on average
    - Burn if there is an observed decrease in forbs
    - Use a return interval of 2-6 years, with an average of four years
- Avoid burning adjacent units consecutively
- Integrate with alternative woody control such as goat grazing, aspen girdling, and brush cutting
- Split individual remnant pockets into multiple units
- Consider using the Consistency of Management technique
- Discourage the formation of hard edges between different community types by sometimes burning across management unit boundaries
- Encourage patchy burns if conditions allow

Photograph 33. Restored remnant of oak savanna within the CPL Phase 3 grant area. Native prairie vegetation dominates without active seeding.

Suppress woody vegetation with alternatives to fire

Goals addressed: maintain restored remnant prairie as open (1, 2), maintain invasive vegetation cover as less than five percent cover (5), enhance native plant diversity (6), and conserve dry prairie specialist wildlife (7).

Improve structural diversity and reduce reliance on prescribed fire by using alternative management tools to suppress woody vegetation. Three potential methods are discussed below.

Goat grazing: Goats preferentially browse shrubs and broad-leaved vegetation and can be used to suppress woody encroachment of remnant prairie. Areas most suited to goat grazing include steep slopes where equipment cannot access and remnant areas with highest cover of brush and lowest cover of sensitive native vegetation. Following initial woody removal at MRPR, goats have been used to browse twice a year, for three or four years in a row following.

Aspen girdling: Invasion of aspen suckers is an issue for the recently cleared remnants. Aspens sucker vigorously following cutting and burning, therefore mowing and fire may not be as effective for long-term control of aspen. Girdling, when implemented correctly, kills aspen while minimizing the sucker response (Perala et al. 1990). Suckers typically originate 20 feet away from the base of a parent tree and may originate up to 80 feet away. Target aspen for girdling within a 20-ft radius of remnant boundaries. As with control of most encroaching native species, do not manage for eradication of aspen but rather to limit areas of target prairie to five percent shrub cover.

Brush mowing: Where slopes allow, brush mowing could be used to suppress woody growth. Mowing is a useful tool for enhancing structural diversity because the operator has greater control over where the treatment effect occurs compared to grazing or girdling. Mowing can be applied to specific areas to provide certain percentage of brush vs. herbaceous cover where desired. For example, typical shrub cover from the

prairie-savanna-woodland gradient varies from less than five percent cover in prairies to nearly 100 percent in some woodlands.

Continue vegetation management and establishment in restored areas

Goals addressed: maintain or reduce invasive vegetation cover (5), enhance native plant diversity (6), and conserve dry prairie specialist wildlife (7).

Existing areas of woody removal and invasive control require ongoing management. The restored UPs13c prairies retained many native species that persisted through woody encroachment, but still require ongoing management and may benefit from the establishment of additional prairie species present in reference UPs13c types. The restored savanna sites have had more variable response. Some areas have less well-established native vegetation due to decades beneath a shaded canopy or are experiencing a flush of invasive species such as buckthorn following increased light availability. On the other hand, some savannas have areas where natives such as prairie violet and hoary puccoon have been released (e.g., the southernmost restored savannas). Continuing spot invasive species control in these savanna areas is critical, in addition to alternative methods discussed above such as prescribed fire, goat grazing, and brush mowing.

To date, 134 acres of remnant prairie, savanna, and woodland have been seeded following woody removal. Vegetation establishment is necessary in some areas where the native seed bank is lacking or reestablishment following woody removal is observed to be slow. Adequate control of invasive species and site conditions are necessary prior to seeding. For example, a flush of buckthorn is common following canopy removal in invaded woodlands and may require several years of control. Additionally, site conditions in some cleared portions of MRPR following forestry mowing have included a dense layer of slash that prevents seed to soil contact. The slash is dense enough that it might take years to naturally degrade. Options to remove or accelerate degradation of slash include a second forestry mow to mulch debris further, prescribed burning, or manual removal.

Seed mixes should target prairie and savanna communities. For heavily degraded sites or those with challenging slopes and soil conditions, a suppression seed mix should be used to ensure good establishment and cover. Following establishment, more conservative species can be overseeded or plugged depending on the species. Similarly, more conservative species absent from the B-quality remnants that might be expected to be present based on NPC descriptions could also be overseeded or plugged. For example, difficult to establish species like bastard toadflax, hoary puccoon, wood betony, and prairie dropseed could be plugged. Commercially limited seed of dry prairie specialists present in remnants such as prairie violet should be collected for reintroduction. Overseeding should be completed following burns and use a high seeding rate to maximize seed to soil contact. Establishment of many species may be difficult, however, and will need to be planned out in detail for each site.

Photograph 34. Restored oak savanna at the summit of a bluff within the CPL grant Phase 2 area. Common buckthorn and ruderal herbaceous species (both non-native and native) are common, typical of many areas immediately following woody species removal.

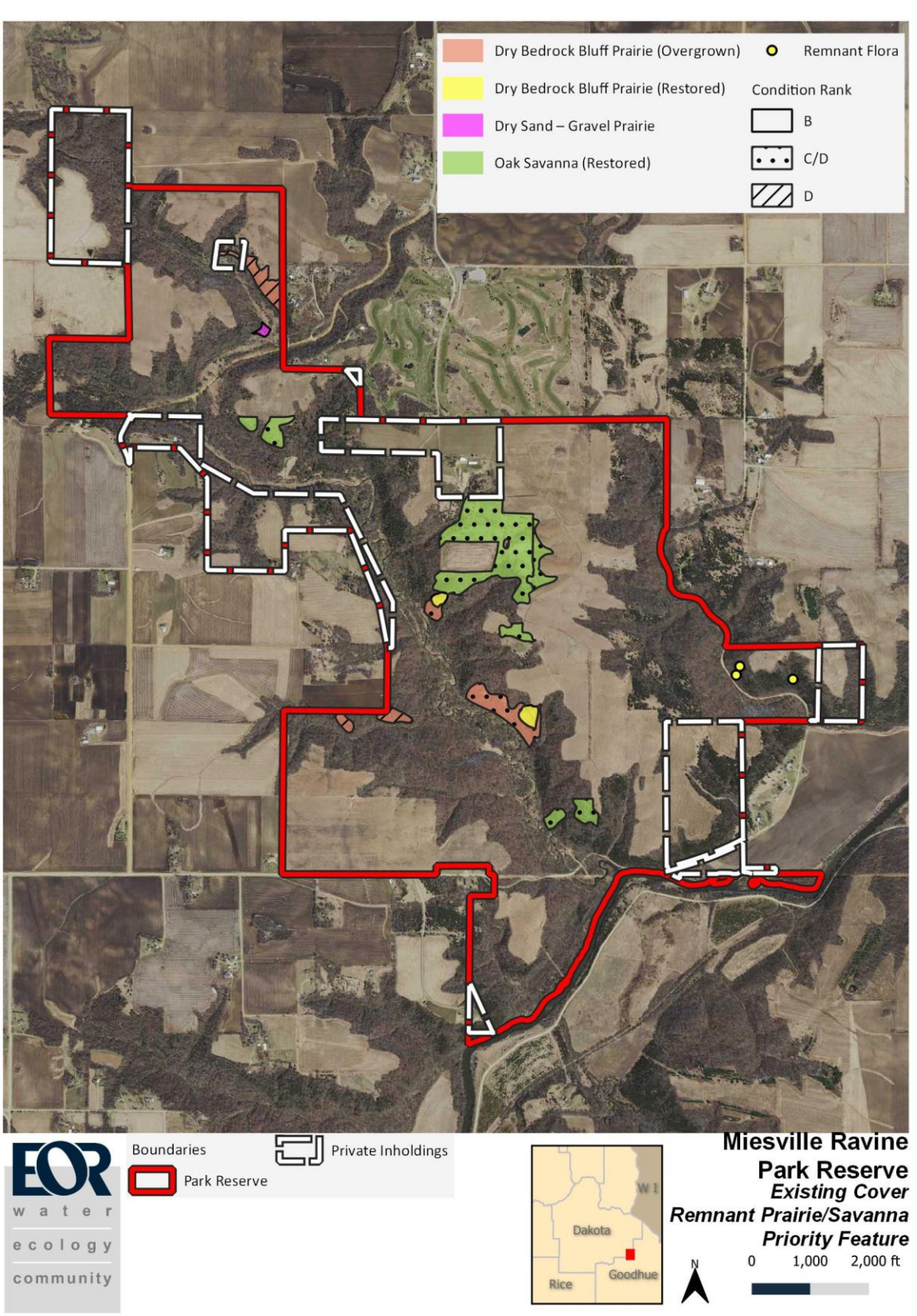


Figure 32. Existing cover and condition rank for Remnant Prairie/Savanna priority feature.

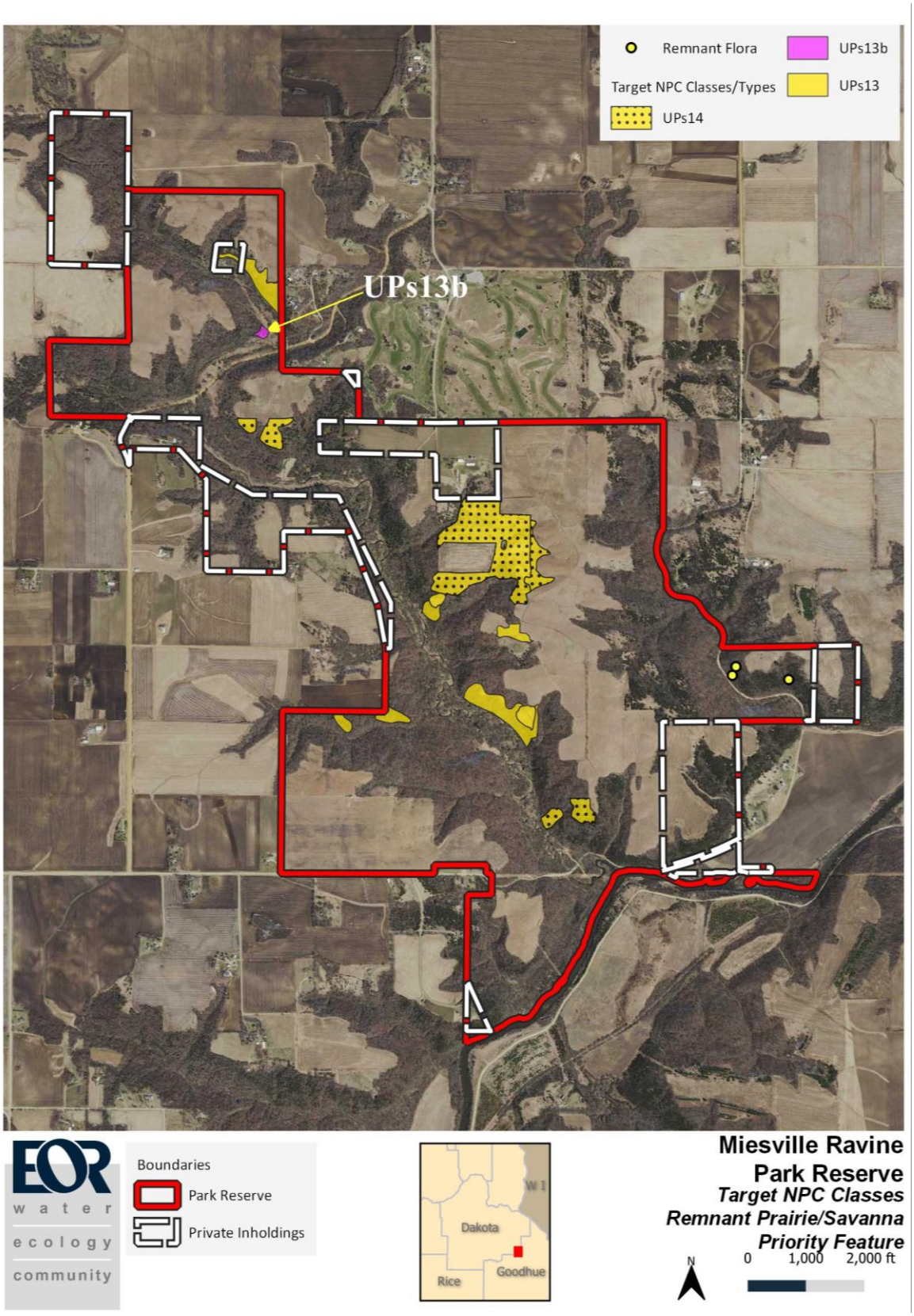


Figure 33. Target NPCs for Remnant Prairie/Savanna priority feature.

4.2.4. Reconstructed Prairie

Reconstructed Prairie resembles two different DNR NPC types which serve as target NPCs:

- Dry Prairie (UPs13)
- Mesic Prairie (UPs23)

Prairie reconstructions have been completed in all former row crop agricultural areas within the park reserve and are located on blufftops. Reconstructions primarily consist of mesic tallgrass prairie (UPs23), but there are areas of dry shortgrass prairie (UPs13) such as a 16-acre short-grass restoration completed in 1999 north of 280th Street on the south end of the park reserve. In general, UPs23 NPCs are grass-dominated but forb-rich communities where soil moisture availability remains relatively high, on average, due to soil texture and composition. Recurrent fire is a critical disturbance within UPs23 as environmental conditions are otherwise suitable for forest succession. Fires also temporarily expose the soil surface and are vital to plant regeneration and nutrient cycling. Grazing by native ungulates, primarily bison, was another important disturbance historically that contributed to compositional and structural diversity.

While the prairie reconstructions of MRPR are dominated by native prairie vegetation and resemble target NPCs, they did not receive a condition rank indicating a true NPC, as they have been restored from a severely degraded condition (row crop agriculture) and lack some key characteristics. Prairie reconstructions almost always lack the floristic diversity, composition, and structure of prairie remnants whether due to initial seed mix, poor establishment, soil conditions, or other factors. Even the most diverse reconstruction seed mixes often do not include sufficient viable seed of some species or face challenges in establishment of certain species (Newbold et al. 2019). Further, prescriptive management practices and lower diversity often result in lower structural heterogeneity in reconstructions compared to remnants. Heterogeneity in plant height and density over various spatial scales is critical to providing diverse wildlife habitat.

Primary issues within Reconstructed Prairie include:

- Reduced diversity and structure relative to target NPCs
- Cool season non-native pasture grass invasion
- Lack of faunal associates typical of remnant tallgrass prairie
- Equipment access

Goals

1. Maintain reconstructed prairie with less than five percent shrub/tree cover
2. Maintain or reduce invasive vegetation cover to less than five percent cover on average
3. Enhance native plant diversity and increase FQI scores toward a reference condition
4. Maximize structural heterogeneity. (Note: some metrics for measuring structural heterogeneity include average height, depth of litter, ration of standing dead to live biomass, ratio of grasses to forbs)
5. Conserve prairie specialist wildlife

Strategies

Continue vegetation management using prescribed fire, mowing, and spot-invasive treatment

Goals addressed: maintain low shrub/tree cover (1) and maintain/reduce invasive vegetation cover (2).

The existing management regime integrates prescribed fire, mowing, spot invasive treatments, and select overseeding of conservative species. All of these practices support goals for this cover type and should be continued. Subsequent strategies aim to establish guidelines and enhance these practices.

Establish burn units with a diversity of management regimes

Goals addressed: maintain low shrub/tree cover (1), maintain/reduce invasive vegetation cover (2), enhance native plant diversity (3), increase structural diversity (4), and conserve prairie specialist wildlife (5)

It is well known that fire immensely benefits the prairie plant and wildlife community. But it may be lesser known that prairies were also maintained by disturbance caused from bison grazing and indirectly by moisture condition (climate, slope aspect, and soil type). In fact, the prairie community was woven together with the climate and grazers of the biome, having evolved over millennia together. Thus, burning is a key component of the prairie ecosystem, and it naturally favors fire-tolerant species to the detriment of fire intolerant species, with variable impacts to individual species based on burn timing, intensity, and size. If overused, however, fire can be detrimental to many prairie species, including many insects. Therefore, the right balance of fire and grazing (or haying) should be struck.

Recommendation: Establish burn units with a diversity of management regimes, including some fire-free refugia that are maintained via mowing, haying, or grazing. Alternatively, specific burns may be associated with particular goals, such as to reduce cover of non-native cool season grasses. The overall approach should be intentionally haphazard in space, time, and intensity within the bounds of established goals. Historically, fires did not burn the same spot in regular patterns. The intentionally haphazard approach better mimics nature, allows schedule flexibility, and is adaptive to on-the-ground conditions. General guidelines for prescribed burns are below with the intent to promote community diversity.

- Develop specific goals for a prairie area and for each burn unit that it consists of
- In general, vary return intervals of burns every three to six years, and consider longer burn intervals based on observations below:
    - Burn if woody cover within reconstructed prairie exceeds 5% on average.
    - Burn if observed decrease in forbs overall or certain forbs, but consider other factors that influence forbs such as grazing
- Integrate with alternative woody control such as mowing, haying, and grazing
- Maintain at least one unit as fire-free
- Split contiguous tracts of greater than 100 acres of reconstructed prairie into multiple units
- Encourage patchy or partial burns if conditions allow
- Vary seasonality of burns, including growing season burns, while considering potential impacts to sensitive wildlife such as invertebrates and nesting birds; general guidelines are to avoid disturbance during the nesting season from May 15 to August 1

Introduce/continue grazing, mowing, and haying

Goals addressed: maintain low shrub/tree cover (1), maintain/reduce invasive vegetation cover (2), enhance native plant diversity (3), increase structural diversity (4), and conserve prairie specialist wildlife (5).

Grazing, mowing, and haying are all methods of mimicking the historical disturbance of prairie and savanna that can complement prescribed fire. Bison grazing strongly influenced prairie in the past and was critical to maintaining habitat and creating heterogeneity. Bison will be reintroduced to Dakota County at Spring Lake Park Reserve in October 2022. Reintroduction of bison should also be considered for prairies of MRPR. Cattle are an alternative to bison that could also be considered and can provide some similar benefits when managed specifically for prairie health. Patch-burn grazing is a cattle grazing technique that approximates historical grazing patterns of bison. Timing and intensity of grazing, because it changes nutrient cycling and spatial patterns of plant communities, can help accomplish goals such as providing habitat structure, controlling invasive species, or promoting forb abundance and diversity, keeping grasses in check.

Mowing and haying can also mimic fire and grazing. The primary objective of mowing and haying at MRPR is to suppress woody vegetation, particularly in fire-free units. Mowing and haying can also provide variable structure. Even haphazardly mowing a unit with uniform structure helps add habitat heterogeneity.

Consider consistent diversity of management

Goals addressed: maintain low shrub/tree cover (1), maintain/reduce invasive vegetation cover (2), enhance native plant diversity (3), increase structural diversity (4), and conserve prairie specialist wildlife (5).

An option to more stringently adhere to disturbance management guidelines aligned with the above fire and grazing guidelines is to adopt a "consistent diversity of management" approach, where a reconstructed prairie is divided into different management units and each one is managed differently and consistently over time (Johnson 2021; Swengel & Swengel 2006). Hypothetically, if adhered to consistently, each unit will develop different niches that should result in a more diverse biota overall. If consistent management is not performed, there is no way to tell whether, for example, fire and fire frequency is beneficial or not to some species, especially over a long period of time. So, in addition to a fire-free unit, other units could be prescribed with differing fire intervals, some frequent, some intermediate, and some infrequent. Also, mixing different management practices (e.g., patch-burn grazing) and staying consistent over time is recommended for this practice.

Introduce and establish additional native plant species

Goals addressed: maintain low shrub/tree cover (1), maintain/reduce invasive vegetation cover (2), enhance native plant diversity (3), increase structural diversity (4), and conserve prairie specialist wildlife (5).

Recent seed mixes planted at MRPR have adhered to or exceeded guidelines set forth by the DNR for establishing diversity in prairies. However, older prairies planted at the park reserve may lack some diversity of frequently overlooked guilds like sedges, bunchgrasses, cool-season grasses, and forbs. Even recent prairie restorations may lack species that are commercially limited or failed to establish. Consider interseeding such species into lower diversity prairies with goals of enhancing not just species richness but also phenological (e.g., flowering time or active growth period), structural (i.e., plant height), and functional (e.g., legumes) diversity. This may require a site assessment prior to enhancement activities. Purchase seed

as is available. For commercially-limited species, collect seed that is present in MRPR remnants, such as prairie violet, to disperse into reconstructed prairies or grow out in propagation beds. Take care not to over-collect (no more than one-third of available seed for a species) from a population in a given season or in consecutive years.

Photograph 35. Overview of reconstructed prairie on blufftop in the center of MRPR between Trout Brook and Orlando Trail.

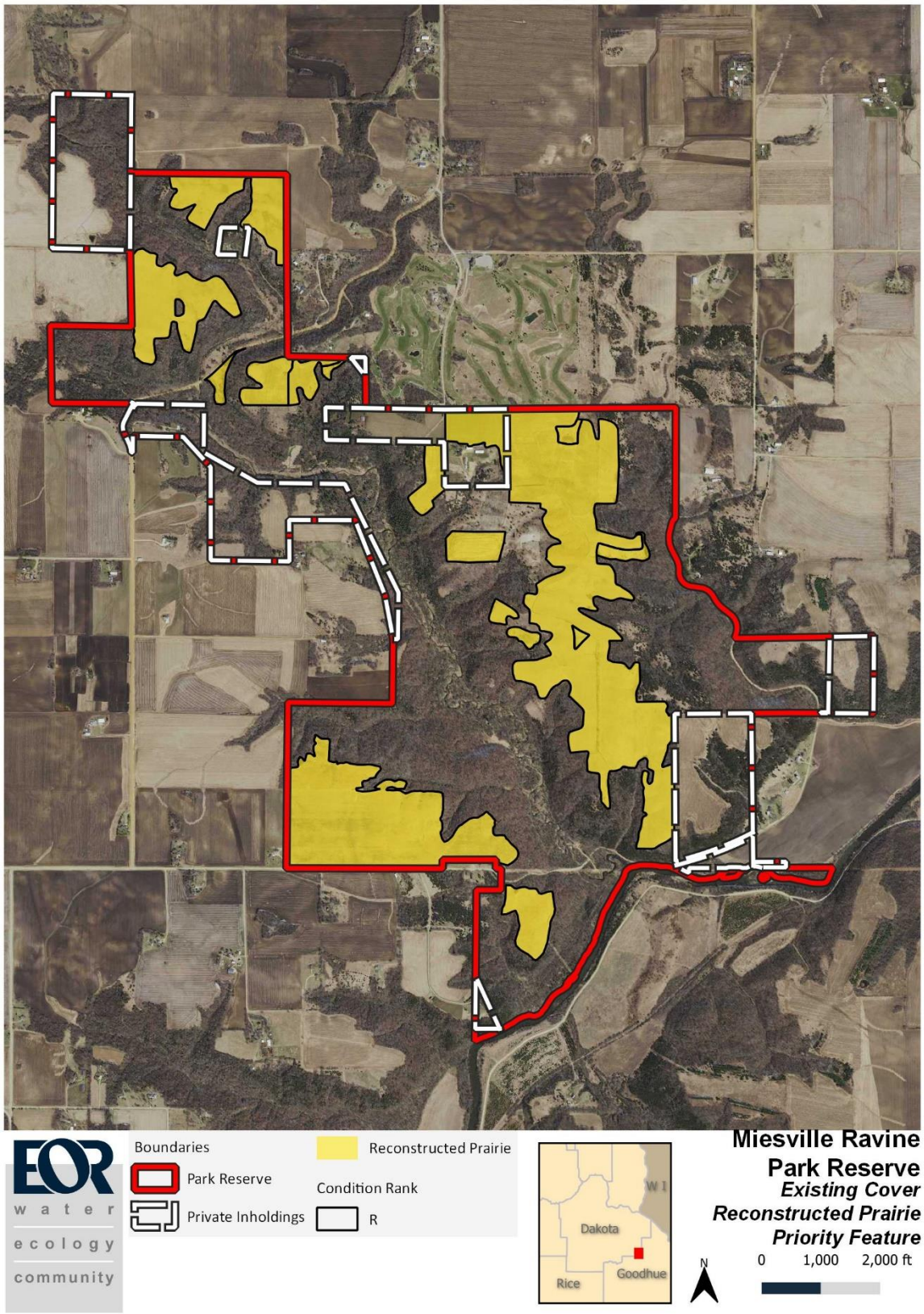


Figure 34. Existing cover and condition rank for Reconstructed Prairie priority feature.

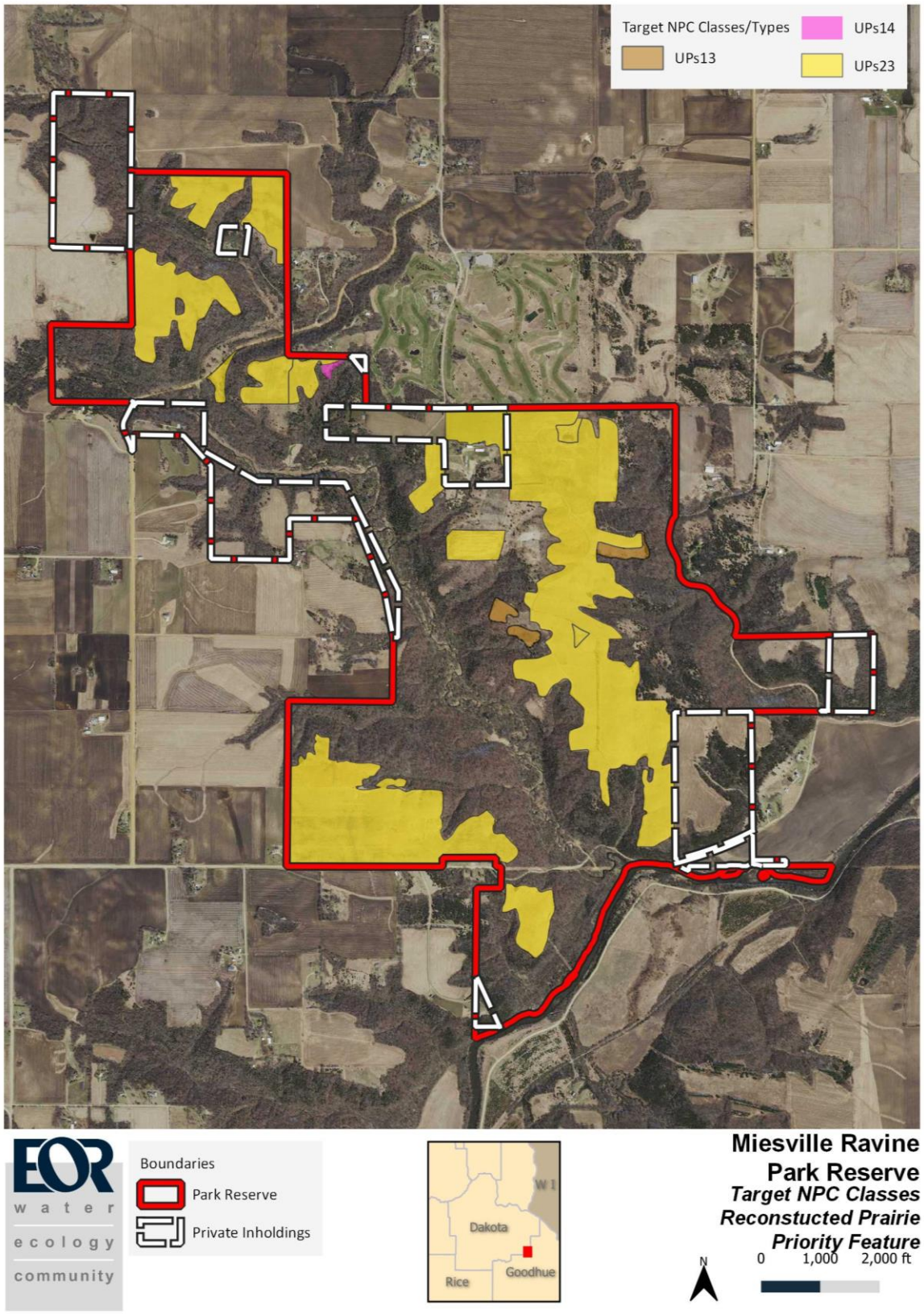


Figure 35. Target NPCs for Reconstructed Prairie priority feature.

4.2.5. Overgrown Oak Woodland/Savanna

Oak Woodland at the park reserve consists of two DNR NPC classes:

- Southern Dry-Mesic Pine-Oak Woodland (FDs27)
- Southern Dry-Mesic Oak-Hickory Woodland (FDs38)

These woodland NPCs are characterized as fire-dependent natural community types commonly found on well- to excessively-drained bedrock and sandy soils. FDs27 is primarily found in areas of sand deposits while FDs38 is more commonly associated with steep south and west facing slopes on loess-covered bedrock bluffs, often adjacent to bedrock bluff prairies. Existing vegetation and landform at the park reserve most commonly represents FDs38, but a large area of FDs27 appears to be present in the north-central portion (see FDs38 target NPC, Figure 37). This area of apparent FDs27 is characterized by abundant white pine and sandy soils both along steep slopes and at the foot of the ravine. A sandy footslope at the foot of a ravine farther south on the west side of Trout Brook may also historically have been FDs27 and has suitable soils, topography, and remnant open oaks, but lacks white pine. Historically, stand-replacing fires occurred every 135-150 years in FDs27 and FDs38, with mild surface fires about every 15 years.

Existing condition rank of Oak Woodlands varies from C to D. A canopy of remnant open-grown bur oak is frequently present, but structure and composition of the sub-canopy and ground layer vegetation are generally not representative of NPCs. Areas of C-rank are those that have been recently thinned to remove dense woody growth and restore structure more typical of woodland NPCs. According to field guide descriptions, both NPCs should have patchy-to-interrupted (25-75%) canopy cover with oaks as dominants, but FDs27 often has white or jack pine as a dominant as well.

Photograph 36. Example of open-grown bur oak within Overgrown Oak Woodland.

Primary issues within Oak Woodland include:

- Suppression of fire over the last 150 years, resulting in woody encroachment
- Interaction of invasive vegetation, invasive earthworms, deer browse, and grazing legacy resulting in reduced native plant diversity of both herbaceous and regenerating tree species
- Bare soils and soil erosion due to earthworms and reduced understory cover and diversity
- Limited equipment access due to steep slopes or lack of access through private lands

Much of the Oak Woodland consists of overgrown prairie/savanna, along with some north- and east-facing ravines that may be best suited to mesic hardwood forest communities. Depending on the density of remnant canopy, slope, and aspect, the following may also serve as target NPCs in addition to FDs27 and FDs38:

- Dry Prairie (UPs13)
- Dry Savanna (UPs14)
- Mesic Savanna (UPs24)
- Southern Dry-Mesic Oak Forest (MHs37)
- Southern Mesic Oak-Basswood Forest (MHs38)
- Southern Mesic Maple-Basswood Forest (MHs39)

Target NPCs are mapped in Figure 37.

Goals

1. Increase native plant diversity and abundance (significantly increase FQI scores)
2. Reduce invasive vegetation cover to five percent cover or less, on average
3. Regenerate native tree species composition and structure that follows the successional stages and natural history of the target native plant community (see *DNR NPC Field Guide*, 2005, for detailed plant community descriptions)
4. Rebuild healthy soils by significantly increasing vegetation cover
5. Reduce deer population below 10 deer per square mile

Strategies

Thin and remove non-oak tree and shrub species

Goals addressed: increase native plant diversity and abundance (1), reduce invasive vegetation cover (2), regenerate native tree species and structure (3), rebuild healthy soils (4), and reduce deer pressure (5)

The Oak Woodland cover type at MRPR is characterized by a sparse to patchy remnant canopy of open-grown oaks with 50-100 percent cover of the following: non-native invasive shrubs, aggressive native shrubs like prickly ash, and early successional native trees (primarily eastern red cedar and boxelder). The understory is typically bare or dominated by shade-tolerant species.

The primary restoration approach is to remove non-oak woody vegetation. Woody vegetation removal provides a foundation for restoring the understory to target NPCs. Target canopy cover should vary between as little as zero to-25 percent (prairie/savanna) to 75 percent (woodland) based on biophysical site characteristics like remnant canopy, slope, and aspect, as well as practical considerations such as equipment

access, budget, and time. Be aggressive, even mimicking stand replacing fire for natural reset where the target community might resemble savanna or prairie. Woody vegetation removal has been completed on hundreds of acres of MRPR already, to restore prairie and savanna, with specific methods described in Section 4.2.3 Remnant Prairie/Savanna.

In some cases, woody vegetation removal may be limited by restricted vehicle/machinery access due to steep slopes and the network of private lands within and surrounding the park reserve. In these cases, hand crews would need to be deployed using light equipment such as chainsaws, brush cutters, and hand tools.

A major benefit of reserve-wide thinning of woodlands will be to reduce deer habitat. The dense cedar woodlands are favored by deer, especially wintering grounds of dense growth on south facing slopes. Thinning will also reduce sharp edge habitat, which deer prefer, between existing woodlands and open habitats of the park reserve.

Control common buckthorn and Tartarian honeysuckle, following initial woody removal

Goals addressed: increase native plant diversity and abundance (1), reduce invasive vegetation cover (2), and rebuild healthy soils (4).

Increased light availability typically results in a flush of buckthorn and honeysuckle from the seed bank and requires 2-3 years of control, typically via foliar herbicide applications. Following initial control, integrate prescribed burns combined with goat browsing to set back seedling growth. Seed the area with a mix customized to site conditions and target NPC. An example timeline for common buckthorn is provided in Table 9, but it is recommended to be flexible and adaptive to site conditions and resource availability.

Table 9. Example management timeline for buckthorn in Oak Woodland.

Year	Treatment	Timing
Year 1	Forestry mow in combination with hand cut/treat on steep slopes	Late fall/winter
Year 2	Foliar spray resprouts/flush	Late summer/fall
Year 3	Goat browse	Summer or winter
Year 3 (continued)	Foliar spray spot treatments	Late summer/fall
Year 4	Prescribed burn	Spring, fall
Year 4 (continued)	Seed diverse mix suitable to target NPC	Late spring/early summer/late fall
Years 5-10	Continued follow up treatments to include spot treatment, prescribed burns, goat browse, supplemental seeding	

Native revegetation

Goals addressed: increase native plant diversity and abundance (1), reduce invasive vegetation cover (2), regenerate native tree species and structure (3), rebuild healthy soils (4), and reduce deer pressure (5).

Following buckthorn and honeysuckle control, phase native revegetation from a cover crop or fuel building mix (i.e. a "suppression" seed mix) toward a more conservative species mix. Initial seeding should include a cover crop such as oats to suppress weed growth, minimize erosion, and provide fuel for prescribed fire. Suppression seed mixes are weighted toward restoring aggressive native species such as wild rye, common tall grass prairie species, and certain forbs such as partridge pea, black-eyed susan, and hoary vervain. Once well established, more conservative woodland species could be introduced via overseeding following site preparation with prescribed fire. This strategy presents some risk that establishing conservative species at a later date will struggle to compete with restoration aggressive species. Therefore, vary the approaches based on site conditions to assess performance of suppression mixes compared to higher diversity conservation mixes. A summary of different revegetation strategies is provided in Table 10.

Woodland revegetation could also include tree plantings in openings. Historically, bur oaks frequently occurred in clumps, within both savanna and woodland. Replicate this structure by planting acorns or saplings in clusters within savanna and woodland target NPCs with less than five percent cover. Fence the clusters to protect them from herbivory. Shagbark hickory is another species to consider planting in target FDs38 NPCs. Shagbark hickory is typical of FDs38, but the park reserve is at the northern limits of its range and has not been observed in the park reserve. Planting shagbark hickory could introduce both a species typical of oak woodland communities and a potentially climate-adaptive species.

Photograph 37. Oak and white pine within FDs27.

Table 10. Summary of various revegetation methods.

Revegetation Method	Pros	Cons	Use cases	Notes
Cover Crop	Establishes well and provides cover quickly Contributes immediately to soil and fuel building	Annual, non-native; requires overseeding with native seed mix	Sparsely vegetated, steep bluffs/ravines where soil erosion is a concern	A cover crop is typically included in more diverse seed mixes as well, with the intent of providing immediate benefits while native vegetation establishes.
Suppression Mix	Native, establishes well Provides good competition with invasives Contributes immediately to soil and fuel building	Low diversity Requires overseeding or plugs (typically following a burn) to establish forbs and overall diversity necessary to achieve target NPC goals	Highly degraded sites Sites where intensive invasive removal has been conducted Sites where fuel building is needed to conduct a prescribed burn	
High Diversity Mix	Includes diversity/composition suited to target NPCs Assuming establishment provides ecological benefits of diverse ecosystems	Establishment may be variable based on site conditions such as seed/soil contact, invasive competition, and other biophysical factors Seed availability of target species may be challenging	Sites with low invasive species pressure and favorable environmental conditions (adequate light availability, soil conditions) Overseeding into low-diversity sites.	Seeding high-diversity into recently cleared sites may be desirable under certain conditions. For example, following conversion from row crop agriculture or broad-spectrum herbicide control of an old field. However, seeding high-diversity mixes into some sites can risk low establishment. For example, sites with a long history of invasive cover where multiple years of control will likely be necessary or sites where lots of woody debris is still present (preventing seed/soil contact).

Transplants (plugs and shrubs)	Opportunity to establish species that are difficult to seed Higher establishment in some contexts May be more immediately competitive	Higher cost Establishment is very context dependent	Transplanting hard to germinate species (e.g., bastard toadflax) into remnants or established restorations. Transplanting shrubs post-invasive removal to provide immediate canopy cover competition over invasive seedlings.	

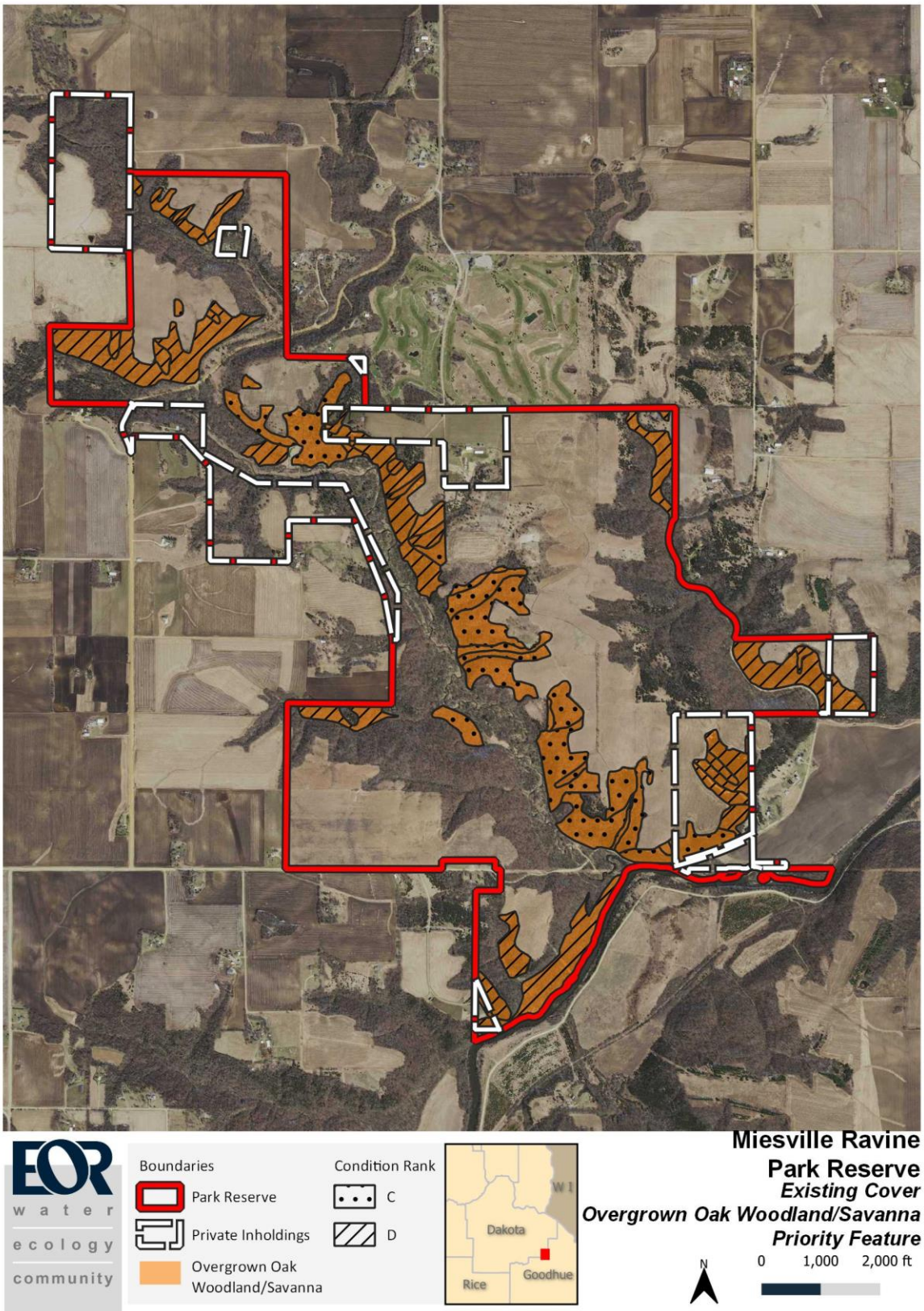


Figure 36. Existing cover and condition rank for Overgrown Oak Woodland/Savanna priority feature.

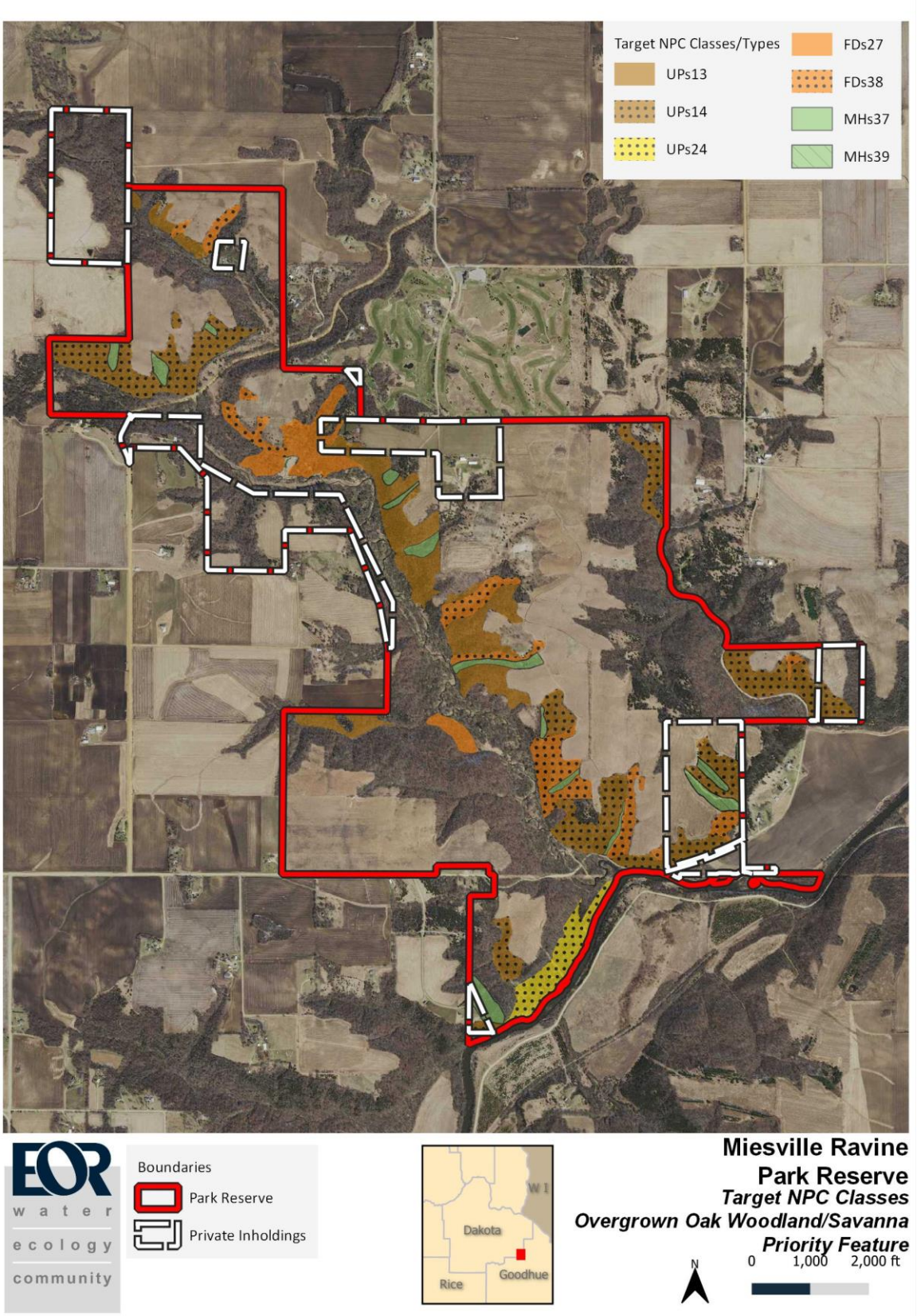


Figure 37. Target NPCs for Oak Woodland priority feature.

4.2.6. Seepage Meadows

Two seepage meadows are located at the park reserve and are classified as DNR NPC type WMs83a. The northern seepage meadow is associated with Beaver Spring and the southern seepage meadow is associated with Swede Spring. Seepage Meadow NPCs are characterized by open wetlands dominated by dense cover of broad-leaved sedges in areas of groundwater seepage along streams and sloping terraces, and at bases of slopes. Water levels are high enough to prevent trees (and often shrubs) from becoming established. Typically, water level fluctuations prevent peat formation; but if water levels are stabilized, succession to rich fen is possible. At MRPR, anecdotal observation of potential tamarack stump/log remnants in the Beaver Spring seepage meadow indicate rich fen conditions could have been present in the past, though this observation is highly speculative and would require further investigation regarding historical site conditions.

At MRPR, both seepage meadows are located at the base of bluff slopes where groundwater discharges and terrain slopes gently toward the Trout Brook floodplain. Each seepage meadow is dominated by reed canary grass, but with areas of remnant sedge. A seepage channel meanders through each meadow and is dominated by the non-native aquatic plant watercress. At the Beaver Spring seepage meadow, remnant sedge appears to be dominated by *Carex atherodes,* slough sedge, while at the Swede Spring seepage meadow, remnant sedge appears to be dominated by *Carex stricta,* tussock sedge. The Swede Spring seepage meadow also includes a population of *Amorpha fruticosa*, false indigo bush.

The Swede Spring seepage meadow is the location of the Blanding's turtle record and was also noted as potentially suitable habitat for calciphiles by the Minnesota Biological Survey (MBS) in 1990. This seepage meadow has a very interesting recent history based on aerial photograph review. The 1991 aerial photograph shows nearly the entire basin to be inundated (Figure 38). The inundation is likely due to beaver activity based on Minnesota Biological Survey notes recorded in 1993 that note a beaver dam at this location. Alternatively, it has been speculated that the area was used a commercial trout pond. In all images from 2003 onward, the meadow is no longer inundated (Figure 39). The extent of inundation visible in the 1991 image correlates very closely to the current extent of reed canary grass invasion, suggesting prolonged inundation may have drowned out prior vegetation and provided a niche for reed canary grass to establish in this seepage meadow (Figure 40).

Existing condition ranks of each seepage meadow is C/D. The remnant sedges and relatively intact hydrology resemble the DNR NPC description, but dominance of reed canary grass in each meadow is severely degrading these communities. Though watercress has invaded the channels, it does not appear to be significantly impacting the community and is not practical to manage.

Primary issues within Seepage Meadows include:

- Reed canary grass invasion

Goals

1. Better understand existing and historical conditions
2. Increase native plant diversity and abundance to resemble reference remnants and DNR native plant community descriptions
3. Reduce invasive vegetation cover to 5% cover on average

Figure 38. 1991 aerial image of southern seepage meadow.

Figure 39. 2010 aerial image of southern seepage meadow. The red line indicates the transition from reed canary grass (east) to remnant sedge meadow (west).

Figure 40. Looking east toward Trout Brook from the western portion of the southern seepage meadow. The foreground is dominated by *Carex stricta* and false indigo, and beyond the red line is dominated almost exclusively by reed canary grass.

Conduct floristic inventory and geomorphic assessment

Goals addressed: better understand existing and historical conditions (1).

Though the seepage meadows are primarily dominated by reed canary grass, some areas containing an abundance of native sedges still remain. There are indicators that the seepage meadows could harbor regionally uncommon or potentially rare plant communities. The 1990 MBS records indicate potentially suitable habitat for calciphiles at the Swede Spring meadow, while 2021 field observations noted dead trees that may have been tamarack (or an upland conifer like eastern red cedar) in the Beaver Spring meadow. Groundwater seepage in southern Minnesota supports uncommon communities of tamarack swamp and critically imperiled calcareous fen. The seepage meadows at MRPR should be assessed for existing plant communities and indicator geomorphic attributes such as peat formation and seepage patterns. Review existing or collect water chemistry data for fen assessment according to DNR methods (MN DNR 2016). Soil cores could be examined for remnants of peat and plant remnants such as tamarack needles or other plant remnants. Findings would help guide and prioritize restoration strategies for the meadows.

Control reed canary grass in seepage meadows

Goals addressed: increase native plant diversity and abundance (2), reduce invasive vegetation cover (3).

Both seepage meadows are dominated by reed canary grass with small pockets dominated by sedges. A mix of chemical control, burning, and mechanical methods are recommended; an example removal schedule is provided in Table 11. Scraping is not recommended (and regardless, likely not feasible) due to potential presence of native seed bank and proximity of native vegetation.

Table 11. Example management plan for reed canary grass monoculture removal with native seed bank present (BWSR 2008).

Treatment Timing	Treatment Approach	Herbicide Application Rate
Year 1: Mid-September - mid-October	Conduct application of glyphosate herbicide if desirable native species are not present.	Apply 3% concentration by volume of glyphosate.
30 days after fall herbicide treatment to mid-March	Conduct a prescribed burn to remove thatch layer.	
Year 2: Mid-May - mid-July	Apply grass specific herbicide to reed canary grass seedlings if there is not too much risk to native grasses.	Apply Sethoxydim (VanatageTM or PostTM), Quizolofop P-Ethyl (Assure II) or Clethodim (Select) per label instructions with surfactant. Do not apply near open water as these do not have aquatic certification.
Mid-July - November	Monitor wetland for establishment of native vegetation and re-establishment of reed canary grass. If reed canary grass continues establishing amongst native sedges and forbs, spray with grass specific herbicide as necessary to remove reed canary grass seedlings. Wetland grasses can be added after reed canary grass is controlled.	Apply Sethoxydim (VanatageTM or PostTM), Quizolofop P-Ethyl (Assure II) or Clethodim (Select)per label instructions with surfactant. Do not apply near open water as these do not have aquatic certification.
Years 3-5	Follow up with herbicide as necessary. If native recolonization is depauperate, consider supplemental seeding following a prescribed burn.	

Monitor and plan for beaver activity

Goals addressed: increase native plant diversity and abundance (2), reduce invasive vegetation cover (3).

Based on historical aerial imagery, at least the Swede Spring meadow appears to have been inundated by beaver activity in the recent past. Beaver have most likely played a natural role in influencing hydrology of both meadows historically and contributed to the function of the ecosystem along Trout Brook and as such should continue to be a part of this landscape. However, stressors present in the modern landscape can result in potential negative effects from beaver impoundment on the seepage meadows. The inundation of the Swede Spring meadow is a potential example, although there is the possibility that the inundation was due to a commercial trout pond and not beavers. The inundation drowned out native vegetation, and the open niche was invaded by reed canary grass carried from upstream waters.

Beaver activity within the seepage meadows could benefit or negatively impact the native plant communities within the seepage meadow and therefore should be monitored. For example, a positive benefit could be inundation of existing reed canary grass, which would likely be drowned out as a result. Once ponding would recede, active revegetation of exposed meadow would be necessary immediately to prevent reestablishment of invasive species. Examples where inundation could negatively impact the existing vegetation of seepage meadows would be inundation of remnant sedge areas or inundation following implementation of active native revegetation. If remnant or revegetated areas are inundated, be prepared to manage reed canary grass and actively revegetate once water recedes.

Photograph 38. Beaver Spring seepage meadow.

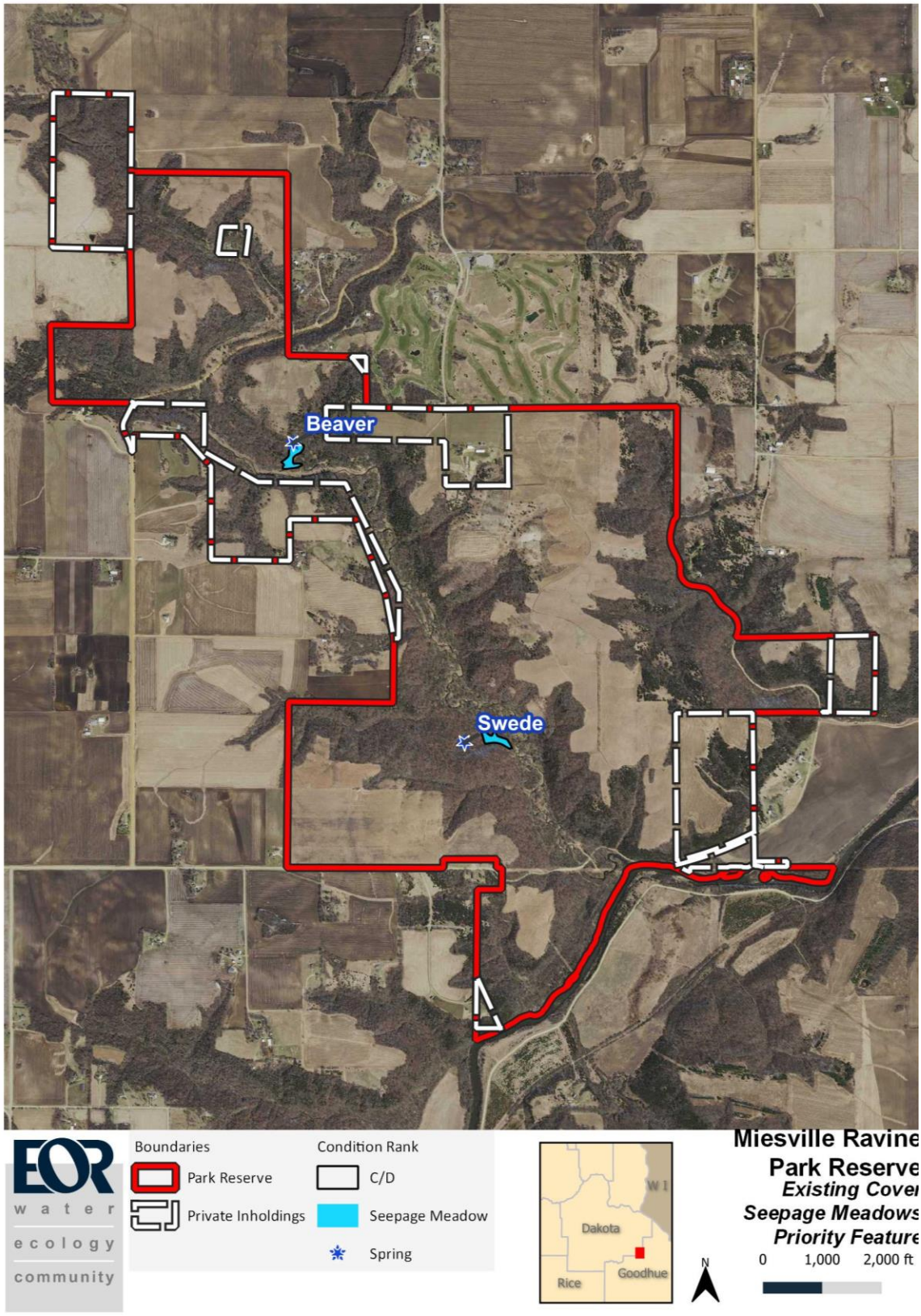


Figure 41. Existing cover and condition rank for Seepage Meadows priority feature.

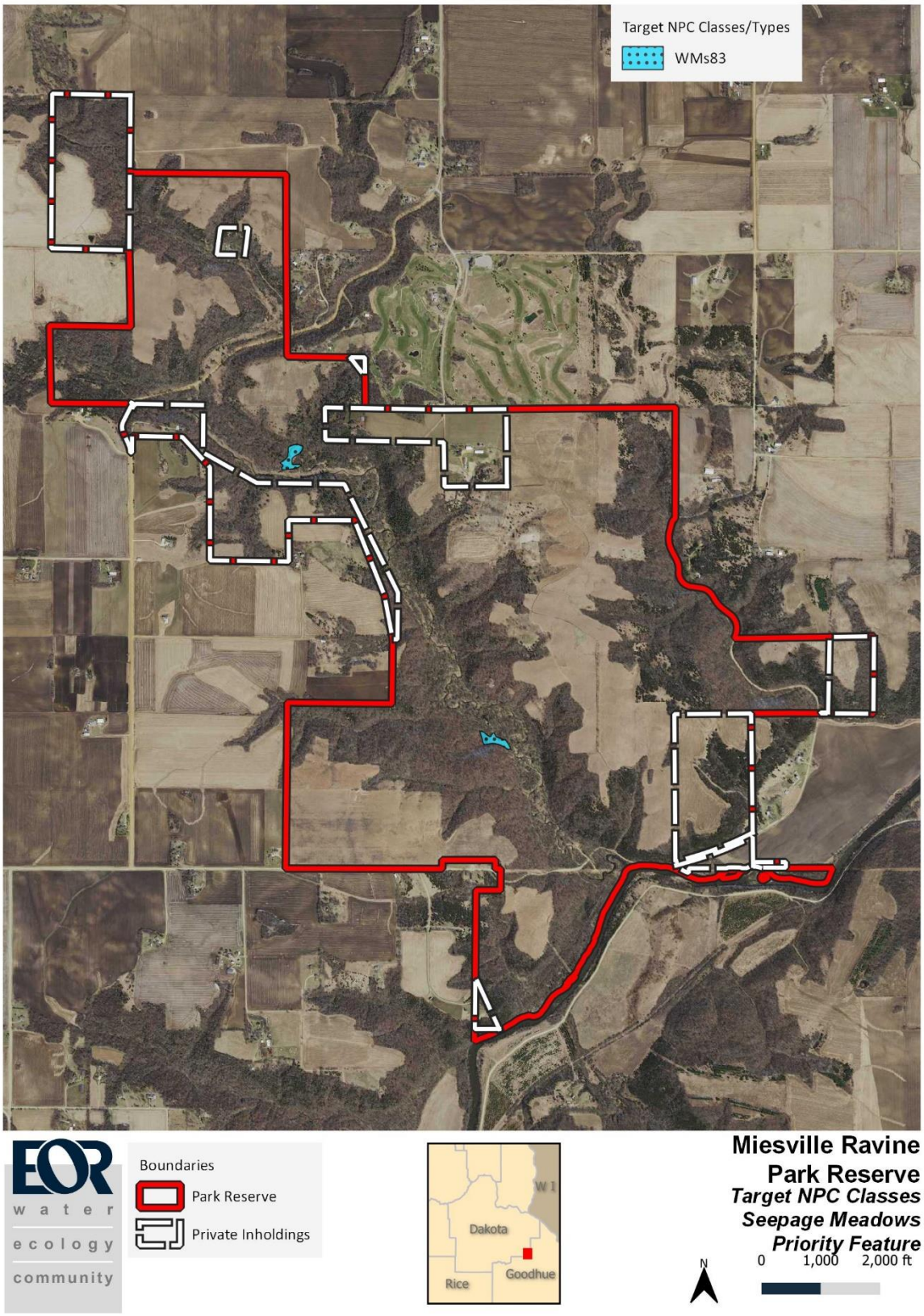


Figure 42. Target NPCs for Seepage Meadow priority feature.

4.2.7. Altered Riparian Area

Altered Riparian Area represents a complex along the Trout Brook valley floor that resembles a mosaic of several different DNR NPC classes. Restoration targets should aim for a mosaic complex of the following NPC classes:

- Southern Wet-Mesic Hardwood Forest (MHs49)
- Southern Terrace Forest (FFs59)
- Northern Wet Meadow/Carr (WMn82)
- Southern Wet Prairie (WPs54)
- Sand/Gravel/Cobble River Shore (RVx32)

The vast majority of Altered Riparian Area within MRPR consists of forested cover, though there are several areas dominated by emergent wetland (adjacent seepage meadows are not included in this cover type). Most of these areas resemble either MHs49 or WMn82, with other NPCs located as inclusions within these. It is possible there may be inclusions of even more NPC classes such as UPs24 (savanna) in more well-drained areas. Prior to European settlement, the complex was part of the connected Trout Brook floodplain that provided hydrology typical of these NPCs and was likely a mosaic of these woodland and open habitats (Trimble 2012). Since then, dramatic changes have occurred within the reach making pre-settlement condition difficult to ascertain. Land conversion to row crop agriculture greatly altered flow regimes and caused erosion in the uplands and sedimentation in the lowlands. Relics of this can be seen in historical aerial imagery where large sand deposits and open vegetative conditions are visible within the Altered Riparian Area (Appendix A: Figure 52). Much of the historical vegetation was likely removed due to large flooding/erosion events or thinning by humans. Furthermore, stream degradation has resulted in channel incision of Trout Brook, disrupting these communities from natural floodplain hydrology.

Overall target NPC composition could aim for approximately 75 percent cover forested NPCs and 25 percent open NPCs. These targets are based on historical reference conditions of bottomlands in the Driftless Area (Trimble 2012) and habitat requirements of SGCN that use the park reserve and rely on riparian forest (for example, cerulean warbler, prothonotary warbler, and red-shouldered hawk).

As a result of historical degradation, as well as field evaluations, most of the Altered Riparian Area received a condition rank of D. The canopy of wooded areas often resembles MHs49 or FFs59, but is frequently dominated by early-successional components like box elder and hackberry. The shrub and ground layers are generally dominated by non-native species. Inclusions of higher-quality areas are present but infrequent. A contiguous area of MHs49 is located on a slightly elevated terrace south of County Road 91 and received a condition rank of C/D. This area is in slightly better condition likely due to natural disconnection from Trout Brook and thus was buffered from hydrologic and historical erosion impacts.

Two areas are dominated by herbaceous vegetation: one area just north of County Road 91 and another just south. The area north of County Road 91 is dominated by almost exclusively reed canary grass. The area south of County Road 91 was part of a 2019 stream restoration project, and was restored with native wetland and prairie vegetation resembling a complex of RVx32, WMn82, and WPs54. The restored area is dominated by native vegetation and received a condition rank of R. It is possible that non-wooded riparian communities may have been kept "open" by activities caused by beavers and that they may have been more

abundant in the past, along other reaches of the stream. Of course, other factors would have been involved such as fire and flooding.

Primary issues within Altered Riparian Area include:

- Disconnected floodplain due to recently (last 150 years) altered watershed hydrology and resultant channel incision
- Dominant understory vegetation comprised of invasive species (woody and herbaceous)
- Equipment access

Photograph 39. A large bur oak within MHs49 of the Altered Riparian Area. This location was much more open in historical aerial photographs.

Goals

Note that accomplishing goals for Altered Riparian Area is **strongly dependent on restoring riparian hydrology (see Section 4.2.1).*

1. Increase native plant diversity and abundance (significantly increase FQI scores)
2. Regenerate native tree species composition and structure that follows the successional stages and natural history of the target native plant community (see *DNR NPC Field Guide*, 2005, for detailed plant community descriptions)
3. Reduce invasive vegetation cover to less than five percent cover on average
4. Target approximately 75 percent forest NPC cover
5. Manage beaver to account for their activities to help maintain and benefit the riparian communities

Strategies

Integrate riparian restoration with stream restoration

Goals addressed: increase native plant diversity and abundance (1), regenerate native tree species (2), reduce invasive vegetation cover (3), target 75% forest NPC cover (4), and manage for beaver (5).

Integration of adjacent riparian restoration with stream restoration is vital to support target NPCs with suitable hydrologic regimes. The target NPCs for Altered Riparian Area depend on natural stream hydrology with a connected floodplain; see hydrologic summaries in Table 12. These hydrologic regimes can guide site specific restoration strategies. Combine restoration of riparian lowlands with channel restoration as concurrent projects, and support with watershed-scale best management practices. Combining riparian restoration with stream restoration will allow integration of complementary management practices. Harvesting early successional trees like box elder from riparian forests would provide bioengineering materials for stream restoration while simultaneously opening up the forest canopy to facilitate herbaceous vegetation establishment. Utilize excess soils generated from bank grading to strategically create pockets of upland habitat to support greater vegetation diversity along the riparian corridor. Place soils into the disconnected floodplain terrace of Trout Brook to allow for greater floodplain capacity during large flood events. Stream restoration typically requires developing at least temporary equipment access, which would facilitate vegetation management in adjacent forest.

Table 12. Hydrologic summaries of Altered Riparian Area target NPCs.

Target NPC	Hydrologic Description
MHs49 (Mesic Hardwood Forest)	Rarely experiences flooding but experiences moist to very moist regimes. Located in stream valleys with prolonged saturated conditions 50-80 inches below the surface.
FFs59 (Floodplain Forest)	Flooding occurs only in wet years or following major rains. Located on stream terraces with saturated conditions 30-60-inches below the surface.
RVx32 (River Shore)	Upper zone is only inundated during highest water levels, typically following spring runoff and heavy rains. Lower zone is inundated early season then generally exposed during normal to low water levels, typically from mid-summer to fall.

Target NPC	Hydrologic Description
WMn82 (Wet Meadow)	Subject to moderate inundation following spring runoff and heavy rains with periodic drawdowns during the summer. Peak water levels are high enough and persistent enough to prevent trees from becoming established.
WPs54 (Wet Prairie)	The water table typically remains within the rooting zone of plants but WPs54 is not as strongly associated with inundation and saturation as WMn82. Vegetation does not tolerate anoxic conditions and herbaceous dominance is maintained primarily by fire rather than wet hydrology.

Prioritize restoration of upstream areas and tributaries

Goals addressed: increase native plant diversity and abundance (1), regenerate native tree species (2), and reduce invasive vegetation cover (3).

Similar to stream restoration, prioritize upstream areas first, then work downstream. Degraded upstream areas negatively affect downstream hydrology and contribute invasive propagules. Carefully planning the staging of restoration areas and activities can help make efforts more effective and efficient. For example, by managing upstream areas first, the likelihood of restoration success downstream would increase, due to more favorable site conditions.

Thin canopy to stage community restoration toward mature forest

Goals addressed: increase native plant diversity and abundance (1), regenerate native tree species (2), reduce invasive cover (3), and manage for complex age and structure (4).

Early in the 20th century, the lowland forest of MRPR was much more open due to disturbance (likely flood damage and/or logging). The lack of disturbance, combined with altered hydrology, has resulted in a community dominated by a canopy of early successional trees with an understory dominated by invasive vegetation. Following (or paired with) hydrologic restoration, a "re-set" is needed to remove the dominant invasive vegetation and establish a foundation for target NPCs. Historically, selective tree loss, due to flooding and windthrow, resulted in canopy thinning and canopy openings. Therefore, thinning the canopy, by targeting early-successional trees, would mimic this natural disturbance, and allow light to reach the ground. It would further provide equipment access to manage invasive understory vegetation. Target canopy cover to 5-25% to allow adequate light for understory restoration. Retain large, mature native trees characteristic of MHs49 and FFs59, especially along stream banks, as well as snags that provide wildlife habitat.

The extent of vegetation management needed following canopy thinning may vary. Most of the lowland forest is dominated by non-native shrubs, forbs, and grasses and natives with low conservatism. Floodplain dynamics and microtopography vary along reaches and site-specific habitat assessment should be conducted concurrent with stream restoration. There are also likely isolated areas that already resemble target NPCs that could be conserved and used as reference sites. For example, large spring ephemeral populations have been observed at the toeslopes of lowland forest bordering maple-basswood forest and are most likely representative of MHs49.

Invasive vegetation removal could generally include brush mowing followed by broadcast herbicide. If conservative native vegetation is present, spot treat instead. Prescribed burning after a year or two of control could also be used to prepare the site for seeding. Seed with an appropriate native seed mix suited to site hydrology and remaining canopy cover. Example mixes include state floodplain, riparian, woodland, wet prairie, or mesic prairie mixes. Plugs may also be suitable for specific sites. Deep-rooted herbaceous vegetation will stabilize stream banks and provide dense cover to compete with invasives.

Plant a diversity of lowland hardwood and softwood trees for resilience to disease and climate change. Species to consider planting include a number of willows, including black willow and peach-leaved willow, hackberry, American elm, Eastern cottonwood, and quaking aspen in lowlands with bur oak, white oak, paper birch, sugar maple, American basswood, black cherry, black walnut, butternut, and red elm in transitional areas and higher elevations of the terrace.

Remove dense patches of reed canary grass

Goals addressed: increase native plant diversity and abundance (1), regenerate native tree species (2), and reduce invasive vegetation cover (3).

Several extensive patches of reed canary grass exist within open meadows of the Altered Riparian Area such as the population just north of County Road 91 along the north Trout Brook Tributary. Either mechanical scraping or chemical treatments should be considered for these dense patches. Scraping produces spoils which require suitable removal or placement. Spoils could be placed in abandoned floodplain terraces to create pockets of upland habitat to support greater vegetation diversity and allow for grater floodplain capacity during large flood events. Chemical control of dense reed canary grass can be combined with mowing and/or burning. An example removal schedule is provided in Table 13.

Table 13. Example management plan for reed canary grass monoculture removal with limited native seed bank (BWSR 2008).

Treatment Timing	Treatment Approach	Herbicide Application Rate
Year 1: May 15-August 15	Mow or hay reed canary grass	
Year 1: September 15 October 15	Conduct herbicide application	Apply 3% concentration by volume of glyphosate following label instructions
Year 1: 30 days after fall herbicide treatment AND/OR Year 2: mid-March to mid-April	Conduct a prescribed burn to remove thatch layer (multiple treatments if possible/needed)	
Year 2: April 15 – May 15	Apply herbicide to seedlings	Apply 3% concentration by volume of glyphosate following label instructions

Treatment Timing	Treatment Approach	Herbicide Application Rate
Year 2: May 30 – until native seeding	Follow up with herbicide as necessary	
Year 2: Late fall	Broadcast seed	
Year 3-5	Follow up with herbicide as necessary;if native recolonization is depauperate, consider supplemental seeding following a prescribed burn	

Photograph 40. Example of typical MHs49 Altered Riparian Area with abundant garlic mustard and creeping charlie in the understory.

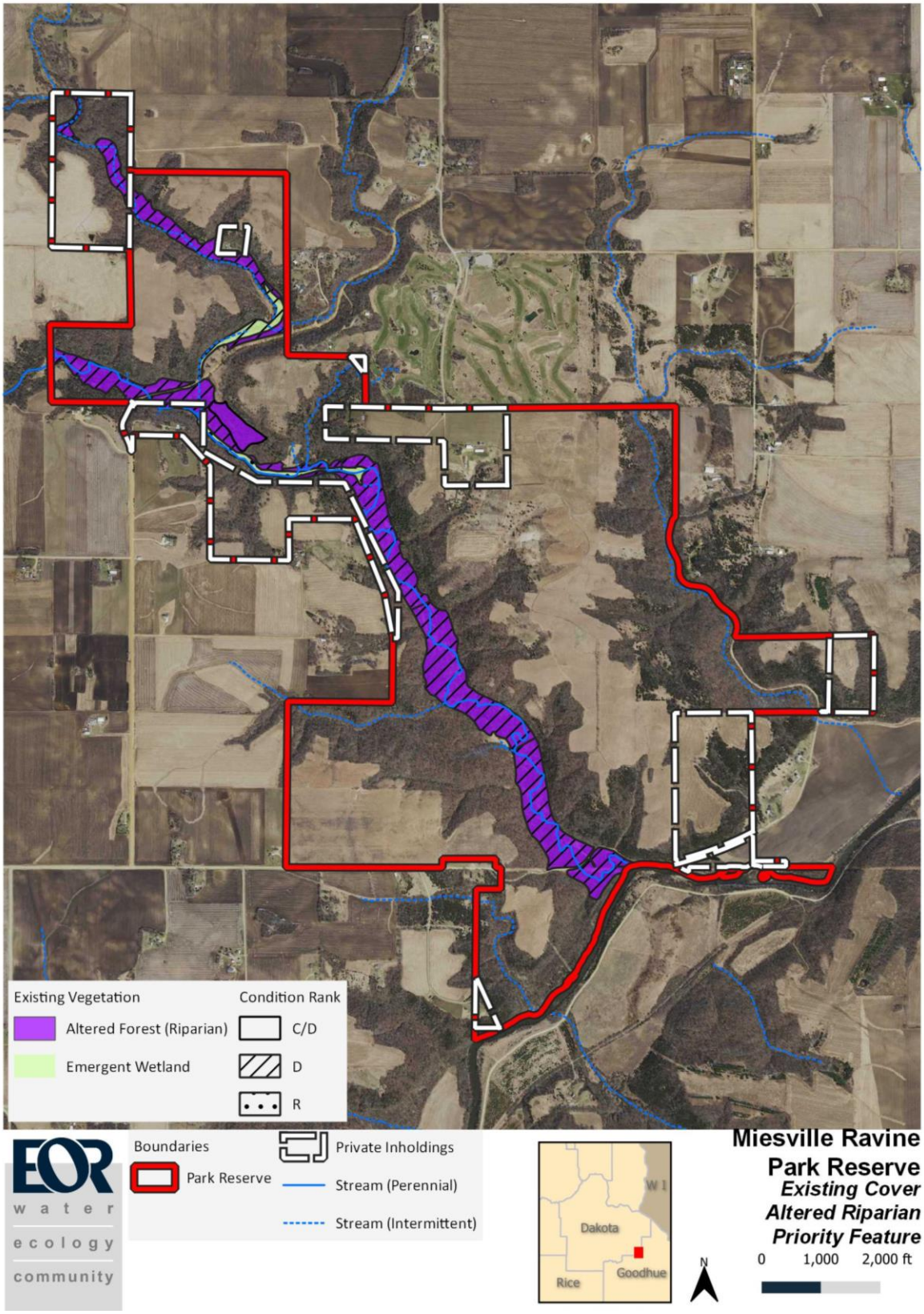


Figure 43. Existing cover and condition rank for Altered Riparian Area priority feature.

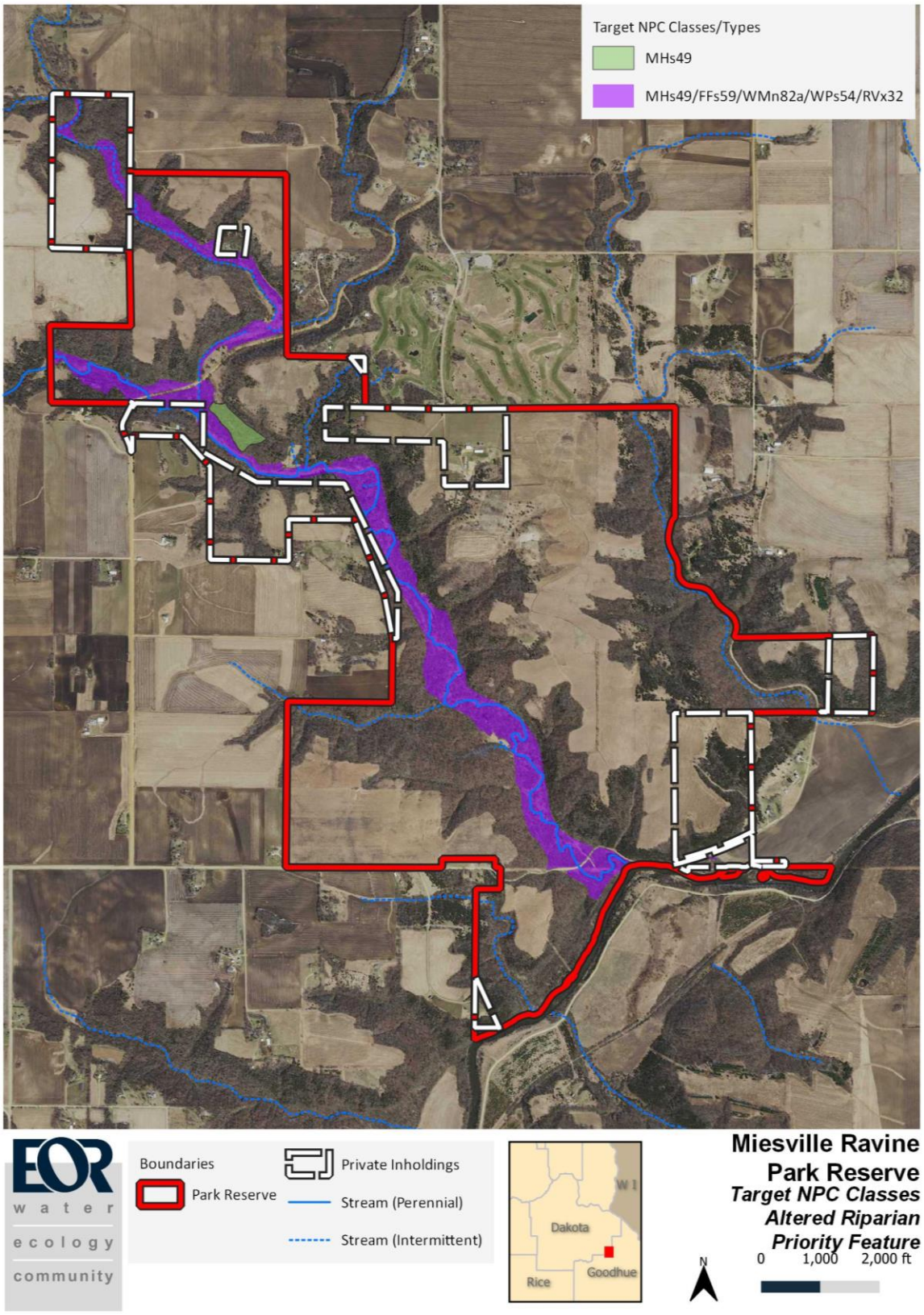


Figure 44. Target NPCs for Altered Riparian Area priority feature.

4.2.8. Altered Upland Forest

Altered Upland Forest does not resemble a DNR NPC class and mostly consists of historically thinned, pastured, or cropped lands that are now dominated by early-successional tree species with low-diversity or invaded understories (Figure 45). The condition rank for this entire feature is "Z". Target NPCs will be based on landscape position and current ecological condition, and include the following:

- Dry Prairie (UPs13)
- Dry Savanna (UPs14)
- Mesic Prairie (UPs23)
- Mesic Savanna (UPs24)
- Southern Dry-Mesic Pine-Oak Woodland (FDs27)
- Southern Dry-Mesic Oak-Hickory Woodland (FDs38)
- Southern Dry-Mesic Oak Forest (MHs37)
- Southern Mesic Oak-Basswood Forest (MHs38)

Target NPCs are depicted in Figure 46.

Goals

1. Improve native understory diversity and composition toward that described in applicable DNR NPC descriptions
2. Reduce invasive vegetation cover to less than five percent cover on average
3. Maintain or reduce shrub and tree cover to less than five percent on average for target prairie NPCs and no more than 50 percent for target savanna NPCs
4. Maintain or increase oaks and white pine within target woodland NPCs with target canopy cover of at least 50 percent
5. Maintain or increase oaks and basswood within target mesic hardwood forest NPCs with target canopy cover of at least 50 percent

Strategies

Thin or clear trees and shrubs to blend with adjacent prairie, savanna, or woodland habitat

Goals addressed: increase native plant diversity and abundance (1) and reduce invasive vegetation cover (2).

The Altered Upland Forest is generally small and fragmented, with only one stand greater than 10 acres. Shared traits among stands include: 1) a history of clear-cutting/pasturing, 2) low cover of bur oaks and cedar and high cover of box elder and hackberry (compared to Overgrown Oak Woodland cover type), and 3) an understory dominated by invasive vegetation and degradation-tolerant natives. Many of the stands abut Reconstructed Prairies and Altered Grassland (old fields). Due to being small fragments and in poor condition, Altered Upland Forest should generally be cleared or thinned to blend with adjacent communities as prairie, savanna, or woodland. Restoration can be combined with Altered Grassland units. Blending with these types of adjacent communities has many advantages, such as softening "sharp edges", and allows for concurrent routine vegetation management in the long-term.

Restore target NPCs using strategies described for prairie, savanna, woodland, and mesic hardwood forest priority features

Goals addressed: increase native plant diversity and abundance (1) and reduce invasive vegetation cover (2), maintain or reduce tree and shrub cover for target prairie/savanna NPCs (3), maintain or increase oaks and white pine within target woodland NPCs (4), and maintain or increase oaks and basswood within target mesic hardwood forest NPCs (5).

For target prairie, savanna, and woodland NPCs, remove all woody vegetation with the exception of remnant oaks. For target forest NPCs, remove all woody vegetation except for oaks and basswood, which are typical of early successional MHs37 and MHs38 NPCs. Target forest NPCs may also require supplemental plantings of species like northern red oak, basswood, and disease-resistant American elm to put the community on a trajectory toward a more closed canopy. Understory revegetation will also likely be necessary and can follow methods described for other priority features within the NRMP.

Photograph 41. Typical altered forest dominated by buckthorn and early-successional trees.

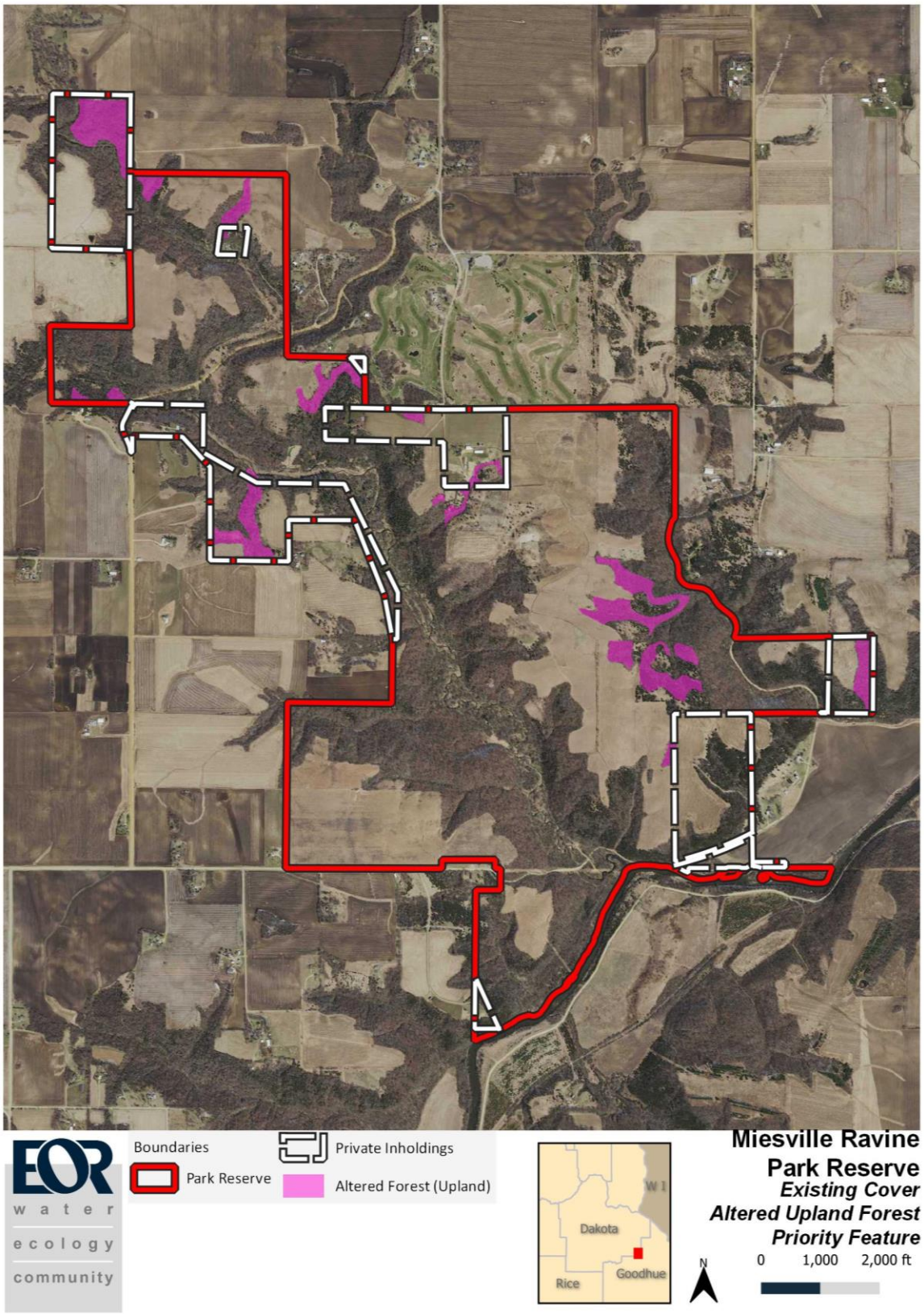


Figure 45. Existing cover for Altered Upland Forest priority feature. Condition rank for entire cover type is "Z".

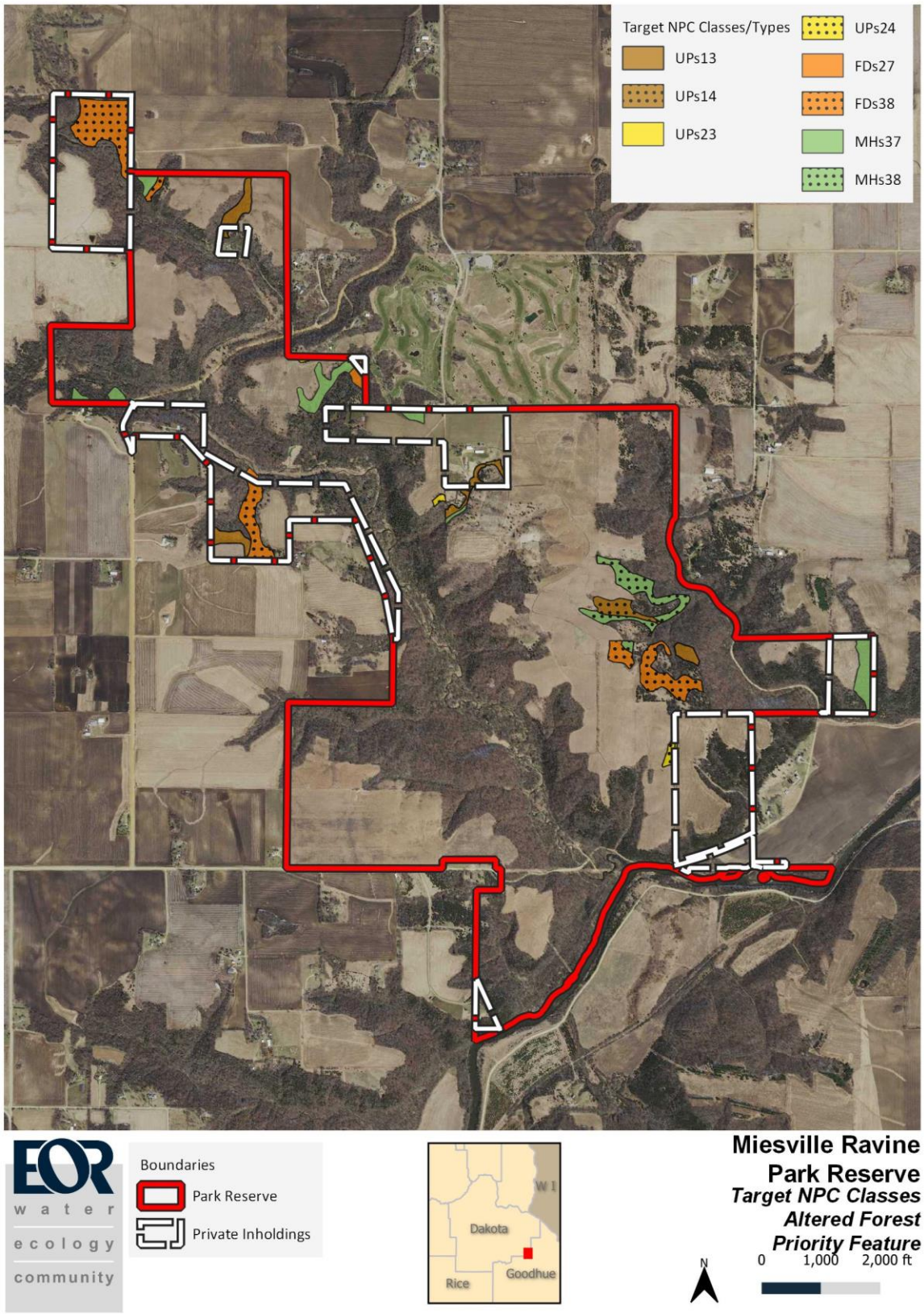


Figure 46. Target NPCs for Altered Upland Forest priority feature.

4.2.9. Altered Grasslands

Altered Grasslands do not resemble a DNR NPC class and mostly consist of non-native cool-season pasture grasses that were likely planted historically. Most are located on crests and upper bluff slopes adjacent to more level blufftops consisting of Reconstructed Prairie. Variable degrees of woody encroachment are present within the Altered Grassland, primarily by eastern red cedar and both native and invasive shrubs. Condition ranks varied from Z to D based on degree of remnant native vegetation present. Remnant prairie vegetation varies from absent to sparse, mostly consisting of species like goldenrod, asters, and wild bergamot. The far eastern Altered Grassland includes a substantial remnant population of false boneset, whorled milkweed, and a few native tall grasses. Therefore, this area received a condition rank of D despite being dominated by non-native pasture grasses.

Target NPCs are based on landscape position and current ecological condition. At least two are located on north- and east-facing slopes and are targeted toward mesic hardwood forest communities:

- Dry Prairie (UPs13)
- Dry Savanna (UPs14)
- Mesic Prairie (UPs23)
- Southern Dry-Mesic Pine-Oak Woodland (FDs27)
- Southern Dry-Mesic Oak-Hickory Woodland (FDs38)
- Southern Mesic Oak-Basswood Forest (MHs38)

Goals

1. Increase native plant diversity and abundance toward target NPC descriptions as described in DNR field guide
2. Reduce invasive vegetation cover to less than five percent cover on average
3. Maintain or reduce shrub and tree cover to less than five percent on average for target prairie NPCs and to no more than 50 percent for target savanna NPCs
4. Maintain or increase oaks and white pine within target woodland NPCs with target canopy cover of at least 50 percent
5. Increase oaks and basswood within target mesic hardwood forest NPCs with target canopy cover of at least 50 percent

Strategies

Thin or clear trees and shrubs to restore prairie and savanna habitat

Goals addressed: increase native plant diversity and abundance (1), reduce invasive vegetation cover (2), maintain or reduce tree and shrub cover for target prairie/savanna NPCs (3), maintain or increase oaks and white pine within target woodland NPCs (4), and maintain or increase oaks and basswood within target mesic hardwood forest NPCs (5).

Large tracts of land within the park reserve were once cultivated or grazed but have since been abandoned. Most fields were seeded with non-native pasture grasses such as smooth brome and Kentucky bluegrass for pasture or after the fields were retired from crop production. Altered Grasslands are dominated by these non-native grasses and native species like goldenrod, which persists in many historically grazed fields due

to unpalatability for cattle. Variable levels of succession to woody vegetation are occurring within the old fields of the park reserve. Restoration of these areas should aim for open prairie and savanna communities by removing woody vegetation (conserving bur oaks, if present) and existing herbaceous vegetation. Several similar projects have been completed throughout the park reserve that included woody removal, burning, and chemical treatment followed by seeding. Replicate successes and lessons learned from these past projects.

Plant trees suited to target NPCs

Goals addressed: increase native plant diversity and abundance (1), maintain or reduce tree and shrub cover for target prairie/savanna NPCs (3), maintain or increase oaks and white pine within target woodland NPCs (4), and maintain or increase oaks and basswood within target mesic hardwood forest NPCs (5).

Historically, bur oaks frequently occurred in clumps within savanna. Replicate this structure by planting acorns or bur oak saplings in clusters within Altered Grasslands targeted for savanna or woodland target NPCs. Cluster ences or use *tree protectors* to prevent herbivory. Within the mesic hardwood forest targeted NPCs that are currently altered grasslands, significant staging may be required to put these on a trajectory toward target NPCs. Plant species like northern red oak, basswood, and disease-resistant American elm to put the community on a trajectory toward a more closed canopy. Understory revegetation will also likely be necessary and can follow methods described for other priority features within the NRMP.

Photograph 42. Overview of typical Altered Grassland taken from edge. Cool season grasses dominate with eastern red cedar colonization visible in distance. A lone bur oak is growing on the left of the photo.

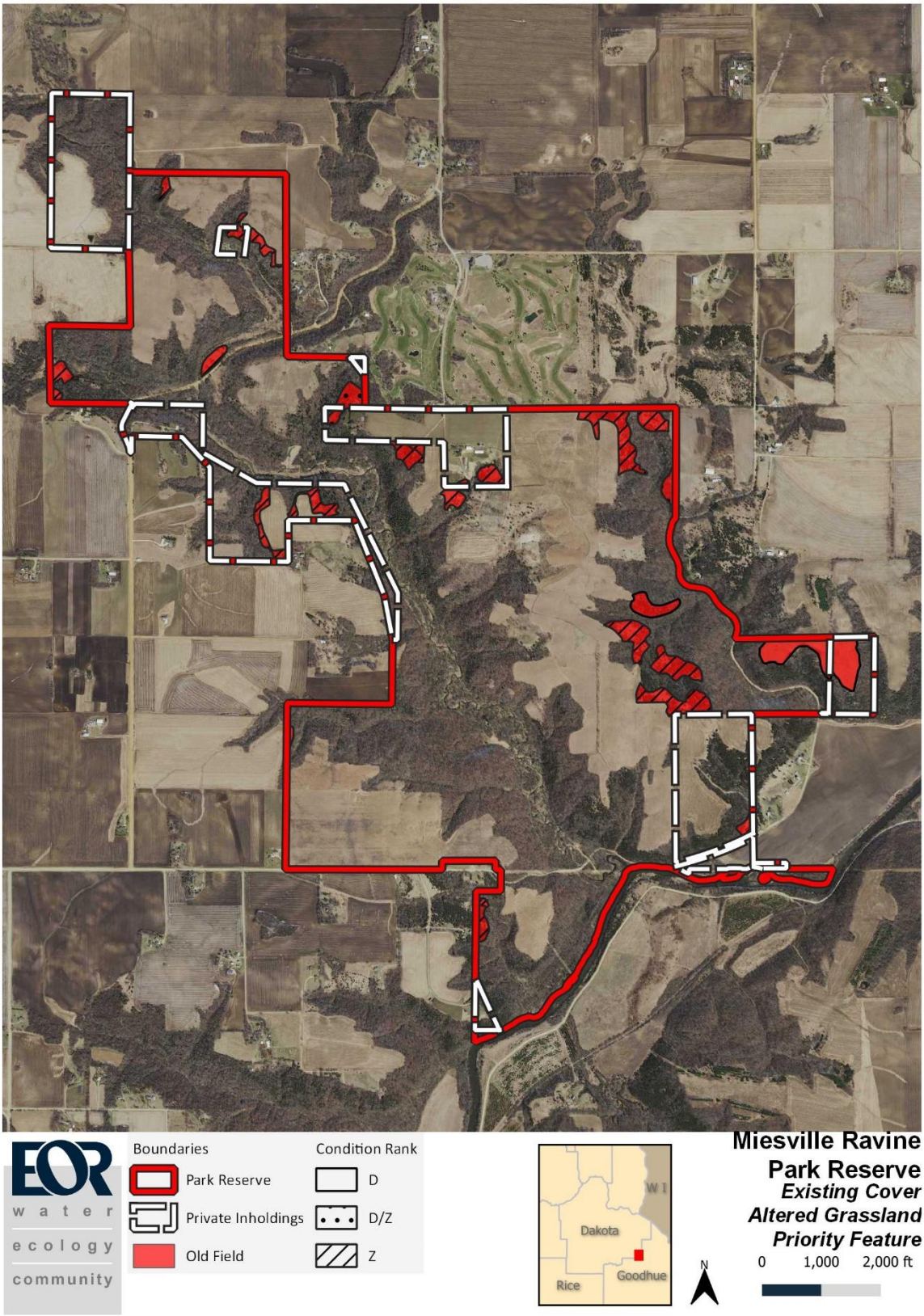


Figure 47. Existing cover and condition rank for Altered Grassland priority feature.

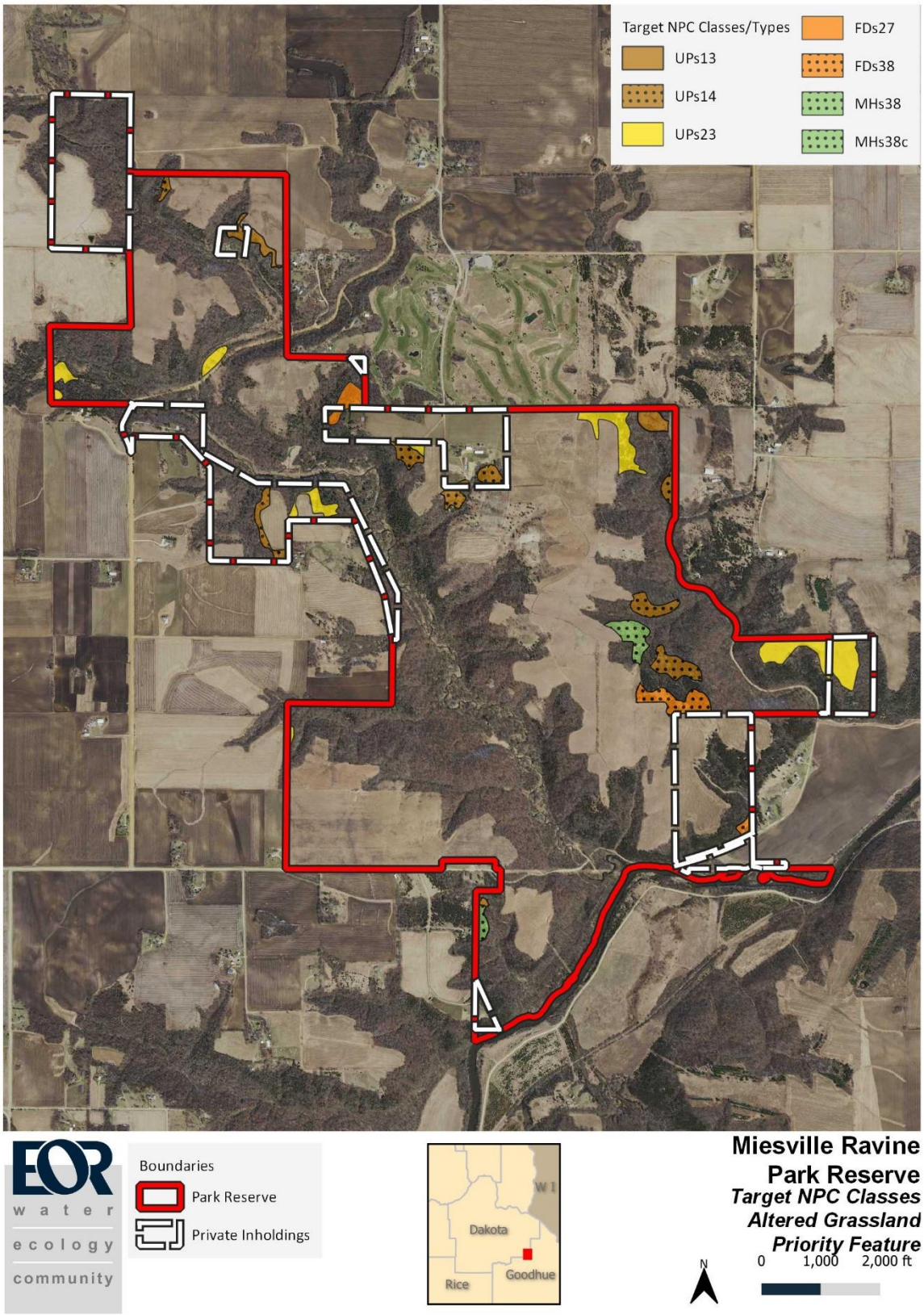


Figure 48. Target NPCs for Altered Grassland priority feature.

4.2.10. Cliffs and Rock Outcrops

Cliff and outcrop communities are generally small, scattered, and occur as inclusions within other communities along steep ravine slopes. A notably large exception of mesic to wet cliff occurs along the north- and northeast-facing slopes of Trout Brook south of County Road 91. Though these communities have not been intensively surveyed or mapped at the park reserve, existing communities likely consist of the following:

- Southern Dry Cliff (CTs12b)
- Southern Mesic Cliff (CTs33b)
- Southern Wet Cliff (CTs53b)
- Southern Bedrock Outcrop (ROs12c)

Both cliff and rock outcrop communities are open plant communities with exposed bedrock or thin substrate. There is substantial overlap of vegetation among cliff and rock outcrop communities, especially CTs12 and ROs12 where desiccation regimes from low-moisture capacity substrates and sun and wind exposure are similar. Several cliff lichen specialists are limited to vertical bedrock exposures distinct from rock outcrops. The different cliff communities of CTs12, CTs33, and CTs53 are classified based on moisture, light regimes, and bedrock type. Moisture and light vary at MRPR according to slope aspect and also adjacent vegetation and proximity to Trout Brook, both of which may provide some thermal/moisture regulation. Bedrock type at MRPR is limestone and dolomite, which dictates the NPC type modifiers for both cliff and outcrop communities.

Differences between CTs12b and ROs12b communities are largely a matter of scale. The larger an exposure, the more likely it is to have distinctive cliff species. Technical classification distinguishes cliffs as vertical exposures greater than six-feet tall, though practical differences between a four-foot outcrop and a six-foot cliff may be indistinguishable. Distinguishing vegetation includes rock spikemoss (*Selaginella rupestris*) and rock sandwort (*Minuartia dawsonensis*, state threatened) for ROs12c and slender lip fern (*Cheilanthes feei*), cliff goldenrod (*Solidago sciaphila*), and smooth cliff brake (*Pellaea glabella*) for CTs12b. None of these indicator species were observed during NRMP field visits, but suitable habitat is present.

Primary issues within cliff and outcrop communities include:

- Poor understanding of distribution, extent, and condition within the park reserve
- Suppression of fire over the last 150 years, resulting in woody encroachment of ROs12c

Target NPCs generally align with existing locations (both known and unmapped), with exception of rock outcrops which are more prone to being overgrown with woody vegetation. Inclusions of overgrown ROs12c may be present within Overgrown Oak Woodland/Savanna, Altered Upland Forest, and Altered Grasslands.

Goals

1. Understand distribution, extent, and condition of cliff and outcrop communities within the park reserve
2. Reduce woody vegetation within ROs12c communities to zero to five percent
3. Maintain or increase FQI scores based on initial condition with composition and structure representative of target native plant communities (see *DNR NPC Field Guide*, 2005, for detailed plant community descriptions)

Photograph 43. Rock outcrop inclusion within Overgrown Oak Woodland where kittentails were observed.

Strategies

Map distribution, extent, and condition of cliff and rock outcrop communities

Goals addressed: understand distribution, extent, and condition (1).

Cliff and rock outcrop communities at the park reserve are often small, disjunct, and for outcrops, potentially overgrown/obscured by woody vegetation. At least one large cliff community is present along Trout Brook, but its exact extent, NPC classification, and existing condition are unknown. Frequently, these communities occur as inclusions within the larger matrix of forest, woodland, and prairie. Targeting these communities with field efforts to map and characterize would help refine goals for this priority feature. These goal refinements could include identifying rock outcrop communities that are inclusions within existing managed areas or within woodlands proposed for restoration and may need specific goals within these larger units; observations of rare species for conservation focus; prioritization of woody removal sites; and establishment of baseline FQI metrics for tracking progress toward goal maintaining and increasing FQI. Inventory of rock ROs12c and CTs12b may easily be combined with the Remnant Prairie/Savanna strategy to assess priority remnant sites for restoration.

Remove woody vegetation encroaching on ROs12 communities

Goals addressed: reduce woody vegetation (2), increase FQI scores (3).

Once identified and characterized, ROs12 communities should be prioritized for woody removal, as it is likely several of these sites are overgrown. Outcrop communities are open, and tree and shrub cover should be less than five percent. Long-term management may integrate prescribed fire if the ROs12 community is an inclusion within a larger fire-dependent matrix such as prairie or woodland. Small sites controlled by subtle changes in topography/aspect and adjacent to more mesic communities may require repeated mechanical or hand removal of woody vegetation for long-term management.

Restore and maintain adjacent communities and ecological processes

Goals addressed: reduce woody vegetation (2), increase FQI scores (3).

Because cliff and rock outcrop communities are often small and occur as inclusions within a broader matrix of plant communities, management of these adjacent communities is especially important. For example, prescribed fire in prairie, savanna, and woodlands will help maintain open character of rock outcrop inclusions or CTs12 edges. Supporting hydrologic restoration in the watershed and along Trout Brook would also mitigate erosive events that could impact cliff communities.

4.2.11. Cannon River

Given the small percentage of the MRPR that comprises of the Cannon River Watershed (< 0.2%) and Cannon River shoreline, this NRMP will have limited direct impact on the health of the Cannon River. The NRMP can, however, serve as an environmental stewardship precedent for Dakota County and the Cannon River Watershed stakeholders. Furthermore, protection and rehabilitation of the Cannon River can only be achieved via singular and multiple, compounding conservation steps. Implementing water quality projects that improve Trout Brook will contribute to the larger network of projects aimed at improving the Cannon River within the greater watershed.

While this NRMP may have limited impact on the Cannon River, the following goals and strategies within the park reserve can have direct benefit.

Goals

1. Support water quality of the Cannon River
2. Support wildlife using the Cannon River
3. Minimize erosion and disturbance along the banks of the Cannon River

Strategies

Implement watershed and stream restoration practices within the Trout Brook subwatershed

Goals addressed: support water quality (1), support wildlife (2).

Though Trout Brook improvements would only marginally affect water quality within the Cannon River, they will contribute to the network of smaller projects that as a whole may benefit the watershed. Further, improvements to Trout Brook will support aquatic life that use both the Cannon River and Trout Brook.

Assess the recreational tubing launch at Orlando Trail

Goals addressed: support water quality (1), support wildlife (2), minimize erosion and disturbance along banks (3).

The Trout Brook and Cannon River confluence is utilized for commercial put-in and take-out for recreational tubing. The location is also utilized as an ad hoc launch for carry-in watercraft. The amount of concentrated foot traffic over the stream bank has created some minor streambank instability issues. The launch is located on a cutbank (outside bend of a river where erosive forces tend to be highest) of the Cannon River. Should this recreational activity continue, greater instability and subsequent impacts (e.g., erosion, sedimentation aesthetic degradation) are likely. Furthermore, this informal drop off along the narrow Orlando Trail shoulder, with poor sightlines, may be a traffic safety concern.

The forthcoming Park Reserve Master Plan should address the potential resource sensitivity and traffic safety constraints of this popular launch. Strategies for improving are as follows:

- Protect/stabilize the existing launch via the design of a stable launch and restricted access to the stabilized location.

- Move commercial launch to the existing south parking lot, site the launch (likely paired with overhead powerlines, although this location is also on a cutbank), and establish a stabilized launch from this safer (traffic) location.
- Move commercial launch to existing upstream launch off Sunset Trail (Goodhue County).

Remember that launch design must address the varying flood stages and associated shear stresses of the river, which threaten the launch via erosion and/or sedimentation. There are more formal options discussed than are suitable to MRPR, but the following guidance, via River Management Society, is a reference for launch siting and design: https://www.river-management.org/prepare-to-launch-.

Photograph 44. The Cannon River is one of Minnesota's most popular tubing destinations with put-in and take-out at the Trout Brook & Cannon River confluence. Image courtesy of MN Department of Tourism.

4.2.12. Ravines

Dozens of ravines are present within MRPR draining to Trout Brook or Cannon River tributaries. A ravine, also referred to as coulee, is a small narrow steep-sided valley that is larger than a gully and smaller than canyon and is usually worn by running water. MRPR contains ravines that are both stable, (nominal current net erosion) and actively eroding ravines, which contributes to downstream water quality issues and degradation of the local plant communities within and adjacent to the ravine. Both Dakota County and Dakota County SWCD have been active in stabilizing ravines within the park reserve and within the Trout Brook watershed. One such project, approximately one-half mile upstream of Trout Brook crossing of Orlando Trail, was completed in 2005. Stakeholders successfully stabilized this ravine by reducing watershed runoff via conversion of a percentage of the drainage area from row crop to native prairie and soil-bioengineering inputs within the ravine itself.

Photograph 45. Before image of actively eroding ravine (L) and after image of stabilized site at same location along Trout Brook (R).

Goals

1. Minimize erosion from ravines to limit the impacts on adjacent and downstream resources

Strategies

Inventory and monitor ravines

Goals addressed: identify and address ravines with erosion issues (1).

Create an inventory of the park's ravines and identify ravines with aggressive or accelerated erosion. Monitor any active and severely eroding ravines via profile and cross-section topographic survey and

reproduce the survey within two to five years to determine erosion rate and any subsequent nutrient input to stream.

Delineate the surface water catchment of ravine(s) and denote the following to aid in conservation planning:

- Private ownership versus Dakota County ownership
- Percentage of catchment in row crop
- Identify any additional groundwater signatures within or near ravine, In addition to the known springs and seeps.
- Known drain tile and discharge location(s)
- Existing conservation practice(s) and date of completion
- Proposed conservation practice(s)
- Soils

Develop plans to address concerns, garner funding, and quantify returns

Goals addressed: identify and address ravines with erosion issues (1).

Lead by example and address all priorities within MRPR and/or County control.

For erosion and runoff priorities both within and outside of MRPR proper, including but not limited to ravines, continue to work with the SWCD and stakeholders (e.g., Trout Unlimited) to prioritize and implement BMPs identified via the 2016 Trout Brook Subwatershed Analysis. Continue to work with landowners within the watershed to reduce the impacts of runoff. Improve landcover (perennial and temporary) within the drainage/watershed area to reduce volume and rate of runoff. Improve vegetation cover within ravines through integration with native plant community restoration to minimize soil loss. If any severe erosion locations are identified, consider water and sediment control basins to reduce runoff volume and rate. Monitor regularly for evidence of new or exacerbated erosion so that any new issues can be promptly addressed.

Implementation of the 2016 Trout Brook Subwatershed Analysis should be a priority for both the Park Reserve and Trout Brook. Provide necessary support and resources to ensure priorities are adequately addressed. Suggest and support an update of the study to quantify success, take advantage of new data and/or technology, further refine analysis and recommendations (e.g., completed subcatchment delineation described above for the entire Trout Brook drainage), and reprioritize next steps.

Photograph 46. Overview of a relatively stable, large ravine that drains to Trout Brook. Garlic mustard dominated the ravine bottom.

4.2.13. Rare Species and Wildlife

Goals

1. Protect and provide habitat for rare species known or likely to occur in the park reserve
2. Provide habitat for a diversity of indigenous wildlife species and SGCN known or likely to occur within the park reserve
3. Reduce deer population below 10 deer per square mile

Strategies

Continue and expand native plant community restoration

Goals addressed: protect and provide habitat for rare species (1), provide habitat for a diversity of indigenous wildlife (2), reduce deer population (3).

Restoration of native plant communities as described for priority features is the best means to support the rare species and wildlife of the park reserve. No specific action will benefit all species, but restoration of the historical landscape diversity of MRPR will provide the greatest benefit to the maximum number of

species and is the wildlife strategy with the greatest positive impact. Many of the restoration actions will also help address deer overpopulation by reducing suitable deer habitat such as edge and dense cedar stands.

Assess rare plant species prior to management actions and park-development activities

Goals addressed: protect and provide habitat for rare species (1).

Two rare plant species have records within MRPR, including several populations of kitten-tails. Though risk from management is low, assess rare plant species habitat and presence prior to intensive management of new areas such as broadcast chemical application, mechanical woody removal using heavy equipment, or prescribed fire. Assessments might include records review and a meander survey of the management unit prior to implementation to flag avoidance areas. In general, native plant community restoration and management described within the NRMP will support these species and greatly improve habitat. Potential negative impacts of management could include non-target herbicide damage, which would present most risk during broadcast application of highly invaded communities where it is unlikely rare species have persisted. Additionally, timing of herbicide application for woody invasives would generally be later in the growing season when most native plants are less likely to be impacted. Of lesser concern are impacts from fire or trampling during mechanical woody removal. Kitten-tails are typically not damaged by fire, and the remaining rare plant species occupies habitats where these management techniques would not be extensively used. Mechanical woody management typically occurs outside of the growing season when soil conditions are less likely to be disturbed.

Prior to any park reserve development activities, locations and routes should be surveyed for rare plant species populations. It is critical is to assess these locations to avoid potential permanent impacts to populations. For example, there is at least one population of kitten-tails located along an informal trail (and likely abandoned roadbed) on the east side of the Trout Brook ravine. A few plants are located within the trail tread itself. While this location may seem well suited for trail development due to its current and historical use as a trail route, development would directly impact the rare species population Re-route or site development based on survey results and apply avoidance measures as needed.

Assess Blanding's turtle presence and habitat

Goals addressed: protect and provide habitat for rare species (1).

A Blanding's turtle observation was recorded in 1991, but they are no longer thought to exist in the park reserve due to existing lack of suitable habitat (see discussion in Section 2.6.2). A turtle survey and detailed analysis of Blanding's turtle habitat could determine if suitable habitat exists or would be expected to exist based on pre-European settlement conditions and projected target NPCs. While the Cannon River likely supports Blanding's turtles, it is not clear that the Trout Brook's pre-settlement and target conditions would provide adequate habitat. However, if there is a turtle population, it is worthwhile to protect and enhance the population with a focus on suitable areas that could provide nesting, foraging, and overwintering, perhaps closer to the Cannon River confluence where sand deposits could be naturally sustained.

Manage deer to reduce impact on native plant communities

Goals addressed: reduce deer population (3)

Reducing deer browse is discussed above in Section 4.2.2 and focuses on reducing deer density to 10 deer per square mile via continuation of the public hunt, potential sharpshooting, vegetation protection from browse, and native plant community restoration that reduces desirable deer habitat.

Restore beaver populations throughout Trout Brook in the Park Reserve and throughout the Trout Brook watershed

Beavers, a wetland ecosystem keystone species, have suffered catastrophic drops in their populations throughout North America, including Minnesota, as a result of being heavily trapped during the beaver trad era, to the great detriment of ecosystems. They also are the target of discrimination by people who do not understand their important ecological role, or where beavers come into direct conflict with human infrastructure. Focusing on Miesville Park Reserve, currently, there occur incised streams whose channels are disconnected from their floodplains, altered plant communities in riparian areas, lost water retention in the spring, lowered base flow in fall, lowered water tables, and more—all of which can be remedied in large part by having a robust beaver population with their associated network of wetlands and channels.

Habitat requirements of beavers (Jerry Altermatt, Wyoming DNR) are relatively simple. They need the following:

- Food (willows, cottonwoods, aspen)
- Deep water (large streams, or smaller streams that are dammed)
- Suitable range of water flows (consistent flow, not too much or too little)
- Stream gradient (two to six percent)
- Dam building material

Candidate restoration areas can be assessed, fairly simply, for beaver reintroduction by the following:

1. Is the area in need of restoration?
2. Does it have the hydrology, gradient, floodplain, and food source? (e.g., can start with a patch of willow/cottonwood/aspen—the size or amount will increase once beavers get established).
3. Are there low potential for conflicts? (e.g., do not put beaver where there is a culvert).

Here are some important things to consider for beaver conservation, reintroduction, and stream restoration using beavers:

- Identify where beavers are active based on caches.
- Site preparation methods:
    - Temporary dams
    - Beaver Dam Analogs (BDAs) to start at deeper pools (~3' deep) and easy spots for beavers to build on that have the sound of trickling water
    - Re-establishment of cottonwoods/willows/aspen (protect by excluding browsers, i.e, deer)
    - Length of project (may take 10-30 years)
- Acquisition of beaver by getting nuisance beavers in April, and **August-October** (avoid heat, kits, and increase retention). Holding them in a mobile trailer—allows releasing family unit together (single beavers will just take off looking for other beavers); spatial disassociates with trap sites and reduces homing behavior.
- Processing—weigh and sex (aging—want a mated pair of adults), attach a transmitter (in their tail).

- Transport and release—at least two families released in >1/2 mile apart within a stream segment with contiguous habitat, augmented by singles on the periphery.
- Monitoring: vhf transmitters, dam searches, drone images.

Results of Jerry Altermatt's work in Wyoming:

  - Example: 15 beavers were released (8 as families, 7 as individuals) at three locations on a stream in the Absaroka mountain range near Hot Springs, Wyoming
  - 4-5 successfully colonies were established
  - 54 dams were built,
  - 25 acres of wetlands were created.

Beavers are a very economical way of building wetlands and restoring stream geomorphology, compared to having humans have to do it ourselves.

NOTE: Prior to construction of Phase 2 of Trout Brook stream restoration, MN Trout Unlimited agreed that after the restoration was finished, they would not attempt to remove or trap out beaver, if beaver re-colonized the stream in this reach or elsewhere in the park reserve.

Consider bison reintroduction to reconstructed prairie

Goals addressed: provide habitat for a diversity of indigenous wildlife (2)

Bison reintroduction is discussed above in Section 4.2.4 and focuses on using bison to mimic historical grazing disturbance and heterogeneity of prairies.

Consider reintroductions of dry prairie specialist wildlife

Goals addressed: protect and provide habitat for rare species (1).

The quantity and quality of remnant prairie restoration and cropland to prairie reconstructions at MRPR has potential to support prairie specialists with historical ranges within but not known to occur at MRPR. Consider reintroductions of dry prairie specialist wildlife. That said, it is important to ensure reintroductions are justified and do not replace resources better allocated to management within existing habitat or deplete source populations. Consult with species specialists with DNR, MN Zoo, or others as a first step to gauge regional justification and feasibility. Further, carefully assess suitable habitat such as proper brooding/nesting sites, vegetation composition and structure, host plant and/or food source presence and abundance, hibernaculum requirements, and habitat size. Compatibility with existing management and recreation should also be considered. The reintroduction process can take years to decades and may be accompanied by significant permitting.

Under those caveats, some potential species to assess for reintroduction are listed below. Species were selected based on existing or historical range and potential for suitable habitat at MRPR.

- Regal fritillary (*Speyeria idalia*)
  - Prairie violet host plants are present at MRPR

    - Recent introductions occurred at Crow-Hassan Park Reserve
- Leonard's skipper (*Hesperia leonardus*)
    - Noted as a potential for introduction at Spring Lake Park Reserve (Johnson 2021)
    - Requires varied structure typical of bison grazing
- Whitney's underwing (*Catocala whitneyi*)
    - Lead plant hosts are present at MRPR
- Gophersnake (*Pituophis catenifer*)
    - This species has been reintroduced at Crow-Hassan Park Reserve
- Timber rattlesnake (*Crotalus horridus*)
    - The MN DNR completed a timber rattlesnake recovery plan in 2009; reintroductions were recommended on state lands only at that time
- North American racer (*Coluber constrictor*)

Coordinate with DNR to review fisheries data and, if necessary, conduct a fisheries survey and habitat assessment

Goals addressed: protect and provide habitat for rare species (1), provide habitat for a diversity of indigenous wildlife (2).

DNR Fisheries regularly samples Trout Brook and the Cannon River near their confluence. However, little information is publicly available beyond general observations of trout species. The County should reach out to DNR to discuss available data and assessment for Trout Brook to better understand the fish population. Specific objectives should be to:

- Better understand the historical brook trout population. Was it extirpated and reintroduced in the 1970s/80s, or was the reintroduction to supplement the existing population?
- Understand the status of non-game fish within Trout Brook such as brook stickleback and sculpin.
- Understand feasibility and success of regional sculpin reintroductions.

Photograph 47. A regal fritillary nectaring on thistle. Image courtesy of MN DNR rare species guide.

4.2.14. Connectivity

Goals

1. Reduce edge effects
2. Build connectivity and core habitat within and surrounding the park reserve
3. Increase core habitat and connectivity

Strategies

Continue native plant community restoration, especially removal in overgrown woody areas

Goals addressed: reduce edge effects (1), build connectivity and core habitat (2), increase core habitat (3).

Continue native plant community restoration to connect areas of core habitat and reduce edge effects. The greatest benefit in improving connectivity will be to connect patches of remnant bluff prairie by removing and thinning overgrown woody vegetation as described for Remnant Prairie/Savanna and Overgrown Woodland/Savanna priority features. Thinning overgrown woodland slopes will also soften edges between blufftop prairie reconstructions and densely wooded slopes.

Continue to purchase inholdings, as feasible, to connect and to buffer habitat

Goals addressed: reduce edge effects (1), build connectivity and core habitat (2), increase core habitat (3).

Inholdings harbor the last remaining row crop agriculture and pasture lands within the park reserve boundary. Unmanaged overgrown woodland slopes also contribute to fragmentation within the park reserve. As feasible, purchase in-holdings or acquire easements for inholdings and restore lands within. Consider acquisitions or easements for adjacent properties that would add to core habitat and increase connectivity, particularly areas that include wooded ravines and tributary slopes that may contain restorable native plant communities.

4.2.15. Climate Change Resiliency

As discussed in 3.11, human-induced climate change will invariably have impacts on the natural resources of MRPR.

Goals

1. Mitigate harmful changes to natural resources
2. Manage for resilient native plant communities

Strategies

Continue native plant community restoration with emphasis on plant and habitat diversity

Goals addressed: mitigate harmful changes (1), manage for resilient communities (2).

Diversity within and across habitats supports resilient plant communities. Many impacts from climate change are uncertain, but plant species and habitat diversity can help account for unknown future conditions.

Monitor for shifts in plant and wildlife populations to inform and adapt management

Goals addressed: mitigate harmful changes (1)

Changes in plant and wildlife populations in response to climate change may be subtle or dramatic. The DNR provides an expected response for tree species of wooded NPCs that can help inform potential shifts at MRPR. More dramatic shifts could occur where environmental factors like hydrology significantly change. A well-publicized example is at Nerstrand Big Woods State Park, where a wetter climate, flat topography, and a shallow clay layer have shifted the community from a mesic to wet-mesic forest. It is unknown if such an example could occur at MRPR, but it is important to monitor for such events and be prepared to respond.

Manage overgrown woodlands and second growth forest to restore more open woodland and savanna conditions

Goals addressed: mitigate harmful changes (1), manage for resilient communities (2)

Oak woodlands and savanna are more resilient to heat, drought, and wind stresses. They were also a dominant plant community at MRPR prior to European settlement.

Selectively and carefully apply assisted migration of plant species or ecotypes that may be climate adaptive

Goals addressed: mitigate harmful changes (1), manage for resilient communities (2)

Assisted migration might include species with historically more southerly ranges or that are suited to projected changes in temperature and precipitation (i.e., maybe not from more southern ranges, but drier climates of western Minnesota or the Dakotas). Example tree species include shagbark hickory and black oak.

Consider a "regional admixture" approach to seed sourcing

Goals addressed: mitigate harmful changes (1), manage for resilient communities (2)

The regional admixture approach tries to balance local ecotypes along with more regional ecotypes to achieve adaptive potential without risking introduction of maladaptive traits from distant locations. No guidelines or species-specific research exists at this time, but The Nature Conservancy has used ranges of 5-50 miles for regional admixtures. To support building adaptive seed mixes, The Nature Conservancy created the "Seeds of Resilience" mapping network for practitioners to locate remnant seed sources through Minnesota, North Dakota, and South Dakota.

Prioritize surface water and groundwater projects throughout the watershed

Goals addressed: mitigate harmful changes (1), manage for resilient communities (2)

Prioritizing surface water and groundwater projects will help mitigate the impacts of increased precipitation variability and severity. For example, restoring plant communities to replace row crop agriculture, will help maintain critical cold-water base flows and lessen the destructive peak runoff events. Simply incorporating a cover crop with row crops may also be beneficial.

4.2.16. Citizen Outreach, Stewardship, and Education

Surveys from the County NRMSP established that the public values a high-quality natural environment and supports conservation and management of natural resources on County lands. The park reserve is an opportunity to showcase an example of valuable natural lands and engage the public in stewardship opportunities.

Goals

1. Increase public interest, natural resource literacy, and support for parks and open space
2. Reduce labor costs and leverage in-kind volunteer match for grants
3. Expand site monitoring and data collection capabilities
4. Provide public benefits of natural resources education and stewardship such as knowledge, exercise, and building community

Strategies

Coordinate with Park Reserve Master Plan to work toward common goals

Addresses all goals.

The Park Reserve Long Range Plan will likely be developed after completion of the NRMP. Coordinate with the Long Range Plan to ensure common goals are shared. Outreach, stewardship, and education are interconnected with broader programmatic goals.

Continue to organize volunteer efforts consistent with current County efforts

Goals addressed: increase public interest and support (1), reduce labor and leverage in-kind match (2), provide benefits of natural resources education and stewardship (4)

The 2017 NRMSP includes a general framework for volunteer programming. Existing County programs existed prior to the NRMSP and have continued to present. Sustain and build upon existing programs along with additional strategies described below.

Develop volunteer opportunities that combine education, outreach, and stewardship

Goals addressed: increase public interest and support (1), reduce labor and leverage in-kind match (2), expand site monitoring/data collection (3), provide benefits of natural resources education and stewardship (4)

Citizen outreach, education, and volunteerism go hand in hand. Citizens are motivated to volunteer time by desires to help the environment, learn about nature, and enhance areas that they enjoy (Ryan et al. 2001). Community education regarding natural resources supports these motivations (Measham and Barnett 2008). Therefore, for MRPR, citizens may be more likely to volunteer time and money to protect the park reserve when they are aware of and understand the unique resources of this site. When they can see the fruits of their labor and are informed about the tangible returns volunteers are making, they are more likely to become sustaining volunteers. When the environment in which they are working is educational and social, volunteers are more apt to commit long-term, spread the work, and become recruiters. An integrated

approach may help further engage the community in stewardship of MRPR and overcome the challenges associated with the recruiting volunteers to a remote park reserve (relative to other County lands).

The Ice Age Trail Alliance (IATA), with its passionate volunteer base, is an organization to emulate. The IATA mission is to conserve, create, maintain, and promote Wisconsin's Ice Age National Scenic Trail. The Ice Age National Scenic Trail is built, supported, and maintained by the IATA with hundreds of passionate volunteers. They donate thousands of hours of time every year to care for the Trail, lead hikes and field trips, and connect with communities near the Trail.

The IATA volunteer success is due in part to the following key strategies, which Dakota County should emulate:

- Provide volunteer training and education
- Maintain dedicated website and social media accounts and content
- Organize system-wide (entire County) with local chapters (by park system)
- Recruit key volunteer 'chapter' leads
- Document and disseminate volunteer accomplishments
- Combine work outings with social gatherings

Pilot a site stewardship program and recruit one to two volunteer site stewards

Goals addressed: reduce labor and leverage in-kind match (2), expand site monitoring/data collection (3), provide benefits of natural resources education and stewardship (4)

The large size, scale of landscape diversity, and remoteness at MRPR lends the park reserve well to a dedicated volunteer site stewardship program that can serve as eyes and ears for managers. The DNR Scientific and Natural Areas program uses a site steward volunteer position to assist in conservation, management, education, and research goals, with guidance from staff. Responsibilities for site stewards are varied but at MRPR could consist of regular (monthly to quarterly) visits to the site, reporting observations from site visits, and learning about and participating in the protection and management goals for a site. Specific task examples could include documenting species phenology within a given area; monitoring live plantings such as plugs that may require maintenance/protection or checking in on deer fencing to ensure it is in good condition. Depending on the success of the programs, responsibilities could be expanded to include project work such as seed collecting or leading volunteer projects.

Given the size of the park reserve, it is recommended to focus initial steward(s) on specific areas of the park reserve or projects. Recruit two stewards if possible and expand the program depending on outcomes. Guidance from park staff should include familiarizing stewards with this NRMP and specific projects, providing means of documenting and reporting observations, and ensuring volunteers are safe and prepared for field conditions. Recruiting could focus on postings at the park reserve, the County web site, and social media, as well as word of mouth. Note that site stewardship differs from 'chapter lads' described in the IATA example above, which are more focused on community coordination and implementation.

Identify MRPR-specific volunteer tasks

Goals addressed: reduce labor and leverage in-kind match (2), expand site monitoring/data collection (3)

Compile a list of specific volunteer tasks for MRPR. Categorize according to characteristics as defined in the NRMSP to describe specifics, scope of staff and volunteer commitment, and performance metrics.

Some example one-time tasks could include:

- Garlic mustard pulls within prioritized areas (see Section 4.2.2)
- Prairie seed collection
- Planting plugs or trees for revegetation projects

Some examples of ongoing tasks include:

- Site stewardship (see above strategy)
- Monitoring restoration infrastructure such as fences and tree protection (cages, bud caps)
- Simple ecological monitoring (such as focused checklist-based plant inventories)
- Oversight of other volunteers

Continue restoration and management of the native plant communities within the park reserve and educating visitors about its ecology and value

Goals addressed: increase public interest and support (1), provide benefits of natural resources education and stewardship (4)

The restoration and management of the native plant communities within the park reserve are the best means of showcasing the immense ecological value of MRPR to visitors and adjacent landowners. High use areas such as existing and proposed trail networks and near the Cannon River picnic area may provide visible examples to highlight unique features or restoration projects. Install and maintain signage that explains and showcases efforts. In-person nature education programming at MRPR could be beneficial at MRPR, but may be limited by the remoteness of site. For this reason, development of self-guided education materialsr maybe practical at MRPR. Use of nature observation mobile applications like iNaturalist continue to grow vigorously, suggesting that the public is interested in interactive ways to engage with nature (Di Cecco et al. 2021). Examples of self-guided education and virtual engagement include the SNA program's virtual tours and Three Rivers Park District production of blog posts and podcasts describing specific projects and management activities.

4.2.17. Partnerships

Partnerships with public and private stakeholders increase project efficiencies and leverage synergies. Strengthening and expanding collaborative relationships and partnerships would advance the successful management of MRPR's natural resources.

Goals

1. Partner with organizations to share resources, leverage funds, and collaborate on funding opportunities
2. Partner with organizations to coordinate and implement projects, including education and volunteerism
3. Partner with private landowners to implement water quality and habitat management projects

Strategies

Continue and expand conservation and restoration project partnership

Goals addressed: partner to share resources andfunds and collaborate on opportunities (1), partner to coordinate and implements (2), partner with private landowners to implement (3).

Continue and expand working with adjacent landowners to protect their lands as a means to improve water quality while increasing core habitat quality and quantity. A partial list of existing and potential partnership organizations is provided below:

- Cannon River Watershed Partnership
- Conservation Corps – Minnesota & Iowa
- Dakota County SWCD
- Friends of Mississippi River
- Gopher Hills Golf Course
- Great River Greening
- Local Governments (Cities and Townships)
- Minnesota DNR
- Minnesota Forest Resources Council
- Minnesota Land Trust
- Minnesota Trout Unlimited
- Minnesota Zoo
- The Nature Conservancy
- North Cannon River Watershed Management Organization
- Pheasants Forever
- Private landowners
- Private tubing/kayak outfitters
- University of Minnesota and other educational institutions

Some specific examples of existing and potential partnerships/collaborations for MRPR include:

- Continuing to work with adjacent and inholding private landowners for access through their properties or for management/restoration activity
- Collaboration on Trout Brook restoration with Minnesota Trout Unlimited and MNDNR
- Water quality BMP implementation with Dakota SWCD and private landowners throughout the Trout Brook subwatershed
- Work with SWCD and NCRWMO to organize field trips for adjacent private landowners to show them how their actions effect the park's features (erosion, sedimentation, water pollution, invasive species).
- Assess potential partnerships with Gopher Hills Golf Course such as potential irrigation water reuse projects.
- Consider forming a Cooperative Weed Management Area (CWMA) to coordinate invasive species management and leverage resources among private landowners, government units, and other interested parties. Eligible grant applicants are SWCDs, frequently in partnership with other organizations.
- Encourage research opportunities to further MRPR interest and advance understanding.

Pursue partnerships to secure management access to park reserve lands

Goals addressed: partner with private landowners to implement (3).

Continue working with private landowners who may provide access to specific lands through adjacent lands and inholdings. Identify priority access routes for management. Further, coordinate the planning of access for resource management with access for recreational development. Balance any increase in accessibility with potential for habitat fragmentation. Prevent diminishment of intact natural communities and 'wilderness experience' that may stem from increased maintenance or visitor traffic.

5. IMPLEMENTATION

5.1. Implementation Overview

The implementation plan outlines costs and timelines for executing the recommended strategies identified for priority features in Section 4. Implementation is based on management units as delineated in Figure 49. There are a total of 46 management units, seven of which comprise inholdings. Subsequent sections describe cost implementation for native plant community, water resources, and wildlife management. Implementation of inventory, assessment, and monitoring is also described.

5.1.1. Costing

An adaptive cost table was developed for the NRMP and used to create the static tables within the implementation plan. The cost table is editable and is based on the management units and mapped plant communities. Editable fields include start year of management and a list of management tools/strategies with adjustable task pricing. This dynamic cost table allows managers to adapt to changing ecological and economic conditions and integrate new strategies appropriately. For example, the implementation plan for high quality remnant bluff and sand-gravel prairies (management units 8A-C) primarily focus on routine management such as prescribed fire and brush removal. However, if progress toward goals such as improving FQI scores is not observed, strategies detailed in the NRMP such as reintroduction of conservative native plant species could be input into the cost table.

Pricing is based on prior County projects and costs incurred for similar projects in the region. Contractor costs were adjusted to account for economies of scale associated with restoration of entire management units rather than discrete sub-units.

5.1.2. Prioritization and Timeline

Management units were prioritized for native plant community management. Approximately 677 acres of upland have already been restored and are under varying levels of baseline management. The remaining areas are prioritized for restoration. Based on the rate of the restoration over the last 24 years, it will take approximately 20 to 30 years to restore the entire park reserve. Costs for native plant community restoration are split into one to five and six to twenty years costs, with understanding that costs (and certainly baseline management) could extend beyond 20 years due to the complexity and size of the park reserve.

Priorities for baseline maintenance included 1) sustaining existing high-quality areas such as remnant bluff prairies and 2) nurturing existing restorations such as recently completed bluff prairie, savanna, and woodland restorations as well as reconstructed blufftop prairies.

Priorities for restoration included 1) sensitive and rare habitats such as overgrown bluff prairies, degraded FDs27, and seepage meadows, 2) prioritizing upstream areas of the watershed that influence downgradient areas, and 3) "low-hanging fruit" restorations such as altered grasslands or riparian areas adjacent to managed areas or priority stream restorations.

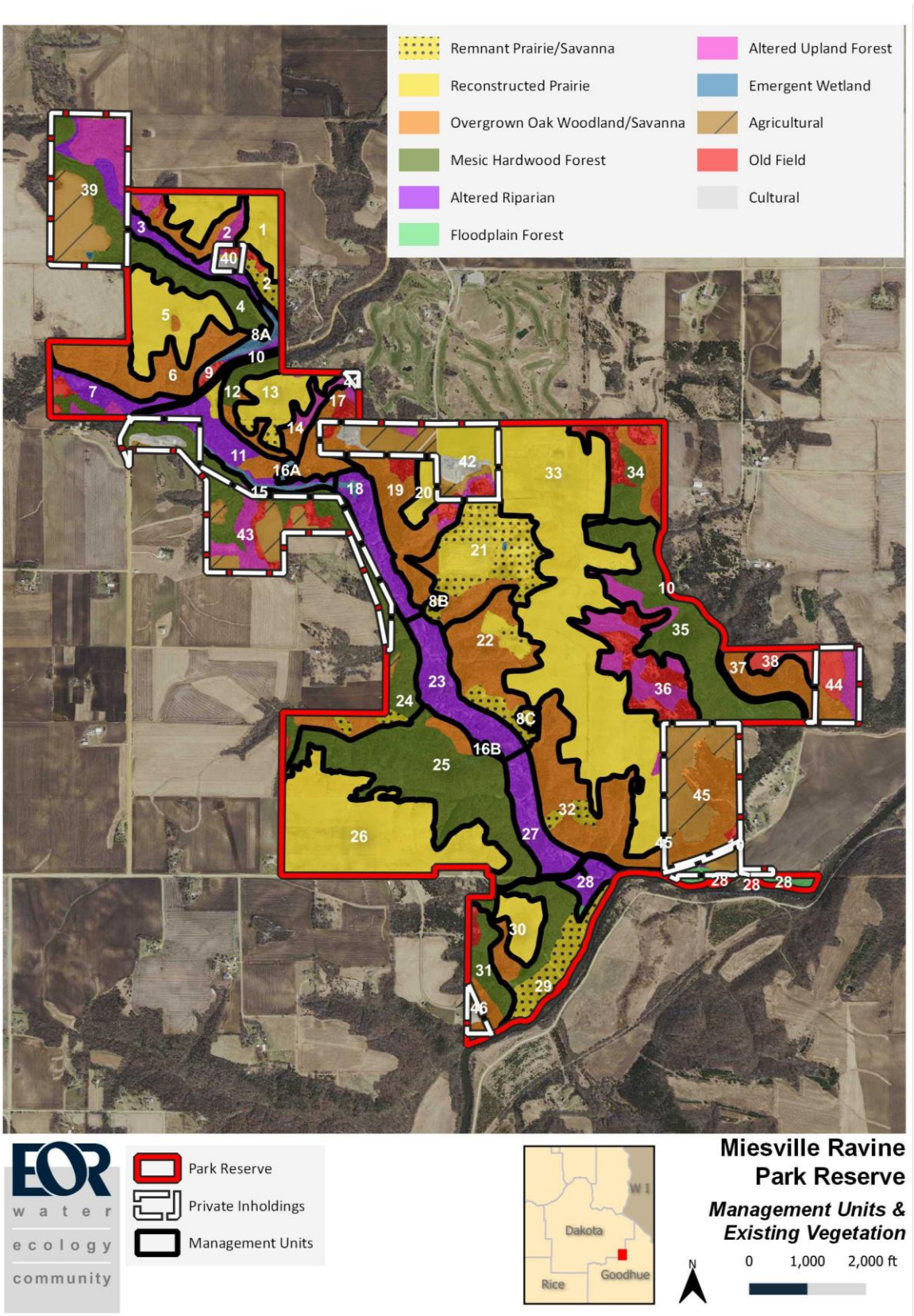


Figure 49, Proposed management units for MRPR.

5.2. Native Plant Community Management

5.2.1. Baseline Management-Units Already Restored

Management of existing high-quality NPCs (e.g., remnant Dry Sand-Gravel Prairie) and restored NPCs (e.g., reconstructed prairies) is ongoing. This management comprises baseline management. Management units were categorized based on their stage of management as either "Maintenance 1" or "Maintenance 2". Maintenance 1 units are those that have only recently been restored and still require some intensive follow-up maintenance such as buckthorn removal, additional woody vegetation management, or supplemental seeding. These primarily consist of completed and ongoing CPL-funded bluff prairie, savanna, and woodland restorations. Maintenance 2 units are those that only require long-term management practices such as routine prescribed burning or invasive spot-treatments.

Table 14. Cost summaries for management units categorized as Maintenance 1. These generally consist of recent bluff prairie, savanna, and woodland restorations that may still require intensive follow-up management.

Management Unit	Acres	Cost Summary YR 1-5	Cost Summary YR 6-28	Total 28 YR Cost Summary
12	17	$106,407	$21,281	$127,688
13	28	$19,559	$3,912	$23,471
20	10	$5,850	$1,170	$7,020
21	69	$111,198	$22,240	$133,437
22	55	$145,330	$29,066	$174,396
32	67	$174,798	$34,960	$209,758
Total	**245**	**$563,143**	**$112,629**	**$675,771**

Table 15. Cost summaries for management units categorized as Maintenance 2. These generally consist of reconstructed prairies or high-quality remnant bluff prairies that require routine management activities such as prescribed burns, haying, or spot-treatments for woody invasion or invasive species.

Management Unit	Acres	Cost Summary YR 1-5	Cost Summary YR 6-28	Total 28 YR Cost Summary
1	35	$21,533	$4,307	$25,840
5	44	$26,575	$5,315	$31,890
8	4	$7,816	$1,563	$9,379
26	113	$69,085	$13,817	$82,903
30	16	$9,922	$1,984	$11,906
33	222	$139,059	$27,812	$166,870
Total	**434**	**$273,990**	**$54,798**	**$328,788**

5.2.2. Native Plant Community Restoration-Units That Have Not Yet Been Restored

Management units in need of plant community restoration were categorized according to their priority. High-priority units should be addressed within the first five years of this plan and include the following: altered riparian areas that could be paired with stream restoration (see Section 5.3), overgrown prairie/savanna remnants, FDs27 woodlands, the Swede Spring seepage meadow, and large contiguous tracts of mesic hardwood forest with spring ephemeral populations. Medium priority units are priorities for restoration over the next six to ten years, and low priority units over years 11-28 (see Table 16).

Table 16. Cost summaries for management units.

Mgmt Unit	Acres	Cost Summary YR 1-5	Cost Summary Yr 6-10	Cost Summary YR 11-28	Maintenance	Inholdings	Total 28-YR Cost Summary
6	46	$244,660			$24,466		$269,126
7	25	$154,770			$30,954		$185,724
8A, B, C	5	$15,000			$5,000		
11	34	$246,419			$49,284		$295,703
18	27	$142,592			$14,259		$156,851
27	26	$58,310			$11,662		$69,971
9	12		$57,712		$11,542		$69,255
14	11		$31,258		$6,252		$37,510
17	20		$112,243		$11,224		$123,467
19	45		$308,361		$61,672		$370,034
23	36		$191,217		$38,243		$229,461
24	38		$214,487		$42,897		$257,385
28	20		$106,943		$10,694		$117,637
29	55		$142,870		$14,287		$157,156
37	21		$158,559		$31,712		$190,270
38	9		$48,290		$9,658		$57,948
16A	2		$7,210		$721		$7,931
16B	2		$5,828		$1,166		$6,994
2	30			$150,688	$15,069		$165,756
3	14			$72,656	$14,531		$87,187
4	27			$82,649	$8,265		$90,914
15	10			$30,586	$3,059		$33,645

25	111			$751,884	$150,377		$902,261
31	24			$139,596	$13,960		$153,556
34	45			$268,790	$26,879		$295,669
35	82			$434,502	$43,450		$477,952
36	47			$345,950	$34,595		$380,545
39*	79					$394,736	$394,736
40*	5					$23,469	$23,469
41*	1					$5,389	$5,389
42*	57					$213,592	$213,592
43*	86					$386,237	$386,237
44*	23					$135,020	$135,020
45*	78					$393,736	$393,736
46*	4					$25,073	$25,073
10**	14			N/A	N/A		N/A
Total	**1171**	**$861,751**	**$1,384,978**	**$2,277,301**	**$829,264**	**$1,433,865**	**$6,787,160**

*Inholding; **Roads

Silene nivea, Snowy Campion, in the Trout Brook Riparian Corridor and Beyond

Silene nivea (*S. nivea*) was found in the Trout Brook riparian corridor just prior to commencement of stream restoration construction activities for Phase 2 of the stream restoration by MN Trout Unlimited (TU) in September, 2023. Due to the rare status of this species, state-endangered, special management efforts will be necessary, moving forward. As part of the "take permit" granted by the MN DNR to TU, there are certain requirements that must be met by TU.

<u>During the course of stream restoration, the following were required:</u>

- **Avoidance of *S nivea*** and a 10 foot buffer area
- **Blanding's turtle avoidance**, including inspecting site for turtles before construction begins each morning
- **Agent training** -- prior to construction, crew will be given environmental compliance training and must thoroughly understand all conditions of this permit
- **Relocation** of *S. nivea* outside the avoidance areas by harvesting sod mats with an excavator bucket, and then reinstalling them at the edge of the construction limits
- **Restoration** of vegetation in the stream corridor that will contain a seed mix approved by the DNR Regional Plant Ecologist
- **Propagation** in the form of harvesting *S. nivea* seed prior to construction, in coordination with U of MN Landscape Arboretum and Dakota County Parks

After stream restoration construction is finished, the following will be required. Items highlighted in yellow need to be coordinated with Dakota County staff.

- No in-stream use of **heavy equipment** in pools after October 15
- **Monitoring**, in coordination with U of MN Landscape Arboretum and Dakota County Parks, will conduct post-construction botanical surveys of MRPR for *S. nivea* in year 1, 2, and 3 post project construction, where surveys will document the number and locations of S nivea in the park.
- **Additional measures**, such that if the number of *S. nivea* plants documented in the third year of monitoring is less than 500 plants (ramets) within the project area, TU, in coordination with U of MN and Dak Co Parks, will conduct additional seed collection and propagation efforts to the satisfaction of the DNR.
- **Invasive species management**, in that TU will conduct invasive species control across the project area to improve growing conditions for *S. nivea*, and only hand-pulling/cutting/digging of invasive species will be implemented within 10 feet of rare plants; and no herbicide treatment may occur in areas less than 10 feet from s. nivea without further DNR approval.
- **Habitat management**, such that the stream restoration project area will be protected and managed to maintain suitable habitat conditions for *S. nivea* in the long term.
- **Invasive species prevention**, in accordance with DNR procedures, TU shall prevent invasive species from entering into or spreading within a site, for example, by cleaning equipment and clothing before entering work areas and before moving between construction areas.
- **Reporting**, whereas TU will submit a report to the Endangered Species Consultant by January 31 following construction of the project, in which any deviations from the work anticipated in the application will be described. Additional monitoring reports will be provided by January 31, after each post-construction survey, documenting the condition of restoration of the project area and detailing the park-wide *S. nivea* surveys and invasive species control efforts.
- **Permit lasts until December 31, 2028**

5.3. Water Resources Management

Water resources management projects for implementation include several stream restorations along Trout Brook (Table 16). Implementation of projects within the greater Trout Brook subwatershed is also an NRMP priority that incurs operational costs and costs associated with specific projects.

Table 16. Estimated costs for remaining Trout Brook stream restorations.

Reach Description	Stream Length (linear feet)	Construction Cost
Tributary (perennial flow north of CR91)	1,100	$49,500
Trout Brook (upstream of CR91 to spring)	2,300	$195,500
Trout Brook (management unit 23)	5,000	$425,000
Trout Brook (management unit 27 downstream to Orlando)	3,650	$310,250
Total Construction Cost		**$980,250**
Engineering Fees (lumped into single project)		**$275,000**
Total	**12,050 linear feet**	**$1,255,250**

5.4. Wildlife Management

The primary wildlife management task is ongoing deer management such as the annual deer hunt and aerial surveys. Wildlife inventory, assessment, and monitoring tasks are discussed in Section 5.4 and could potentially spur taxa-specific projects not included in implementation. Bison reintroduction is a potential strategy at MRPR. Costs to implement bison reintroduction at Spring Lake Park Reserve were approximately $1.2 million, with a large portion cost-shared. Other wildlife projects may be implemented, for example, bull snake reintroduction or beaver reintroduction, but the specific projects and costs are yet to be determined.

Table 17. Cost estimates for ongoing wildlife management projects.

Task	Cost YR 1-5	Cost YR 6-20	Total 20 YR Cost
Continued deer management	$25,000	$110,000	$135,000
Wildlife Projects	$20,000	$100,000	$120,000
Totals	**$45,000**	**$210,000**	**$255,000**

5.5. Inventory, Assessment, and Monitoring

Several lump sum inventory and assessment tasks are identified as strategies to achieve NRMP goals for native plant communities, water resources, and wildlife. Long-term monitoring protocols are provided in Appendix D.

Table 18. Native plant community assessment and inventory tasks identified in the NRMP.

Task	Cost
Map garlic mustard park-reserve wide	$5,000
Map spring ephemerals	$5,000
Assess and map priority prairie remnants	$5,000
Seepage meadow floristic inventories and geomorphic assessments	$6,500
Map cliff and rock outcrop plant communities	$5,000
Total	**$26,500**

Table 19. Water resources assessment and inventory tasks identified in the NRMP.

Task	Cost
Ravine assessment and catchment delineation	$8,000
Total	**$8,000**

Table 20. Wildlife assessment and inventory tasks identified in the NRMP.

Task	Cost
Blanding's turtle habitat assessment	$5,000
Rare species reintroduction assessments	$20,000
Fish habitat assessment	$8,000
Beaver reintroduction assessment tool	$2,000
Total	**$53,000**

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APPENDIX A. HISTORICAL AERIAL PHOTOGRAPHS

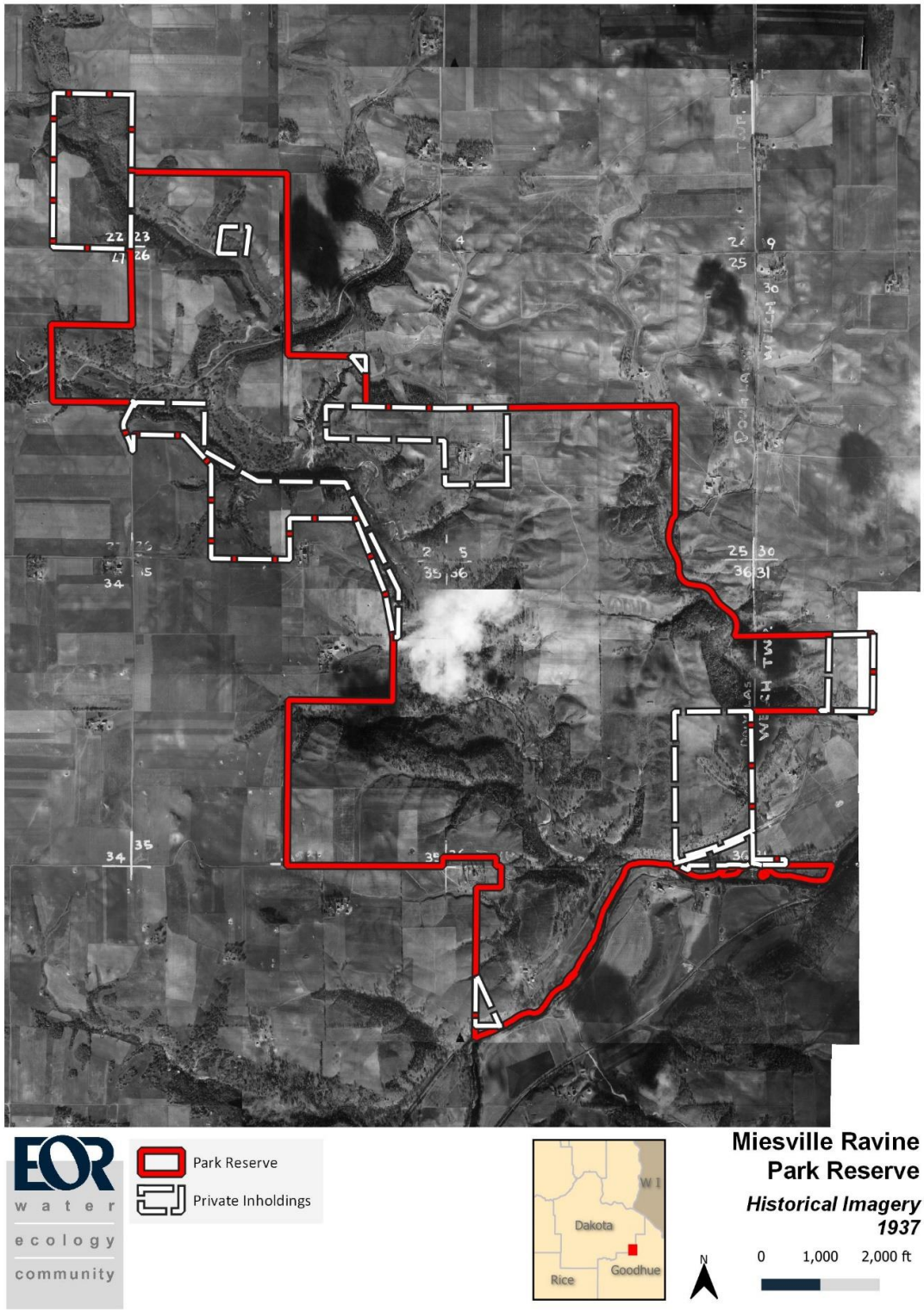

Figure 50: 1937 aerial photograph of present day MRPR.

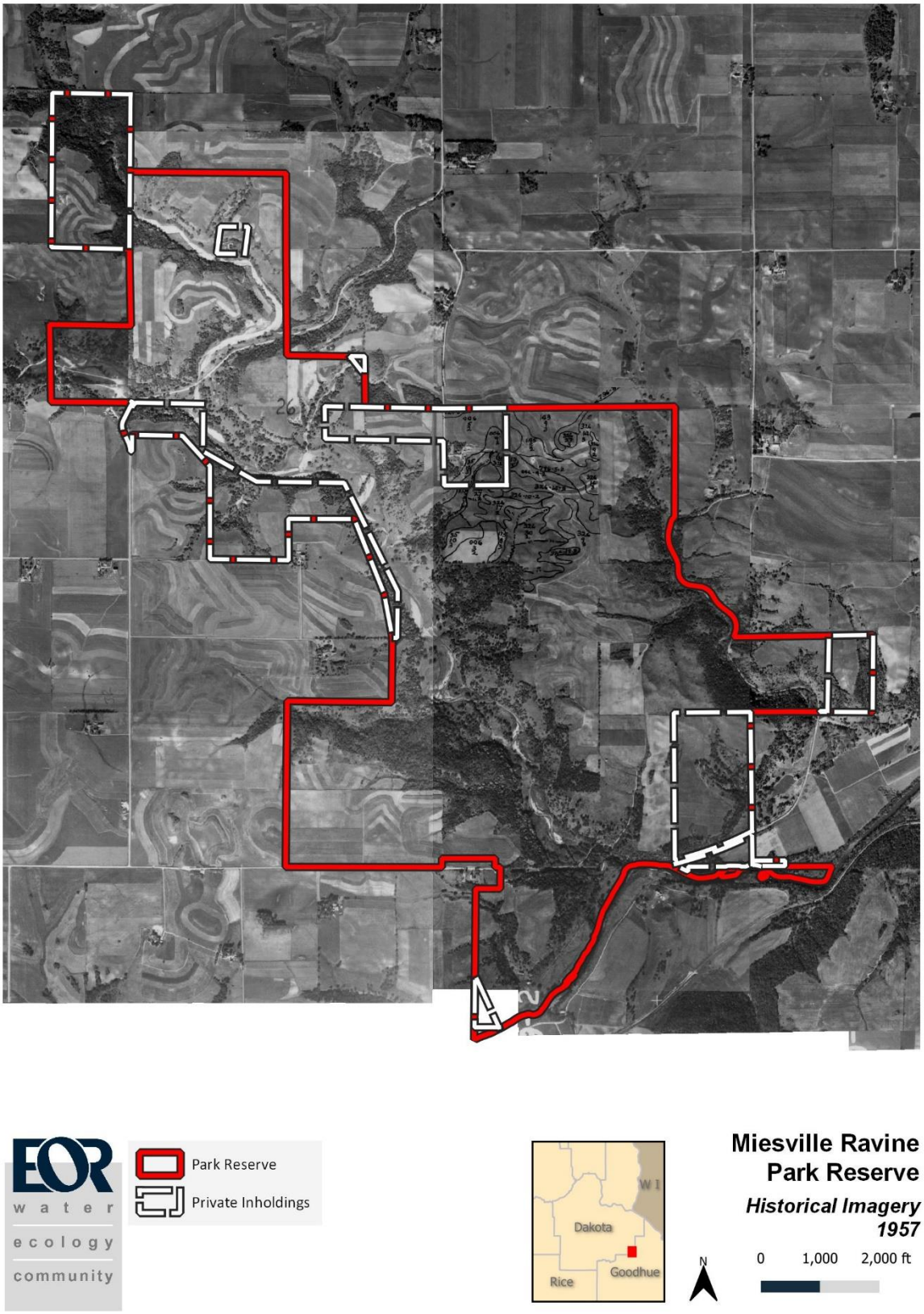

Figure 51: 1957 aerial photograph of present day MRPR.

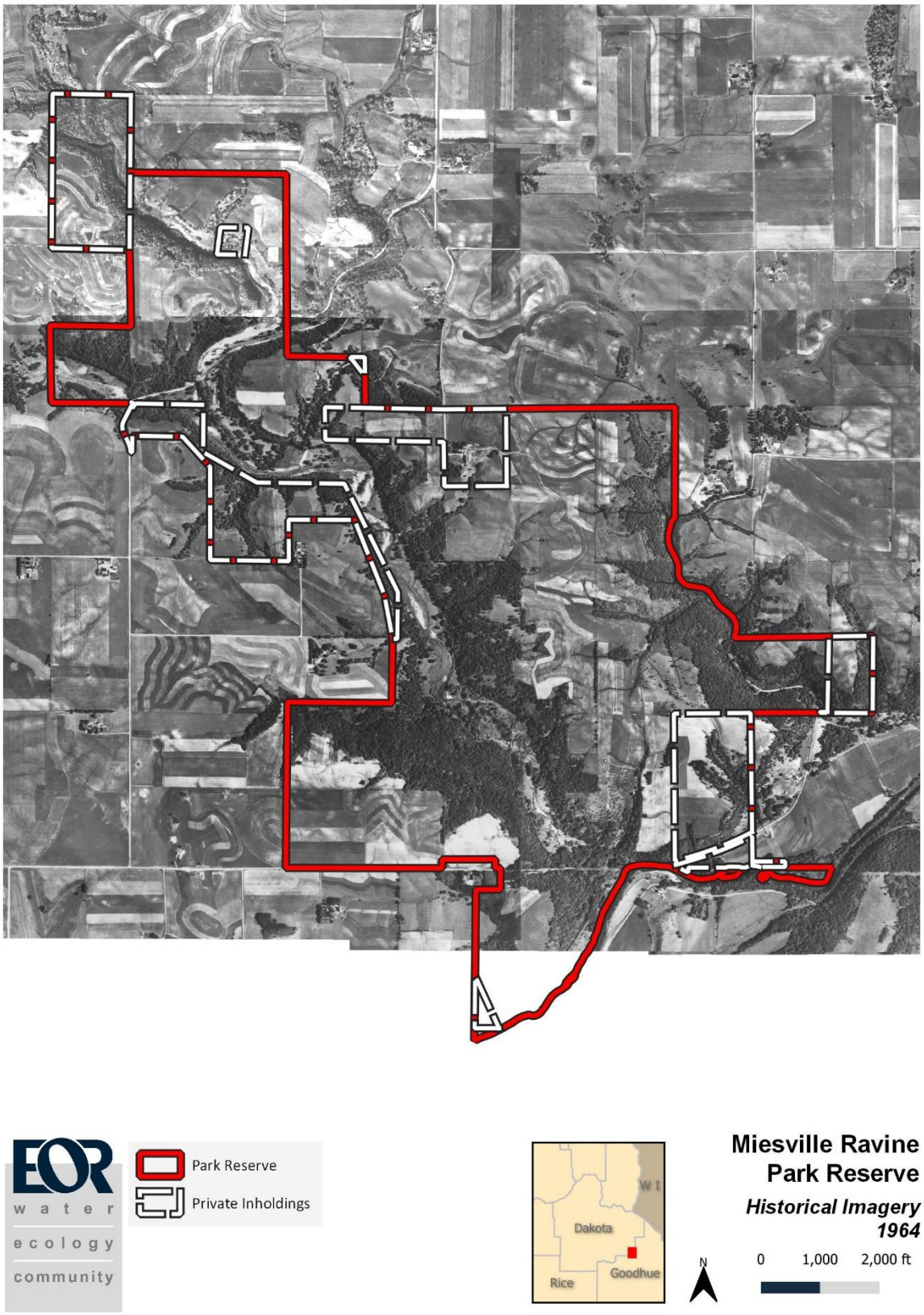

Figure 52: 1964 aerial photograph of present day MRPR.

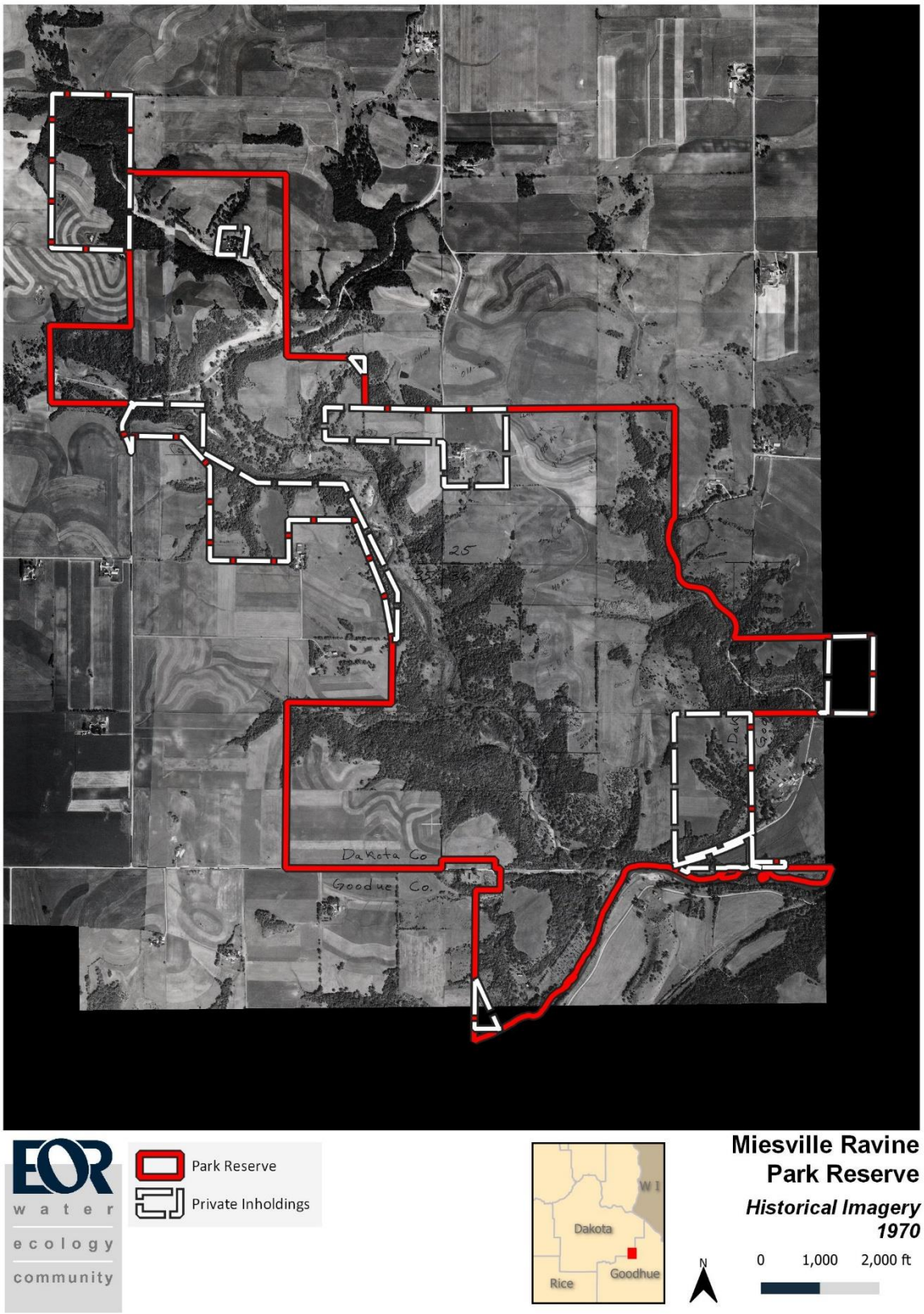

Figure 53: 1970 aerial photograph of present day MRPR.

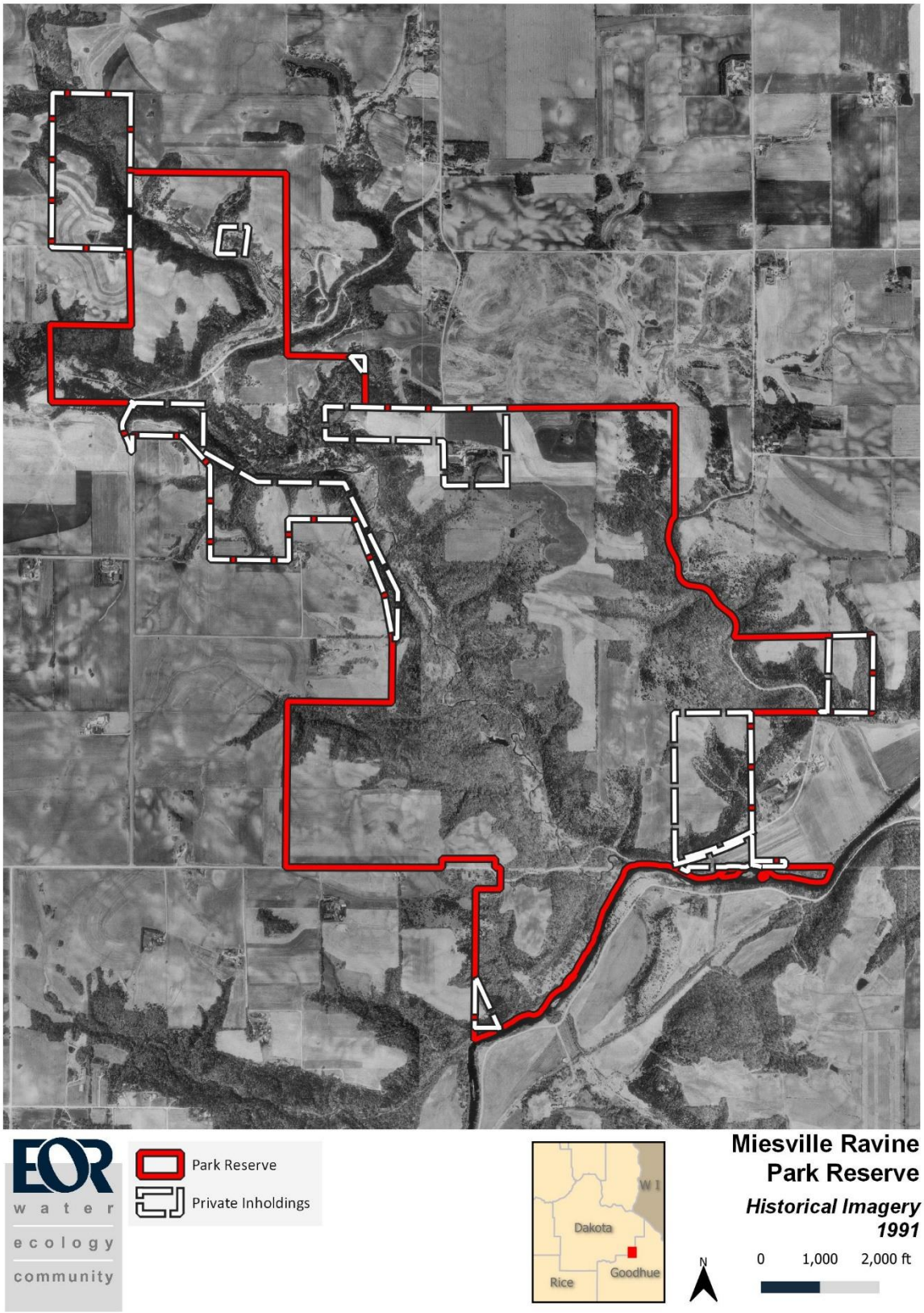

Figure 54: 1991 aerial photograph of present day MRPR.

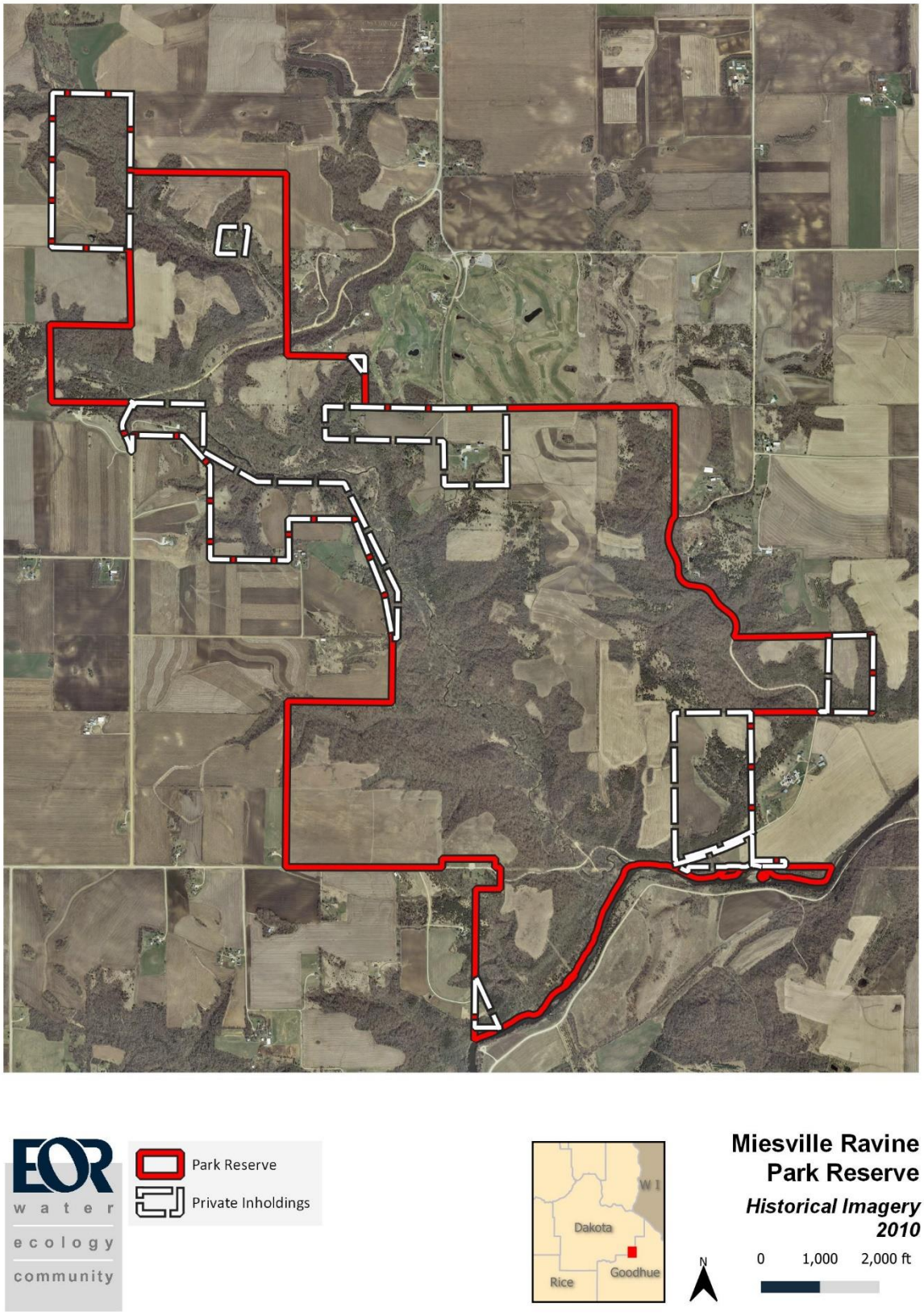

Figure 55: 2010 aerial photograph of present day MRPR.

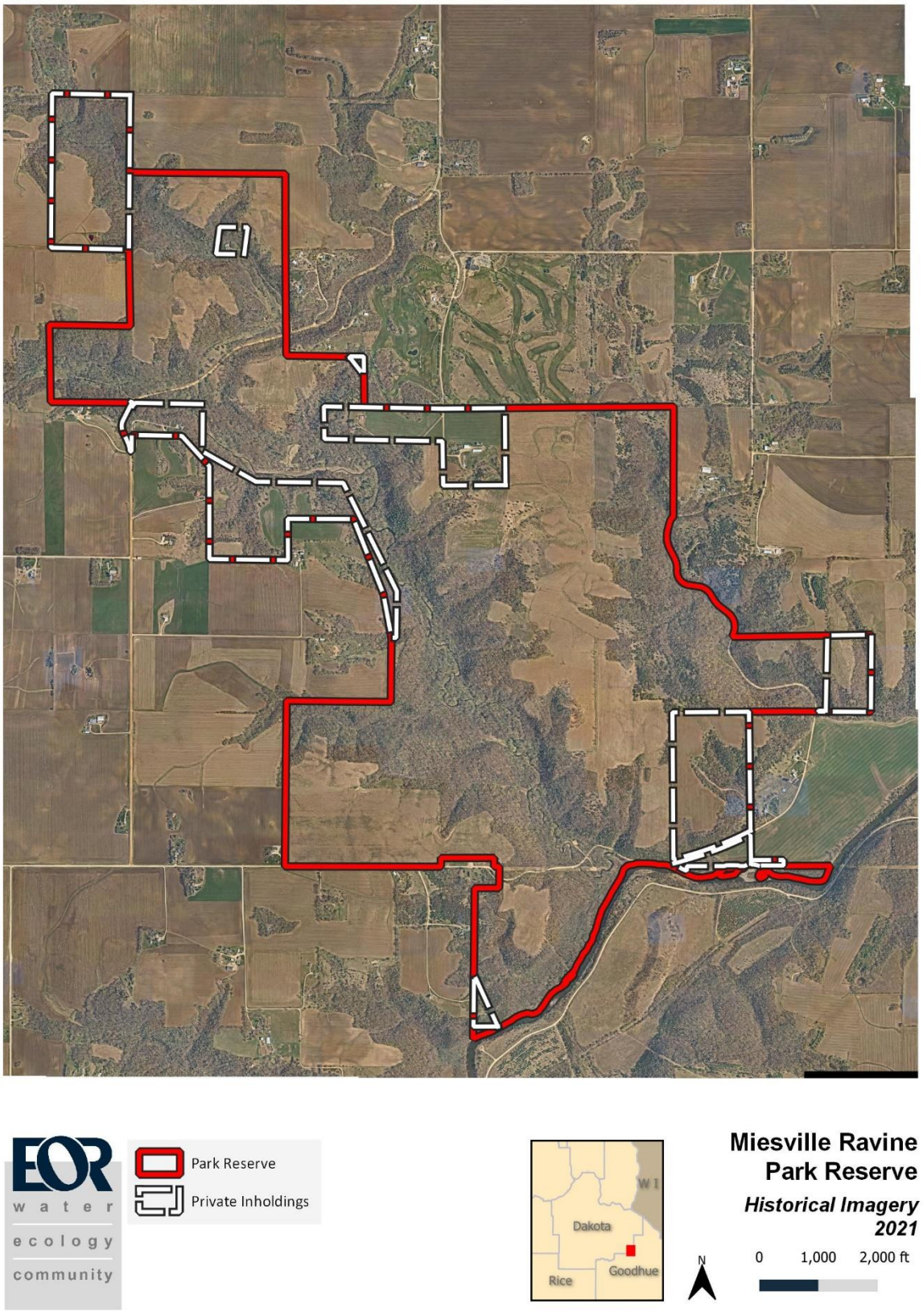

Figure 56. 2021 aerial photograph of present day MRPR.

APPENDIX B. BIRD SPECIES LIST

Species	SGCN	Scientific Name
Cackling Goose		*Branta hutchinsii*
Canada Goose		*Branta canadensis*
Mute Swan		*Cygnus olor*
Trumpeter Swan	X	*Cygnus buccinator*
Tundra Swan		*Cygnus columbianus*
Wood Duck		*Aix sponsa*
American Black Duck	X	*Anas rubripes*
Mallard		*Anas platyrhynchos*
Blue-winged Teal		*Spatula discors*
Northern Shoveler		*Spatula clypeata*
Northern Pintail	X	*Anas acuta*
Green-winged Teal		*Anas crecca*
Ring-necked Duck		*Aythya collaris*
Greater Scaup		*Aythya marila*
Lesser Scaup	X	*Aythya affinis*
Bufflehead		*Bucephala albeola*
Common Goldeneye		*Bucephala clangula*
Hooded Merganser		*Lophodytes cucullatus*
Common Merganser	X	*Mergus merganser*
Ruddy Duck		*Oxyura jamaicensis*
Ring-necked Pheasant		*Phasianus colchicus*
Ruffed Grouse		*Bonasa umbellus*
Wild Turkey		*Meleagris gallopavo*
Pied-billed Grebe		*Podilymbus podiceps*
Double-crested Cormorant		*Phalacrocorax auritus*
Great Blue Heron		*Ardea herodias*
Green Heron		*Butorides virescens*
Black-crowned Night-Heron	X	*Nycticorax nycticorax*
Great Egret		*Ardea alba*

Turkey Vulture		*Cathartes aura*
Osprey		*Pandion haliaetus*
Bald Eagle		*Haliaeetus leucocephalus*
Northern Harrier	X	*Circus hudsonius*
Sharp-shinned Hawk		*Accipiter striatus*
Cooper's Hawk		*Accipiter cooperii*
Red-shouldered Hawk	X	*Buteo lineatus*
Broad-winged Hawk		*Buteo platypterus*
Red-tailed Hawk		*Buteo jamaicensis*
Rough-legged Hawk		*Buteo lagopus*
Golden Eagle		*Aquila chrysaetos*
Sora		*Porzana carolina*
American Coot		*Fulica americana*
Sandhill Crane		*Antigone canadensis*
Black-bellied Plover		*Pluvialis squatarola*
Killdeer		*Charadrius vociferus*
Spotted Sandpiper		*Actitis macularius*
Solitary Sandpiper		*Tringa solitaria*
Greater Yellowlegs	X	*Tringa melanoleuca*
Lesser Yellowlegs		*Tringa flavipes*
Hudsonian Godwit	X	*Limosa haemastica*
Least Sandpiper		*Calidris minutilla*
Pectoral Sandpiper		*Calidris melanotos*
Semipalmated Sandpiper	X	*Calidris pusilla*
American Woodcock	X	*Scolopax minor*
Wilson's Snipe		*Gallinago delicata*
Ring-billed Gull		*Larus delawarensis*
Rock Pigeon		*Columba livia*
Eurasian Collared-Dove		*Streptopelia decaocto*
Mourning Dove		*Zenaida macroura*
Yellow-billed Cuckoo	X	*Coccyzus americanus*
Black-billed Cuckoo	X	*Coccyzus erythropthalmus*

Eastern Screech-Owl		*Megascops asio*
Great Horned Owl		*Bubo virginianus*
Barred Owl		*Strix varia*
Long-eared Owl		*Asio otus*
Northern Saw-whet Owl		*Aegolius acadicus*
Common Nighthawk	X	*Chordeiles minor*
Eastern Whip-poor-will	X	*Antrostomus vociferus*
Chimney Swift	X	*Chaetura pelagica*
Ruby-throated Hummingbird		*Archilochus colubris*
Belted Kingfisher	X	*Megaceryle alcyon*
Red-headed Woodpecker	X	*Melanerpes erythrocephalus*
Red-bellied Woodpecker		*Melanerpes carolinus*
Yellow-bellied Sapsucker		*Sphyrapicus varius*
Downy Woodpecker		*Picoides pubescens*
Hairy Woodpecker		*Picoides villosus*
Northern Flicker		*Colaptes auratus*
Pileated Woodpecker		*Dryocopus pileatus*
American Kestrel	X	*Falco sparverius*
Merlin		*Falco columbarius*
Olive-sided Flycatcher	X	*Contopus cooperi*
Eastern Wood-Pewee		*Contopus virens*
Yellow-bellied Flycatcher		*Empidonax flaviventris*
Acadian Flycatcher	X	*Empidonax virescens*
Alder Flycatcher		*Empidonax alnorum*
Willow Flycatcher		*Empidonax traillii*
Least Flycatcher		*Empidonax minimus*
Eastern Phoebe		*Sayornis phoebe*
Great Crested Flycatcher		*Myiarchus crinitus*
Western Kingbird	X	*Tyrannus verticalis*
Eastern Kingbird		*Tyrannus tyrannus*
Northern Shrike		*Lanius borealis*
Bell's Vireo	X	*Vireo bellii*

Yellow-throated Vireo		*Vireo flavifrons*
Blue-headed Vireo		*Vireo solitarius*
Warbling Vireo		*Vireo gilvus*
Philadelphia Vireo	X	*Vireo philadelphicus*
Red-eyed Vireo		*Vireo olivaceus*
Blue Jay		*Cyanocitta cristata*
American Crow		*Corvus brachyrhynchos*
Common Raven		*Corvus corax*
Horned Lark		*Eremophila alpestris*
Purple Martin	X	*Progne subis*
Tree Swallow		*Tachycineta bicolor*
Northern Rough-winged Swallow	X	*Stelgidopteryx serripennis*
Bank Swallow		*Riparia riparia*
Cliff Swallow		*Petrochelidon pyrrhonota*
Barn Swallow		*Hirundo rustica*
Black-capped Chickadee		*Poecile atricapillus*
Tufted Titmouse		*Baeolophus bicolor*
Red-breasted Nuthatch		*Sitta canadensis*
White-breasted Nuthatch		*Sitta carolinensis*
Brown Creeper		*Certhia americana*
House Wren		*Troglodytes aedon*
Winter Wren	X	*Troglodytes hiemalis*
Sedge Wren	X	*Cistothorus platensis*
Marsh Wren		*Cistothorus palustris*
Carolina Wren		*Thryothorus ludovicianus*
Blue-gray Gnatcatcher		*Polioptila caerulea*
Golden-crowned Kinglet		*Regulus satrapa*
Ruby-crowned Kinglet		*Regulus calendula*
Eastern Bluebird		*Sialia sialis*
Townsend's Solitaire		*Myadestes townsendi*
Veery	X	*Catharus fuscescens*
Gray-cheeked Thrush		*Catharus minimus*

Swainson's Thrush		*Catharus ustulatus*
Hermit Thrush		*Catharus guttatus*
Wood Thrush	X	*Hylocichla mustelina*
American Robin		*Turdus migratorius*
Gray Catbird		*Dumetella carolinensis*
Brown Thrasher	X	*Toxostoma rufum*
European Starling		*Sturnus vulgaris*
Cedar Waxwing		*Bombycilla cedrorum*
Lapland Longspur		*Calcarius lapponicus*
Snow Bunting		*Plectrophenax nivalis*
Ovenbird		*Seiurus aurocapilla*
Louisiana Waterthrush	X	*Parkesia motacilla*
Northern Waterthrush		*Parkesia noveboracensis*
Golden-winged Warbler	X	*Vermivora chrysoptera*
Blue-winged Warbler		*Vermivora cyanoptera*
Black-and-white Warbler		*Mniotilta varia*
Prothonotary Warbler	X	*Protonotaria citrea*
Tennessee Warbler		*Oreothlypis peregrina*
Orange-crowned Warbler		*Leiothlypis celata*
Nashville Warbler		*Oreothlypis ruficapilla*
Connecticut Warbler	X	*Oporornis agilis*
Mourning Warbler		*Geothlypis philadelphia*
Common Yellowthroat		*Geothlypis trichas*
American Redstart		*Setophaga ruticilla*
Cape May Warbler	X	*Setophaga tigrina*
Cerulean Warbler	X	*Setophaga cerulea*
Northern Parula		*Setophaga americana*
Magnolia Warbler		*Setophaga magnolia*
Bay-breasted Warbler	X	*Setophaga castanea*
Blackburnian Warbler		*Setophaga fusca*
Yellow Warbler		*Setophaga petechia*
Chestnut-sided Warbler		*Setophaga pensylvanica*

Blackpoll Warbler		*Setophaga striata*
Black-throated Blue Warbler	X	*Setophaga caerulescens*
Palm Warbler		*Setophaga palmarum*
Pine Warbler		*Setophaga pinus*
Yellow-rumped Warbler		*Setophaga coronata*
Black-throated Green Warbler		*Setophaga virens*
Canada Warbler		*Cardellina canadensis*
Wilson's Warbler		*Cardellina pusilla*
Eastern Towhee	X	*Pipilo erythrophthalmus*
American Tree Sparrow		*Spizelloides arborea*
Chipping Sparrow		*Spizella passerina*
Clay-colored Sparrow		*Spizella pallida*
Field Sparrow	X	*Spizella pusilla*
Vesper Sparrow		*Pooecetes gramineus*
Lark Sparrow	X	*Chondestes grammacus*
Savannah Sparrow		*Passerculus sandwichensis*
Grasshopper Sparrow	X	*Ammodramus savannarum*
Henslow's Sparrow	X	*Ammodramus henslowii*
LeConte's Sparrow	X	*Ammodramus leconteii*
Fox Sparrow		*Passerella iliaca*
Song Sparrow		*Melospiza melodia*
Lincoln's Sparrow		*Melospiza lincolnii*
Swamp Sparrow		*Melospiza georgiana*
White-throated Sparrow		*Zonotrichia albicollis*
Harris's Sparrow		*Zonotrichia querula*
White-crowned Sparrow		*Zonotrichia leucophrys*
Dark-eyed Junco		*Junco hyemalis*
Scarlet Tanager		*Piranga olivacea*
Northern Cardinal		*Cardinalis cardinalis*
Rose-breasted Grosbeak		*Pheucticus ludovicianus*
Indigo Bunting		*Passerina cyanea*
Dickcissel	X	*Spiza americana*

Bobolink	X	*Dolichonyx oryzivorus*
Red-winged Blackbird		*Agelaius phoeniceus*
Eastern Meadowlark	X	*Sturnella magna*
Rusty Blackbird		*Euphagus carolinus*
Common Grackle		*Quiscalus quiscula*
Brown-headed Cowbird		*Molothrus ater*
Orchard Oriole		*Icterus spurius*
Baltimore Oriole		*Icterus galbula*
Purple Finch	X	*Haemorhous purpureus*
House Finch		*Haemorhous mexicanus*
Pine Siskin		*Spinus pinus*
American Goldfinch		*Spinus tristis*
House Sparrow		*Passer domesticus*

APPENDIX C. LEPIDOPTERA SPECIES LISTS

Moths

The following table is sorted by habitat, then by family, and lastly by species. Habitat types are grouped and color-coded by shading.

Family	Species	Habitat	Other Data
Nymphalidae	Nymphalis antiopa (Linnaeus, 1758)	clearing in stream valley bottom mesic deciduous woodland	ex. rotten banana-brown sugar bait; 12:25pm; 21°C; sunny/light to moderate wind; 2+ observed 10:30am-12pm
Pieridae	Pieris rapae (Linnaeus, 1758)	clearing in stream valley bottom mesic deciduous woodland	working Berteroa incana flowers; 2:05pm; 32°C; mostly sunny/light wind; 20+ observed 11am-4:15pm
Depressariidae	Semioscopis aurorella Dyar, 1902	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Depressariidae	Semioscopis inornata Walsingham, 1882	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Depressariidae	Semioscopis megamicrella Dyar, 1902	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Erebidae	Phoberia atomaris Hübner, 1818	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Gelechiidae	Coleotechnites quercivorella (Chambers, 1872)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Gelechiidae	Sinoe chambersi Lee, 2012	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Gelechiidae	Xenolechia velatella (Busck, 1907)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Geometridae	Eupithecia sp.	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night

Geometridae	Lycia ursaria (Walker, 1860)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Geometridae	Paleacrita merriccata Dyar, [1903]	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Geometridae	Paleacrita vernata (Peck, 1795)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Geometridae	Phigalia strigataria (Minot, 1869)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Geometridae	Phigalia titea (Cramer, [1780])	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Noctuidae	Cerastis tenebrifera (Walker, 1865)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Noctuidae	Copivaleria grotei (Morrison, 1874)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Noctuidae	Lithophane bethunei (Grote & Robinson, 1868)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Noctuidae	Lithophane hemina Grote, 1874	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Noctuidae	Lithophane petulca Grote, 1874	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Noctuidae	Lithophane semiusta Grote, 1874	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Noctuidae	Lithophane unimoda (Lintner, 1878)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Noctuidae	Orthosia alurina (Smith, 1902)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Noctuidae	Orthosia garmani (Grote, 1879)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Noctuidae	Orthosia garmani (Grote, 1879)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Noctuidae	Orthosia hibisci (Guenée, 1852)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Noctuidae	Psaphida resumens Walker, 1865	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Noctuidae	Psaphida rolandi Grote, 1874	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night

Sphingidae	Deidamia inscriptum (Harris, 1839)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Tortricidae	Acleris subnivana (Walker, 1863)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Tortricidae	Epinotia zandana (Kearfott, 1907)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Tortricidae	Pseudexentera oregonana (Walsingham, 1879)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Tortricidae	Pseudexentera sepia Miller, 1986	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Tortricidae	Pseudexentera spoliana (Clemens, 1864)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Tortricidae	Pseudexentera spoliana (Clemens, 1864)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Tortricidae	Pseudexentera spoliana (Clemens, 1864)	dry bluff prairie bordering dry-mesic deciduous woodland/Juniperus groves; above stream valley	MV sheet; 10-2°C; clear/calm night
Depressariidae	Semioscopis aurorella Dyar, 1902	dry-mesic deciduous woodland bordering tallgrass prairie restoration; near bluff prairie	ex. rotten banana-brown sugar bait; 10-2°C; clear/calm night
Noctuidae	Eupsilia morrisoni (Grote, 1874)	dry-mesic deciduous woodland bordering tallgrass prairie restoration; near bluff prairie	ex. rotten banana-brown sugar bait; 10-2°C; clear/calm night
Noctuidae	Eupsilia vinulenta (Grote, 1864)	dry-mesic deciduous woodland bordering tallgrass prairie restoration; near bluff prairie	ex. rotten banana-brown sugar bait; 10-2°C; clear/calm night
Noctuidae	Lithophane antennata (Walker, 1858)	dry-mesic deciduous woodland bordering tallgrass prairie restoration; near bluff prairie	ex. rotten banana-brown sugar bait; 10-2°C; clear/calm night
Noctuidae	Lithophane bethunei (Grote & Robinson, 1868)	dry-mesic deciduous woodland bordering tallgrass prairie restoration; near bluff prairie	ex. rotten banana-brown sugar bait; 10-2°C; clear/calm night
Noctuidae	Lithophane hemina Grote, 1874	dry-mesic deciduous woodland bordering tallgrass prairie restoration; near bluff prairie	ex. rotten banana-brown sugar bait; 10-2°C; clear/calm night
Noctuidae	Lithophane scottae Troubridge, 2006	dry-mesic deciduous woodland bordering tallgrass prairie restoration; near bluff prairie	ex. rotten banana-brown sugar bait; 10-2°C; clear/calm night

Noctuidae	Orthosia alurina (Smith, 1902)	dry-mesic deciduous woodland bordering tallgrass prairie restoration; near bluff prairie	ex. rotten banana-brown sugar bait; 10-2°C; clear/calm night
Noctuidae	Orthosia hibisci (Guenée, 1852)	dry-mesic deciduous woodland bordering tallgrass prairie restoration; near bluff prairie	ex. rotten banana-brown sugar bait; 10-2°C; clear/calm night
Noctuidae	Orthosia rubescens (Walker, 1865)	dry-mesic deciduous woodland bordering tallgrass prairie restoration; near bluff prairie	ex. rotten banana-brown sugar bait; 10-2°C; clear/calm night
Noctuidae	Pyreferra pettiti (Grote, 1874)	dry-mesic deciduous woodland bordering tallgrass prairie restoration; near bluff prairie	ex. rotten banana-brown sugar bait; 10-2°C; clear/calm night
Noctuidae	Xylena curvimacula (Morrison, 1874)	dry-mesic deciduous woodland bordering tallgrass prairie restoration; near bluff prairie	ex. rotten banana-brown sugar bait; 10-2°C; clear/calm night
Tortricidae	Acleris flavivittana (Clemens, 1864)	dry-mesic deciduous woodland bordering tallgrass prairie restoration; near bluff prairie	ex. rotten banana-brown sugar bait; 10-2°C; clear/calm night
Nymphalidae	Speyeria aphrodite (Fabricius, 1787)	dry-mesic Quercus savanna bordering deciduous woodland, tallgrass prairie restoration, and dry bluff prairie	flushed during overcast spell; 12:50pm; 31-32°C; mostly sunny/light wind; 3+ observed 11am-4:15pm
Geometridae	Archiearis infans (Möschler, 1862)	dry-mesic tallgrass prairie restoration bordering deciduous woodland/Juniperus groves	basking/tippling on damp areas of sand/dirt 2-track; 10:40am; 11-12°C; sunny/light wind; 5 observed 9am-4pm
Geometridae	Archiearis infans (Möschler, 1862)	dry-mesic tallgrass prairie restoration bordering deciduous woodland/Juniperus groves	tippling on damp soil along 2-track; 10:55am; 17-18°C; sunny/light wind; 3 observed 10:30am-12pm
Nymphalidae	Speyeria cybele (Fabricius, 1775)	dry-mesic tallgrass prairie restoration bordering deciduous woodland/Juniperus groves	flying along prairie edge; 4:45pm; 30-31°C; mostly sunny/windy; 1 observed 3:15pm-5pm
Nymphalidae	Speyeria aphrodite (Fabricius, 1787)	dry-mesic tallgrass prairie restoration; near hilly deciduous woodland	working Cirsium discolor flowers, faint overcast spell; 1:05pm; 32°C; mostly sunny/light to moderate wind; 3+ observed 11am-4:15pm

Lycaenidae	Cupido comyntas (Godart, [1824])	gently rolling dry-mesic tallgrass prairie restoration	flushed; 1:15pm; 32°C; mostly sunny/light to moderate wind; 3 observed 11am-4:15pm
Crambidae	Elophila obliteralis (Walker, 1859)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Crambidae	Scoparia biplagialis Walker, 1866	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Crambidae	Udea rubigalis (Guenée, 1854)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Erebidae	Idia aemula Hübner, 1814	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Erebidae	Idia americalis (Guenée, 1854)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Erebidae	Mocis latipes (Guenée, 1852)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Erebidae	Orgyia leucostigma (J.E. Smith, 1797)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Gelechiidae	Chionodes thoraceochrella (Chambers, 1872)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Gelechiidae	Unidentified Gelechiidae	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Abagrotis anchocelioides (Guenée, 1852)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Abagrotis cupida (Grote, 1865)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Abagrotis cupida (Grote, 1865)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Agnorisma badinodis (Grote, 1874)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Agrotis venerabilis Walker, [1857]	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Allagrapha aerea (Hübner, [1803])	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind

Noctuidae	Amphipyra pyramidoides Guenée, 1852	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Eucirroedia pampina (Guenée, 1852)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Euxoa niveilinea (Grote, 1882)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Galgula partita Guenée, 1852	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Helicoverpa zea (Boddie, 1850)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Nephelodes minians Guenée, 1852	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Papaipema rigida (Grote, 1877)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Rachiplusia ou (Guenée, 1852)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Sunira bicolorago (Guenée, 1852)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Tineidae	Acrolophus morus (Grote, 1881)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Tortricidae	Choristoneura rosaceana (Harris, 1841)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Tortricidae	Endothenia hebesana (Walker, 1863)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Tortricidae	Pelochrista dorsisignatana (Clemens, 1860)	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Tortricidae	Proteoteras aesculana Riley, 1881	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Tortricidae	Unidentified Tortricidae	ridgeline dry-mesic deciduous woodland bordering dry bluff prairie; above stream valley	UV trap; 24-21°C; mostly clear night/variable wind
Erebidae	Caenurgina crassiuscula (Haworth, 1809)	small dry hill prairie remnant with few limestone outcrops; bordering dry-mesic deciduous woodland/Juniperus groves	flushed; 1:55pm; 19°C; sunny/light to moderate wind; 4 observed 9am-4pm
Hesperiidae	Pyrgus communis (Grote, 1872)	trailside through gently rolling dry-mesic tallgrass prairie restoration; few Quercus	flying fast/erratically along 2-track; 1:25pm; 32°C; mostly

			sunny/light wind; 2 observed 11am-4:15pm
Nymphalidae	Danaus plexippus (Linnaeus, 1758)	trailside through gently rolling dry-mesic tallgrass prairie restoration; few Quercus	1 of many working Cirsium discolor flowers; 1:25pm; 32°C; mostly sunny/light wind; 14+ observed 11am-4:15pm
Nymphalidae	Polygonia comma (T. Harris, 1842)	trailside through hillside/ravine dry-mesic hardwood forest; sparse Juniperus	flying leisurely/basking on leaf litter along trail; 10:45am; 16-17°C; sunny/light wind; 2 observed 10:30am-12pm
Nymphalidae	Speyeria cybele (Fabricius, 1775)	trailside through hillside/ravine dry-mesic hardwood forest; sparse Juniperus	flying along 2-track/basking in sun on steep embankment; 11:50am; 30°C; mostly sunny/light wind; 10+ observed 11am-4:15pm
Tineidae	Acrolophus morus (Grote, 1881)	trailside through hillside/ravine dry-mesic hardwood forest; sparse Juniperus	flying low over sandy/gravelly 2-track/landed/crawled under dead leaf; 3:45pm; 30-31°C; mostly sunny/windy; 1 observed 3:15pm-5pm
Coleophoridae	Coleophora sp.	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Coleophoridae	Coleophora sp.	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Coleophoridae	Coleophora sp.	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Coleophoridae	Coleophora sp.	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Coleophoridae	Coleophora sp.	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Coleophoridae	Coleophora sp.	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Cosmopterigidae	Walshia miscecolorella (Chambers, 1875)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Crambidae	Agriphila ruricolellus (Zeller, 1863)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night

Crambidae	Elophila gyralis (Hulst, 1886)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Crambidae	Elophila obliteralis (Walker, 1859)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Crambidae	Evergestis pallidata (Hufnagel, 1767)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Crambidae	Fissicrambus mutabilis (Clemens, 1860)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Crambidae	Microcrambus elegans (Clemens, 1860)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Crambidae	Nomophila nearctica Munroe, 1973	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Crambidae	Parapoynx badiusalis (Walker, 1859)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Crambidae	Pediasia trisecta (Walker, 1856)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Crambidae	Petrophila fulicalis (Clemens, 1860)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Crambidae	Petrophila fulicalis (Clemens, 1860)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Crambidae	Scoparia biplagialis Walker, 1866	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Crambidae	Udea rubigalis (Guenée, 1854)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Crambidae	Unidentified Crambidae	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Crambidae	Unidentified Crambidae	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Crambidae	Unidentified Crambidae	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Crambidae	Urola nivalis (Drury, 1773)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Depressariidae	Agonopterix pulvipennella (Clemens, 1864)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night

Depressariidae	Semioscopis aurorella Dyar, 1902	valley bottom mesic deciduous woodland bordering sedge meadow	UV trap; 10-2°C; clear/calm night
Depressariidae	Semioscopis megamicrella Dyar, 1902	valley bottom mesic deciduous woodland bordering sedge meadow	UV trap; 10-2°C; clear/calm night
Drepanidae	Oreta rosea (Walker, 1855)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Erebidae	Apantesis parthenice (Kirby, 1837)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Erebidae	Catocala cerogama Guenée, 1852	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Erebidae	Catocala neogama (J.E. Smith, 1797)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Erebidae	Catocala parta Guenée, 1852	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Erebidae	Catocala piatrix Grote, 1864	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Erebidae	Catocala piatrix Grote, 1864	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Erebidae	Clemensia albata Packard, 1864	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Erebidae	Clemensia albata Packard, 1864	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Erebidae	Hypena baltimoralis (Guenée, 1854)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Erebidae	Hypena scabra (Fabricius, 1798)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Erebidae	Hypena scabra (Fabricius, 1798)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Erebidae	Hypena sordidula Grote, 1872	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night

Erebidae	Hypenodes caducus (Dyar, 1907)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Erebidae	Hypenodes fractilinea (Smith, 1908)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Erebidae	Idia aemula Hübner, 1814	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Erebidae	Idia aemula Hübner, 1814	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Erebidae	Idia americalis (Guenée, 1854)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Erebidae	Idia americalis (Guenée, 1854)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Erebidae	Idia lubricalis (Geyer, 1832)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Erebidae	Macrochilo orciferalis (Walker, 1859)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Erebidae	Melipotis jucunda (Hübner, 1818)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Erebidae	Metalectra quadrisignata (Walker, [1858])	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Erebidae	Phalaenostola larentioides Grote, 1873	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Erebidae	Rivula propinqualis Guenée, 1854	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Erebidae	Zale lunata (Drury, 1773)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Erebidae	Zanclognatha jacchusalis (Grote, 1872)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Erebidae	Zanclognatha pedipilalis (Guenée, 1854)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night

Gelechiidae	Chionodes thoraceochrella (Chambers, 1872)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Gelechiidae	Gnorimoschema gallaesolidaginis (Riley, 1869)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Gelechiidae	Helcystogramma hystricella (Braun, 1921)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Gelechiidae	Metzneria lappella (Linnaeus, 1758)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Gelechiidae	Stereomita andropogonis Braun, 1922	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Geometridae	Cabera erythemaria Guenée, [1858]	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Geometridae	Campaea perlata (Guenée, [1858])	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Geometridae	Costaconvexa centrostrigaria (Wollaston, 1858)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Geometridae	Euphyia intermediata (Guenee, [1858])	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Geometridae	Euphyia intermediata (Guenee, [1858])	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Geometridae	Euphyia intermediata (Guenee, [1858])	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Geometridae	Eupithecia sp.	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Geometridae	Hypagyrtis unipunctata (Haworth, 1809)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Geometridae	Lycia ursaria (Walker, 1860)	valley bottom mesic deciduous woodland bordering sedge meadow	UV trap; 10-2°C; clear/calm night
Geometridae	Macaria aemulataria Walker, 1861	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Geometridae	Paleacrita merriccata Dyar, [1903]	valley bottom mesic deciduous woodland bordering sedge meadow	UV trap; 10-2°C; clear/calm night

Geometridae	Paleacrita vernata (Peck, 1795)	valley bottom mesic deciduous woodland bordering sedge meadow	UV trap; 10-2°C; clear/calm night
Geometridae	Phigalia strigataria (Minot, 1869)	valley bottom mesic deciduous woodland bordering sedge meadow	UV trap; 10-2°C; clear/calm night
Geometridae	Phigalia titea (Cramer, [1780])	valley bottom mesic deciduous woodland bordering sedge meadow	UV trap; 10-2°C; clear/calm night
Geometridae	Protoboarmia porcelaria (Guenée, [1858])	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Geometridae	Xanthorhoe ferrugata (Clerck, 1759)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Geometridae	Xanthorhoe lacustrata (Guenée, [1858])	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Geometridae	Xanthotype sp.	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Geometridae	Xanthotype sp.	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Gracillariidae	Phyllonorycter sp.	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Hesperiidae	Ancyloxypha numitor (Fabricius, 1793)	valley bottom mesic deciduous woodland bordering sedge meadow	flying slowly/low among sedges bordering trail; 2:40pm; 32°C; mostly sunny/light wind; 6+ observed 11am-4:15pm
Lasiocampidae	Tolype velleda (Stoll, 1791)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Noctuidae	Abagrotis alternata (Grote, 1864)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Abagrotis anchocelioides (Guenée, 1852)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Agrotis ipsilon (Hufnagel, 1766)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Amphipyra pyramidoides Guenée, 1852	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night

Noctuidae	Apamea dubitans (Walker, 1856)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Apamea helva (Grote, 1875)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Noctuidae	Apamea helva (Grote, 1875)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Cerastis tenebrifera (Walker, 1865)	valley bottom mesic deciduous woodland bordering sedge meadow	UV trap; 10-2°C; clear/calm night
Noctuidae	Condica videns (Guenée, 1852)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Copivaleria grotei (Morrison, 1874)	valley bottom mesic deciduous woodland bordering sedge meadow	UV trap; 10-2°C; clear/calm night
Noctuidae	Feltia herilis (Grote, 1873)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Noctuidae	Feltia herilis (Grote, 1873)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Feltia tricosa (Lintner, 1874)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Noctuidae	Graphiphora augur (Fabricius, 1775)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Helotropha reniformis (Grote, 1874)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Noctuidae	Helotropha reniformis (Grote, 1874)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Homophoberia apicosa (Haworth, 1809)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Noctuidae	Leucania lapidaria (Grote, 1876)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Noctuidae	Leucania lapidaria (Grote, 1876)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night

Noctuidae	Leucania phragmitidicola Guenée, 1852	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Noctuidae	Lithacodia musta (Grote & Robinson, 1868)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Noctuidae	Lithophane hemina Grote, 1874	valley bottom mesic deciduous woodland bordering sedge meadow	UV trap; 10-2°C; clear/calm night
Noctuidae	Magusa divaricata (Grote, 1874)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Noctuidae	Mesapamea fractilinea (Grote, 1874)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Mythimna oxygala (Grote, 1881)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Mythimna unipuncta (Haworth, 1809)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Noctuidae	Mythimna unipuncta (Haworth, 1809)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Noctua pronuba (Linnaeus, 1758)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Orthosia alurina (Smith, 1902)	valley bottom mesic deciduous woodland bordering sedge meadow	UV trap; 10-2°C; clear/calm night
Noctuidae	Orthosia garmani (Grote, 1879)	valley bottom mesic deciduous woodland bordering sedge meadow	UV trap; 10-2°C; clear/calm night
Noctuidae	Orthosia garmani (Grote, 1879)	valley bottom mesic deciduous woodland bordering sedge meadow	UV trap; 10-2°C; clear/calm night
Noctuidae	Orthosia hibisci (Guenée, 1852)	valley bottom mesic deciduous woodland bordering sedge meadow	UV trap; 10-2°C; clear/calm night
Noctuidae	Papaipema rigida (Grote, 1877)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Noctuidae	Phlogophora periculosa Guenée, 1852	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Protolampra brunneicollis (Grote, 1865)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night

Noctuidae	Psaphida resumens Walker, 1865	valley bottom mesic deciduous woodland bordering sedge meadow	UV trap; 10-2°C; clear/calm night
Noctuidae	Pseudeustrotia carneola (Guenée, 1852)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Noctuidae	Pseudohermonassa bicarnea (Guenée, 1852)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Tricholita signata (Walker, 1860)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Noctuidae	Xestia normanianus (Grote, 1874)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Noctuidae	Xestia normanianus (Grote, 1874)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Xestia smithii (Snellen, 1896)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Noctuidae	Xestia smithii (Snellen, 1896)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night
Noctuidae	Xylena curvimacula (Morrison, 1874)	valley bottom mesic deciduous woodland bordering sedge meadow	UV trap; 10-2°C; clear/calm night
Nymphalidae	Vanessa atalanta (Linnaeus, 1758)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 3:50pm; 32°C; mostly sunny/light wind; 2 observed 11am-4:15pm
Plutellidae	Plutella xylostella (Linnaeus, 1758)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Pterophoridae	Unidentified Pterophoridae	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Pyralidae	Eulogia ochrifrontella (Zeller, 1876)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Pyralidae	Unidentified Pyralidae	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Acleris nigrolinea (Robinson, 1869)	valley bottom mesic deciduous woodland bordering sedge meadow	ex. rotten banana-brown sugar bait; 23-16°C; mostly clear/calm night

Tortricidae	Ancylis metamelana (Walker, 1863)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Argyrotaenia velutinana (Walker, 1863)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Choristoneura rosaceana (Harris, 1841)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Clepsis clemensiana (Fernald, 1879)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Cochylichroa aurorana (Kearfott, 1907)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Cochylichroa aurorana (Kearfott, 1907)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Cochylis bucera Razowski, 1997	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Endothenia nubilana (Clemens, 1865)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Endothenia nubilana (Clemens, 1865)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Endothenia nubilana (Clemens, 1865)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Eucosma ochroterminana (Kearfott, 1907)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Olethreutes bipartitana (Clemens, 1860)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Olethreutes bipartitana (Clemens, 1860)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Pandemis limitata (Robinson, 1869)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Pelochrista derelicta (Heinrich, 1929)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Sparganothis sulfureana (Clemens, 1860)	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Suleima cinerodorsana Heinrich, 1923	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Unidentified Tortricidae	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night

Tortricidae	Unidentified Tortricidae	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Unidentified Tortricidae	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Unidentified Tortricidae	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Tortricidae	Unidentified Tortricidae	valley bottom mesic deciduous woodland bordering sedge meadow	MV sheet; 23-16°C; mostly clear/calm night
Nymphalidae	Lethe anthedon (Clark, 1936)	valley bottom mesic hardwood forest; near stream course/wetlands	flushed along path; 2:25pm; 32°C; mostly sunny/light wind; 2 observed 11am-4:15pm
Cosmopterigidae	Perimede sp.	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Crambidae	Scoparia biplagialis Walker, 1866	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Crambidae	Udea rubigalis (Guenée, 1854)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Erebidae	Caenurgina crassiuscula (Haworth, 1809)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Erebidae	Idia aemula Hübner, 1814	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Erebidae	Idia americalis (Guenée, 1854)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Erebidae	Macrochilo orciferalis (Walker, 1859)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Erebidae	Orgyia leucostigma (J.E. Smith, 1797)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Gelechiidae	Aristotelia roseosuffusella (Clemens, 1860)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Gelechiidae	Chionodes thoraceochrella (Chambers, 1872)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Gelechiidae	Gnorimoschema gallaesolidaginis (Riley, 1869)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind

Geometridae	Costaconvexa centrostrigaria (Wollaston, 1858)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Geometridae	Euphyia intermediata (Guenee, [1858])	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Geometridae	Eupithecia sp.	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Geometridae	Prochoerodes lineola (Goeze, 1781)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Geometridae	Stamnodes gibbicostata (Walker, 1862)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Geometridae	Stamnodes gibbicostata (Walker, 1862)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Momphidae	Mompha eloisella (Clemens, 1860)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Abagrotis alternata (Grote, 1864)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Agnorisma badinodis (Grote, 1874)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Agrotis venerabilis Walker, [1857]	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Anathix puta (Grote & Robinson, 1868)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Lacinipolia renigera (Stephens, 1829)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Noctua pronuba (Linnaeus, 1758)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Papaipema impecuniosa (Grote, 1881)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Papaipema rigida (Grote, 1877)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Sunira bicolorago (Guenée, 1852)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Noctuidae	Xestia smithii (Snellen, 1896)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind

Plutellidae	Plutella xylostella (Linnaeus, 1758)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Schreckensteiniidae	Schreckensteinia erythriella (Clemens, 1860)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Tineidae	Acrolophus morus (Grote, 1881)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Tineidae	Acrolophus morus (Grote, 1881)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Tineidae	Tinea apicimaculella Chambers, 1875	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Tineidae	Tinea apicimaculella Chambers, 1875	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Tortricidae	Choristoneura rosaceana (Harris, 1841)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Tortricidae	Endothenia hebesana (Walker, 1863)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Tortricidae	Endothenia nubilana (Clemens, 1865)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Tortricidae	Endothenia nubilana (Clemens, 1865)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Tortricidae	Eucosma glomerana (Walsingham, 1879)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Tortricidae	Pelochrista dorsisignatana (Clemens, 1860)	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind
Tortricidae	Unidentified Tortricidae	valley bottom mesic Juglans-Ulmus (mixed deciduous) woodland/openings; near stream	UV trap; 24-21°C; mostly clear night/variable wind

Data collected by Kyle Johnson, spring, summer, and fall of 2021.

Butterflies

Butterfly species are sorted by scientific name and then by count data.

Scientific Name	Common Name	Occurrence (throughout range)*	Combined Counts	Dakota County Historical Record
Ancyloxypha numitor	Hackberry Emperor	LU-A	67	Y
Atrytone delaware	Delaware Skipper	U-C	10	Y
Boloria bellona	Meadow Fritillary	LC-C	13	Y
Celastrina neglecta	Summer Azure	C-U	1	Y
Cercyonis pegala	Common Wood-Nymph	C-A	31	Y
Chlosyne nycteis	Silvery Checkerspot	LU	2	Y
Colias eurytheme	Orange Sulphur	C-A	2	Y
Colias philodice	Clouded Sulphur	C-A	6	Y
Cupido comyntas	Eastern Tailed-Blue	C-A	30	Y
Danaus plexippus	Monarch	C	29	Y
Enodia anthedon	Northern Pearly-eye	U-LC	16	Y
Epargyreus clarus	Silver-spotted Skipper	C-A	2	Y
Euphyes vestris	Dun Skipper	U-A	3	Y
Limenitis archippus	Viceroy	U-C	7	Y
Limenitis arthemis	Red-spotted Purple	U-C	9	Y
Nymphalis antiopa	Mourning Cloak	U-C	6	Y
Nymphalis l-album	Compton Tortoiseshell	R-LU	2	N

Papilio cresphontes	Giant Swallowtail	LU-C	6	Y
Papilio glaucus	Eastern Tiger Swallowtail	C-A	4	Y
Papilio polyxenes	Black Swallowtail	U-C	1	Y
Phyciodes cocyta	Northern Crescent	C-A	10	Y
Phyciodes sp.	Unidentified Crescent	C-A	7	Y
Phyciodes tharos	Pearl Crescent	C-A	8	Y
Pieris rapae	Cabbage White	C-A	23	Y
Polites mystic	Least Skipper	C-A	10	Y
Polites themistocles	Tawny-edged Skipper	U-A	1	Y
Polygonia comma	Eastern Comma	U-C	6	Y
Polygonia interrogationis	Question Mark	U-C	2	Y
Pompeius verna	Hobomok Skipper	U-C	55	Y
Satyrium calanus	Banded Hairstreak	U-C	5	Y
Speyeria aphrodite	Aphrodite Fritillary	U-C	22	Y
Speyeria cybele	Great Spangled Fritillary	C	127	Y
Vanessa atalanta	Red Admiral	U-C	3	Y
Wallengrenia egeremet	Northern Broken-Dash	U-LA	4	Y

Data collected by Andy Birkey, spring and summer of 2021

*Occurrence Data via Jeffrey Glassberg's *A Swift Guide to Butterflies of North America*:

A=Abundant, C = Common, U=Uncommon, R=Rare, S=Stray, LA, LC, LU, LR=Locally Abundant/Common/Uncommon/Rare.

APPENDIX D. DEER HUNT DATA

Year	Actual Deer Count In Park	Overall Count	Deer Per Square Mile*	Total Permits Awarded	Total Deer Tagged	Antlerless Deer Tagged	Deer Not Recovered	Total Hunter Trips	Total Hunt Days
1994	69		24						
1995	NA				20	NA	NA	NA	NA
1996	99		34		26	NA	NA	NA	NA
1997	81		28		25	NA	NA	NA	NA
1998					20	NA	NA	NA	NA
1999					25	NA	NA	NA	NA
2000	57		20		27	NA	NA	NA	NA
2001					8	NA	NA	NA	NA
2002					8	NA	NA	NA	NA
2003					10	NA	NA	NA	NA
2004	33		12		10	NA	NA	NA	NA
2005					8	NA	NA	NA	NA
2006					9	NA	NA	NA	NA
2007					12	NA	NA	NA	NA
2008					12	NA	NA	NA	NA
2009					12	NA	NA	NA	NA
2010					15	9	NA	NA	NA
2011	44		15		8	6			
2012				40					9
2013	66		23	40					9
2014				40	14	11	0	93	9
2015	94		33	40	9	4	0	99	9
2016				34	9	3	0	79	9
2016				31	4	2	0	68	9
2017	145	241	51	40	11	5	0		9
2017				40	10	8	0		9
2018	170	233	60	40	36	34	2		9
2018				40	8	7	1		9
2019	NA	NA	NA	40	39	39			9
2019				40	18	17			9
2020	109	195	38	40	37	35			9
2020				40	14	14			9

Year	Actual Deer Count In Park	Overall Count	Deer Per Square Mile*	Total Permits Awarded	Total Deer Tagged	Antlerless Deer Tagged	Deer Not Recovered	Total Hunter Trips	Total Hunt Days
2021				40	60	44			9
2021				40	15	13			9

*Recommended not to have deer densities greater than 10 deer per square mile.

APPENDIX E. SURVEY PROTOCOLS

APPENDIX G. COMMENTS FROM PUBLIC OUTREACH

Stakeholder Comments

MIESVILLE RAVINE PARK RESERVE PLAN

Pop-up Input HACER Resource Fair

10/8/2023 11 a.m.-3 p.m., Thompson County Park, West St. Paul

Participants were asked to place blue dots on their priorities for included in the draft plan. Materials were in English and Spanish. High priority activities were wildlife viewing, river recreation, and trail recreation. Though participants were not asked to prioritize natural resource management, many placed dots on various habitats.

Activities

Wildlife viewing (11)

Canoe/Kayaking on the Cannon River (10)

Cannon River tubing (10)

Hiking trails (9)

Wetland boardwalks (6)

Restored prairie (3)

Restored savanna (2)

Oak woodland (1)

White pine in mesic hardwood forest (1)

Trout Brook riparian corridor (1)

Southern mesic hardwood forest (1)

Cliffs and rock outcrops (1)

Seepage meadow (1)

Ravines (1)

Winter hiking and snowshoeing (5)

ADA-accessible trails (4)

Trail seating and overlooks (3)

Stargazing (4)

Rustic fire ring and gathering areas (5)

Fishing (3)

Pine-oak woodland (0)

Remnant prairie (0)

Cannon River fishing (2)

Trout Brook fishing (1)

Wifi (1)

Interpretation (0)

Natural Resource Management

Rare species and wildlife (4)

Douglas Township Board of Supervisors

11/6/2023 7 p.m.

Lil Leatham presented an overview of the Draft Long-range Plan (LP) and Draft Natural Resource Management Plan (NRMP). Generally, the Supervisors were supportive of the amount and type of recreational development and the natural resource restoration and management strategy outlined in the two plans.

Zoom Open House

11/08/2023 5:00 p.m. – 6:00 p.m., Zoom
Approximate number of participants: 3

Lil Leatham and Joe Walton provided an overview of the Draft Long-range Plan (LP) and Draft Natural Resource Management Plan (NRMP) and opened the meeting for questions and discussion.

One individual commented on his hopes to have multi-use trails in the plan that would accommodate mountain biking. (Niki followed up with this individual after the meeting via email)

Joe responded to the person who asked about mountain bike trails at Miesville by saying that it's his opinion that MRPR is not a good place for mountain bike trails primarily because of the abundance of steep slopes that are composed of very fine sand and silt that is very prone to both wind and water erosion.

There were a couple people that wanted to know what was going on at Trout Brook, and Joe explained that during September and October the County approved Trout Unlimited, a non-profit, to hire a contractor to implement the second phase of the restoration of the stream channel. The essence of the project was to reconnect the stream channel to its floodplain, by shaving down the high banks, and brining the floodplain closer to the channel so that it can flood like normal, instead of the situation that preceded it whereby it was deeply incised and most of the flood waters were trapped inside a canyon-like corridor that cause a great deal of erosion to side slopes and banks, which negatively impacts the water quality and quantity and habitat value of the stream for trout and other species.

Community Open House

11/15/2023 5:00 p.m-6:30 p.m.
Cannon River Lutheran Church
Cannon River Lutheran Church; 10960 280th Street; Cannon Falls, MN 55009

Dakota County Attendees:
Mike Slavik, Dakota County Commissioner
Lil Leatham, Principal Planner Dakota County

Joe Walton, Dakota County Senior Ecologist
Niki Geisler, Dakota County Parks Director
Approximate number of participants: 20

Meeting Summary:
Meeting format was display boards summarizing key plan elements and informal discussions with staff

Comments:

- Dakota County should maintain Orlando Trail since most of the traffic is outfitters and park visitors.
- Dakota County should pave CR 91/Miesville Trail.
- The two existing parking lots regularly fill up, so additional parking is a need.
- The park used to be a camp owned by the Lutheran Church. Many meeting attendees recall camping on the land by the river before the park was established.
- Land owners who farm adjacent property by the Cannon River have concerns about the long-term concept for the boat launch (currently outside of the park boundary). The concern is primarily about conflicts between spraying fertilizer/chemicals and nearby public use.
- General support for improving the boat launch.
- The proposed entry drive and turnaround will need no parking signs. People will take advantage of the turnaround and park there/block traffic.
- Appreciation for ADA improvements. The Cannon River Lutheran Church has considered renting the picnic shelter for events but has not out of concerns about access for people with low mobility.
- Side by side ATVs are a problem.
- Concerns were voiced about safety of the road when people are parked along Orlando. Comments were made about people standing in the middle of the road, applying sunscreen, and almost being hit by cars coming by.
- Suggestion to put up no parking signs on Miesville Trail and Orlando Trail through the park.
- One local resident hopes we will build a bridge over the river someday and connect to the Canon Valley Trail.
- A couple residents expressed their displeasure with the way the County marks inholdings on public-facing maps. They said this practice encourages trespassing by random people, and they would like the inholdings to not be shown on maps at all.
- Residents with properties within the park boundary had a number of questions and concerns about park visitors thinking their property is park owned. They mentioned having hunters on their property during hunting season, thinking they were allowed to be there because of their permit with the park.
- Request for additional signage at the park boundary.
- Concerns were mentioned about prescribed burns in the park done during a time with residents were in a fire ban.
- Overall, residents expressed approval about the general direction of management of the park's natural resources. Many people commented on how they liked the prairie and bluff restorations and some approved of the trout stream restoration.

- There was a great turnout for this meeting. Lots of people showed up, and many of them were very interested in natural resources and issues.
- One resident wanted to know more about buckthorn removal and whether we could help him on his property. Joe said that he could offer recommendations and resources to use online, but said that the County cannot actually do work or apply for grants on property that is not permanently protected by a conservation easement. He did say that he would drop in the next time he was in the area, to take a look at the site.
- One person expressed misgivings about whether buckthorn control really works. Joe assured him that it can and it does indeed work, if carried out properly, and offered to give verbal assistance and advice on methods, materials, etc. He also encouraged the person to join in future volunteer invasive species control events that will occur.
- A few neighbors to the park reserve expressed consternation over the way that we are managing adjacent lands to their property. They did not like it when we conduct late fall burns, because they claimed that it was bad for pheasants, since it reduced available cover going into winter. Joe said that he would be willing to adjust the burn schedule to avoid late fall burns in certain areas, but that we can't eliminate them entirely, since they are part of best management practices for managing prairie and savanna.
- A few neighbors to the park reserve shared that they are concerned about beavers and want the County to be conscious of beaver conservation efforts in the park reserve. They said they would be glad to take part in volunteer efforts to help conserve or promote beavers at the site.
- Joe passed out his business cards to many people, encouraging folks to contact him regarding natural resources in the park reserve.
- One resident had specific recommendations for a variety of wildlife species and taxa. He discussed it with Joe, who listened and also encouraged him to reach out and talk more about it later, when they could be discussed at length.
- Several residents shared personal stories about their history with the park reserve and their family's connection and interaction with the land before it became a park. For instance, one man said that his great grandfather planted all of the white pines in the park reserve, and that none of them occurring today in the park are remnant.

MnDNR Staff

12/08/2023 10:30-11:30 a.m., Microsoft Teams

Attendees:
Lil Leatham, Principal Planner Dakota County
Joe Walton, Dakota County Senior Ecologist
Niki Geisler, Dakota County Parks Director
Taylor Huinker, MnDNR South Metro Hydrologist
Joseph Brown, MnDNR Forestry Area Supervisor
Brian Beyerl, MnDNR Fisheries

Notes:

Lil Leatham and Joe Walton provided an overview of the Draft Long-range Plan (LP) and Draft Natural Resource Management Plan (NRMP) and opened the meeting for questions and discussion.

- The pertinent Wild and Scenic Rules related to the potential bridge crossing include Minnesota Rule 6105.0190 and 6105.0200.
- The group talked about phasing and goals of the Trout Brook Restoration.

The park is within the Richard J. Dorer Memorial Hardwood State Forest . The MnDNR is in the process of developing section management plans. The overall goals of the management plans are to encourage diverse land cover types, which is consistent with the Miesville Ravine Park Reserve NRMP.

- Invasive plant species.
    - One consideration is emerging invasive species to southeast Minnesota, such as oriental bittersweet, Japanese barberry, Japanese knotweed, and Poison hemlock in trout stream
    - Regarding garlic mustard control, they suggested using fall herbicide of rosettes; also watch for DNR invasive species staff developing a bio-control weevil that will eat GM plants.
- They suggested that the white pine in the park reserve is probably native, at least some of them, since they occur naturally only about 40 miles away at the Chippewa River in Wisconsin.
- Fisheries.
    - Regarding Trout Brook, a barrier to inhibit brown trout from reaching to the norther reaches of the park should be considered in addition to brown trout removal.
    - Consider reintroduction of slimy sculpins—Brian Beyerl said that he could send a copy of the draft management plan for re-introduction of slimy sculpin.
- Foraging. Dakota County has updated its park ordnance to allow for some foraging. Natural resource management staff is currently working to define what, where, and how much. MnDNR staff suggested only allowing amounts for personal use (as opposed to commercial use).

MnDNR staff will forward next week's meeting and/or plan links to others who may be interested. Additional comments are welcome through December 20, email Lil Leatham or Joe Walton with written comments.

Tribal Historic Preservation Officers

12/13/2023 3-4 p.m. Teams

Attendees:
Lil Leatham, Principal Planner Dakota County
Joe Walton, Dakota County Senior Ecologist
Autumn Hubbell, Dakota County Parks Outdoor Education Supervisor
Anna Ferris, Dakota County Park Outreach Coordinator
Jeff Isachsen, Dakota County Parks Indigenous Liaison
Leonard Wabasha, Shakopee Mdewakanton Sioux Community Director of Cultural Resources

Notes:

- Lil Leatham and Joe Walton provided an overview of the Draft Long-range Plan (LP), with focus on the cultural landscape stewardship recommendations and Draft Natural Resource. Management Plan (NRMP) and opened the meeting for questions and discussion.
- Leonard asked if Prairie Island staff had been involved and suggested contacting Noah White and William Kurtz, particularly for natural resource information.
- Leonard also said that Prairie Island has a list of significant plants that we should obtain, and post in the NRMP and LRP. He also recommended that we continue working with both the Upper and the Lower Sioux communities.
- Staff can also consult the native plant guide that the Lower Sioux has published.
- Leonard asked if cemetery delineations had been completed. They have not, further investigation is one of the long-range plan's stewardship recommendations.
- Overall, there were no concerns, the plans seem to be on the right track.
- Dakota County will schedule a park tour for the THPOs in the spring.

A follow-up email was sent to THPOs not in attendance reminding them to provide comment by 12/20.

Welch Mill Outfitters

12/14/2023 1-2 p.m. Miesville Ravine Park Reserve

Attendees:
Lil Leatham, Principal Planner Dakota County
Niki Geisler, Dakota County Parks Director
Ross Nelson, Owner Welch Mill Outfitters
Jane Nelson, Owner Welch Mill Outfitters

Notes:

- If the boat launch and turnaround was developed in the park, Welch Mill Outfitters would use it – particularly on busy summer days.
- On busy weekend days, the drop off on Orlando Trail is not safe due to traffic, cars parked in the widened area at the side of the road, and customers lingering in the road. During the week it isn't as bad.
- The current location on the side of the road is good for visibility. Outfitters can watch the river for customers and the bus is visible from the river, so people know where to get out. Visibility needs to be a consideration for any improvement.
- More parking is needed. The two park lots fill up regularly.
- Right now, there isn't a great place to turn the bus/trailers around. Even a small turnaround near off of Orlando Trail near the current maintenance access/proposed new access would be helpful.
- Customers would like better access to restrooms and picnicking.
- Most people can navigate the bank alright and the beach area is a great launch spot. Any new improvements should include as wide a beach as possible for people to stage from. ADA accessibility is a problem. If someone needs help, they usually call ahead and additional staff are on hand to lift people up and down the bank.

- If a turnaround is built it needs to be wide enough to allow for passing. It takes people a long time to load/unload their boats.
- More parking along the proposed entrance than shown on the concept would be better.
- Proposed parking along the side of the entrance are low spots, soils may be hydric and flooding could be a problem.

MnDNR

12/14/2023 3-4 p.m. Teams

Attendees:
Lil Leatham, Principal Planner Dakota County
Joe Walton, Dakota County Senior Ecologist
Niki Geisler, Dakota County Parks Director
Grant Fleetwood, Dakota County Parks Operations Coordinator
Neil Rude, MnDNR Fisheries
Brian Beyerl, MnDNR Fisheries
Daniel Spence, MnDNR Fisheries
Louise Thompson, MnDNR Parks and Trails Area Supervisor

Notes:

Lil Leatham and Joe Walton provided an overview of the Draft Long-range Plan (LP) and Draft Natural Resource Management Plan (NRMP) and opened the meeting for questions and discussion.

- Discussion about the MnDNR Water Trail and canoeing, rafting, and tubing uses.
- Existing boat launch is not an official MnDNR launch but is on the water trail map.
- MnDNR staff has concerns about the safety of the current outfitter drop off location on Orlando Trail. The road is very narrow.
- Potential to partner with the MnDNR in the future on water trail improvements (boat landing, camping). More discussions will need to occur.
- Garlic mustard is a concern in the park. MnDNR staff suggested connecting with a MnDNR Invasive Species Specialist to talk about management techniques.

Cannon River Canoe and Bike Rental

1/9/2024 1-2 p.m. Cannon Belles Ice Cream and Coffee

Attendees:
Lil Leatham, Principal Planner Dakota County
Niki Geisler, Dakota County Parks Director
Beth Landahl, Visitor Services Manager
William Lacefield, Cannon River Canoe and Bike Rental
Notes:

Miesville Ravine Park Reserve

- Cannon River Canoe and Bike Rental would use the new boat launch and turnaround if improved.
- Location for 1-2 busses to wait and with a view of the river is desirable.
- A landmark or sign on the riverbank near the pull-out spot and then a clearly marked boat landing would be helpful.
- Beach area for staging/put in/pull out makes sense. Area before the confluence is fine, shorter walk from the drop off.
- As much parking as possible along the entry drive is desirable, people will park there first prior to going to the existing lot.
- Welch Mill is grandfathered in for tubes, Cannon River cannot rent tubes but does have canoes, kayaks, and rafts. Kayaks and rafts are the most popular.
- It is 7-9 river miles between Cannon Falls and Miesville. Cannon River Canoe and Bike only picks up at Miesville – no unloading.
- Turnaround needs to be big enough for a bus and trailer to turnaround. The drive needs to be wide enough for loading and unloading without blocking traffic.
- Season is May-September. June-August weekends trips leave hourly.

Lake Byllesby Regional Park

- Interested in renting lake equipment. Water bikes, inflatable kayaks with a motor (5 mph max), stand up paddleboards. Would want to store equipment in a fenced area in the park.
- Also interested in running a shuttle with mini rafts and small craft on the Cannon River from the dam to Cannon Falls. One-two river miles.
- Would need to have staff in the park, could have a kiosk, and store watercraft in the park.
- If there was a commercial use fee, he'd prefer it be set up as a portion of the proceeds.
- The launch should open summer of 2024.
- William is interested in continuing discussions about equipment rentals for the Cannon Valley Trail, river, and lake.

Konveio Comments.

On-line comments within the draft Natural Resource Management Plan document (20 comments from four individuals and Trout Unlimited).

- Trout Brook is a rare Dakota County water resource that is cold and clean enough to support macro-invertebrates and wild trout. Cold water resources rally trout fishing enthusiasts, conservationists and all nature-lovers to be mindful of all the factors that contribute to cold clean water. Trout Unlimited has invested funds and volunteer hours to repair erosion and make the stream better able to withstand the effects of extreme weather events.
- *Page v, "Allows people to experience the natural heritage of the area via low-impact activities, sensitive to the park reserve's unique resources".* Yes!
- Very excited to see that Dakota County is prioritizing trout brook creek. This a key regional asset worthy of preservation.
- Love that you're calling out the gem that is Trout Brook!! Keep it protected as a place to fish trout!!!
- Fantastic! [referencing the Dakota County Natural Resource Management Vision for the Park System].
- *Page viii, Trout Brook and Tributaries Priority Feature: Goals and Strategies*
    - TCTU will help w.this!
    - TCTU will be a great local partner. In addition, Trout Unlimited's Driftless Area Program has funding through NRCS to work with ag/forest land owners outside the reserve to improve habitat and install BMPs.
    - Twin Cities Trout Unlimited will help w/this! Contact Douglas Moran at doug.moran@twincitiestu.org to get the ball rolling!
- *Page xv*, *"Goal 3: Minimize erosion and disturbance along the banks of the Cannon River".* Yes, the erosion looks terrible and can't be good for the Cannon.
- *Page xvii, "Table 16. Citizen Outreach, Stewardship, and Education Goals and Strategies"*
    - Twin Cities Trout Unlimited will help w/this! Contact Douglas Moran atdoug.moran@twincitiestu.org to get the ball rolling!
- Buckthorn bad!
- *Page 72, Partnerships*
    - Twin Cities Trout Unlimited will help w/this! Contact Douglas Moran at doug.moran@twincitiestu.org to get the ball rolling!
    - Twin Cities Trout Unlimited is interested in expanding its partnership with the County.
- I think the vision, goals and strategies outlined in this plan will help preserve and expand the natural beauty of the entire park.
- *Page 79, "Work with upstream landowners and partners to implement watershed BMPs and restoration"* Twin Cities Trout Unlimited believes watershed restoration to be of utmost importance for the current and future health of Trout Brook, and we appreciate Dakota County's commitment to this important work.
- *Page 80, "Preserve beaver dams but consider removal of large beaver dams based on impacts".* This is a helpful explanation and something Twin Cities Trout Unlimited could potentially share with anglers who express concern about beaver activity on the stream.
- *Page 155, "Develop volunteer opportunities that combine education, outreach, and stewardship".* Twin Cities Trout Unlimited Streamkeepers citizen-science program can assist in monitoring stream conditions including erosion, water quality and water temperature. The chapter also organizes habitat work days and could recruit volunteers for activities like invasive vegetation removal, prairie seed collection/overseeding or tree planting.
- *Page,158, "Continue and expand conservation and restoration project partnership".* Twin Cities Trout Unlimited would appreciate being included in this list, alongside Minnesota Trout Unlimited (a related organization). While the state organization is well suited to coordinate in-stream channel improvements to Trout Brook, our local chapter can help to engage local

volunteers for riparian habitat work – and to help with outreach and education efforts throughout the watershed.

- *Page 165, "5.3. Water Resources Management. Water resources management projects for implementation include several stream restorations along Trout Brook (Table 16). Implementation of projects within the greater Trout Brook subwatershed is also an NRMP priority that incurs operational costs and costs associated with specific projects."* Twin Cities Trout Unlimited supports these stream restoration projects and is interested in sharing updates with our membership as the work progresses.

- I first would like to mention that I am happy to see that this land and habitat has been preserved and restored and is continuing to be. But when I hear that the park reserve "A nature reserve (also known as a wildlife refuge, wildlife sanctuary, biosphere reserve or bioreserve, natural or nature preserve, or nature conservation area)". Is going to make it easier for people to penetrate, access this area it is no longer a safe haven for wildlife which was the intention of this park. Whatever the reasons are to put in all these trails, well intended as they may be, it will surely take away the whole intention of the park's purpose. There are very few places to go anymore where man has not touched and taking away another is truly unfortunate. Parks that are hard to access difficult to navigate should be kept just as that. Making things easier is not always better especially when it comes to preserving an area intended for wildlife not for people. I realize that this is going to fall on deaf ears because this will happen no matter what I feel. I just really hope the people that are pushing for this realize the impact this will definitely have on the wildlife that calls this area home. Keep our wild places WILD! Please work to protect the precious cold water resources of Trout Brook as you develop your plan.
- I'm a member of the Twin Cities Chapter of Trout Unlimited. This is an important resource for the region and I am grateful for the steps being taken to preserve Trout Brook for future generations.
- I think it would be a great addition if the natural surface trails were multi use and allow bicycles. A great example of this is the river bend nature center in Faribault, Mn.
- Twin Cities Trout Unlimited suggests *Page E5. "Restore natural hydrology and habitat to the Trout Brook channel and floodplain and tributaries, via landscape-level management practices and partnerships"* be adjusted as follows, "Restore natural hydrology and habitat to the Trout Brook channel and floodplain and tributaries, via stream restoration projects, landscape-level management practices and partnerships." We feel stream restoration should be specifically called out here.
- Twin Cities Trout Unlimited agrees the park reserve would benefit from invasive species removal (primarily buckthorn), and we have many chapter volunteers who would be interested in helping with this work through habitat improvement events.
- Twin Cities Trout Unlimited is interested in being a partner on water quality solutions, perhaps through public outreach/communications, by providing letters of support for funding proposals, or other efforts that might be helpful. We encourage Dakota County Parks Natural Resources to continue working with Dakota County SWCD, the North Cannon River Watershed Management Organization and other partners to work on nitrate reduction projects in the watershed. This includes implementing land-use best practices (cover crops, perennial crops and vegetated buffers) as well as considering innovative solutions like woodchip bioreactors.
- Twin Cities Trout Unlimited agrees with the assertion that, *"Trout Brook's water quality is affected by land uses throughout the watershed,"* and much of this land currently lies outside of park boundaries. Therefore, we strongly support permanent acquisition of agricultural lands upstream of Trout Brook and along its tributaries with the goal of returning these sensitive areas to perennial vegetation. We believe staff time and funding that is put toward targeted land protection efforts is well spent because clean water is critical to the long-term health of the Trout Brook ecosystem.

Polco Survey

INSERT SURVEY IN PDF FORM

Response to Comments

Mountain Biking

Many comments wished for mountain biking at this site. However, Natural Resource staff feel that this site is not conducive to mountain bike traffic, because of its steep slopes and sandy and fine-silty soils that are highly prone to both wind and water erosion. For example, when you look at the 1937 aerials, from the dust bowl era, you can see several large areas of mass erosion, when native veg was cleared from the upper bluffs and terraces to the detriment of the land. Therefore, we continue to recommend that MRPR does not have a mountain bike system.

RV Camping

A few comments expressed the desire for RV camping at MRPR. RV Camping is currently available at Lake Byllesby Regional Park, which is only a short ride to the west of MRPR. Trying to keep this park as natural and wild as possible is a goal of the NRMP. System-wide planning shows that other parks in our system are better suited to offer these recreational amenities. Therefore, we continue to recommend that MRPR does not have RV Camping.

Biking and Signage

Quite a few comments expressed a desire for more biking, in general, to be allowed, and that better signage needs to be posted if the County wishes biking to be excluded, and to be specific as to which areas bikers should stay out of. More and better signage is an excellent idea, and Natural Resources staff support that.

Responses Are Varied and Interesting

As is typical of surveys, responses and opinions vary across a spectrum. And this poll is no different—as can be seen from the responses. All comments are valid and useful in helping the County manage the site to better serve visitors and the natural communities. Currently, there are channels of communication available for visitors to engage with County staff and commissioners. Public meetings, County webpages, calling staff directly, attending Planning Commission and County Board meetings, are all available and can

be utilized by members of the public. If there are any questions regarding this plan or planning process, feel free to contact the following:

Joseph Walton, Senior Ecologist, joseph.walton@co.dakota.mn.us

Tom Lewanski, Natural Resources Manager, tom.lewanski@co.dakota.mn.us

Lil Leatham, Senior Planner, or lil.leatham@co.dakota.mn.us

Kurt Chatfield, Planning Manager, kurt.chatfield@co.dakota.mn.us

NR Management Questions and Responses

Mowing and Burning

The County is now actively managing this Park Reserve site, unlike the past, where it was receiving a very low level of management. Natural Resource staff rotate burns and mowings around the site, from year to year, as is a best practice, so as to maximize diversity and to build resiliency to environmental stressors. We appreciate the fire may reduce habitat value for some species, but this should be only temporary, and that in the long run, the overall habitat value will increase as a result of the management practices. For example, although pheasants may be negatively impacted by a late fall burn, and may not inhabit the burn site or nearby sites for a couple of years, eventually, after several years of consistent management, habitat value will increase and more pheasants than before, should occupy the site. In other words, fire is a natural disturbance that was part of the ecosystem for millennia, and the negative impacts of its reintroduction are temporary, and the long term impacts are positive. Also, NR managers need to manage for the betterment of all the species that use or could potentially use a site, and not just manage for one a couple of them.

Deer Management

Over abundant deer populations have a very negative affect on the vegetation and soils of the park. The goal for deer density of 10/sq-mile is a commonly held one for Metro parks, but is almost impossible to achieve, and probably will never be attainable at this site. One of the reasons that so many deer flock to this site is that most of the surrounding land has been so greatly altered and converted from prairie, savanna, and woodland, to row crop agriculture. This creates ideal conditions for deer, since they like lots of forest-field edge, where they can feed in the fields and easily retreat to the safety of the forest. They also seek refuge here in winter since the site offers protection in the ravines from the ravages of winter storms and weather. There have been some local landowners that have expressed consternation toward high deer populations and want them reduced to lessen impacts to their crops. Also, if more land in the surrounding landscape were managed as natural plant communities, rather than row-crop agriculture, then perhaps deer would disperse more widely across the area, and thus not concentrate as much at the Park Reserve.

Trails and Park Access

Many of the respondents desired more access to the park, which equates to adding more trails and roads. The approach is to add trails to increase access, but do it in the least ecologically impactful way, so as to

minimize damaging biotic communities. Limiting infrastructure development at this site is aligned with the goals of this plan and the County in general. Some of the survey responses, on the other hand, wish us to not build any more trails at all—that the park is "good the way it is". Arriving at best solution, whereby all viewpoints are fairly considered, and then arriving at a result that benefits all of the people, visitors, and wildlife of the site, and the goals and objectives of site, should reflect that consensus, without compromising the ecological integrity of the site.

Safety

Safety for all visitors is of paramount concern for Dakota County. All visitors should be able and encouraged to use the site in a safe manner. Reporting incidents to the County Parks Department or Park Patrol will help reduce problems. The County has Ordinances in place to maintain safety, law, and order in the parks. Park Patrol meets regularly with Visitor Services and Parks staff, to communicate issues and resolve them in a timely manner. We recognize that staff and patrol cannot be everywhere all the times, so there are systems in place to address safety and other concerns. If these systems do not adequately safeguard the safety of the parks for all visitors, then we need to evaluate why and how we can make them better. For instance, perhaps trail cameras can be placed to capture incidents as they occur, which might help identify perpetrators.

Miscellaneous

A couple comments requested that staff stop mowing walking paths so wide, because it is damaging to plants and pollinators, etc. NR staff feels this is a legitimate concern, and will alert Parks Facility Maintenance staff to be more careful when mowing trails to keep them from getting too wide.