



Rapid Ecological Assessment for the Wildlife and State Natural Areas of the Southern Kettle Moraine Region

A Rapid Ecological Assessment Focusing on Rare Plants, Selected Rare Animals, and High-quality Natural Communities

Properties included in this report are:

- Big Muskego Lake Wildlife Area
- Cherry Lake Sedge Meadow State Natural Area
- Honey Creek Wildlife Area
- Lulu Lake State Natural Area
- New Munster Bog Island State Natural Area
- New Munster Wildlife Area
- Tichigan Wildlife Area
- Turtle Creek Wildlife Area
- Turtle Valley Wildlife Area
- Vernon Wildlife Area

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Cover Photo: A headwater stream fed by Springs and Spring Runs flows through a Calcareous Fen at Tichigan Wildlife Area. Photo by Ryan P. O'Connor, WDNR.

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Blanding's turtles are a rare herptile found in the study area. Photo by Gregor Schuurman, WDNR.

The Southern Kettle Moraine Region At a Glance

Exceptional Characteristics of the Study Area

- **Rare Animals and Plants.** The diverse habitats of the SKMR support numerous rare species. Forty-two rare animal species are known from the SKMR, including five State Endangered, nine State Threatened, and 28 Special Concern species. Thirty-nine rare plant species are known from the SKMR, including two State Endangered, eleven State Threatened, and 26 Special Concern species. One species is a candidate for Federal listing.
- **Wetland Birds and Herptiles.** High-quality wetlands and wetland complexes in the SKMR provide critical habitat to a variety of colonial water birds and marsh birds. In addition, the abundance of wetlands and upper stream reaches make the SKMR a hotspot for several species of rare frogs, turtles, and snakes, especially where high-quality wetland complexes occur adjacent to prairies, savannas, and restorable open habitats.
- **Wetland and Aquatic Resources.** Unique wetland and aquatic resources are present in the SKMR and include Springs and Spring Runs, Calcareous Fen, Wet Prairie, Southern Sedge Meadow, Shrub-carr, Emergent Marsh, and headwater streams. Rare fishes, birds, and plants are known to utilize these high quality habitats.

Site Specific Opportunities for Biodiversity Conservation

Ten ecologically important sites were identified on the SKMR. These “Primary Sites” were delineated because they generally encompass the best examples of 1) rare and representative natural communities, 2) documented occurrences of rare species populations, and/or 3) opportunities for ecological restoration or connections. These sites warrant high protection and/or restoration consideration during the development of the property master plan.

- **Vernon Fen.** This Primary Site is a small but high-quality Calcareous Fen at Vernon Wildlife Area and supports several rare plants.
- **Big Muskego Marsh.** This large wetland site supports many species of rare colonial nesting water birds, marsh birds, and birds of prey.
- **Lulu Lake State Natural Area (SNA).** Exceptionally high-quality oak savanna and pristine wetland complexes support dozens of rare species at this site.
- **Tichigan Wet Prairie.** A relatively large, restorable Wet Prairie supports several rare species at the north end of Tichigan Lake.
- **Tichigan Springs and Fen.** This high-quality fen is fed by numerous springs and supports a state endangered plant along with many other rare plants and animals. It is a major restoration opportunity.
- **Cherry Lake Sedge Meadow SNA.** A wetland complex of Southern Sedge Meadow, Southern Tamarack Swamp, and historic Calcareous Fen adjoins restorable Oak Woodland at Honey Creek Wildlife Area. It supports several rare plants and animals.
- **Turtle Lake Sedge Meadow.** This site supports a small wetland complex of Southern Sedge Meadow and Shrub-carr near the south shore of Turtle Lake.
- **Delavan Marsh.** This site is large Southern Sedge Meadow along Turtle Creek in a landscape where wetlands are otherwise dominated by reed canary grass and Shrub-carr. It supports several rare birds.
- **Turtle Creek Springs.** This site is a large wetland complex at Turtle Creek Wildlife Area and includes Springs and Spring Runs, Calcareous Fen, Southern Sedge Meadow, Shrub-carr, and Emergent Marsh. It supports many rare animals and several rare plants.
- **New Munster Bog Island SNA.** This site includes a Southern Dry-mesic Forest surrounded by wetlands of Shrub-carr, Southern Sedge Meadow, and Emergent Marsh.

Introduction

Purpose and Objectives

This report is intended to be used as a source of information for developing a new master plan for the Wildlife and State Natural Areas (SNA) of the Southern Kettle Moraine Region Planning Group (SKMR; Figure 1). The regional ecological context for the SKMR is also provided to assist in developing the Regional and Property Analysis that is part of the master plan. Properties included in this assessment are:

- Big Muskego Lake Wildlife Area
- Cherry Lake Sedge Meadow State Natural Area
- Honey Creek Wildlife Area
- Lulu Lake State Natural Area
- New Munster Bog Island State Natural Area
- New Munster Wildlife Area
- Tichigan Wildlife Area
- Turtle Creek Wildlife Area
- Turtle Valley Wildlife Area
- Vernon Wildlife Area

Biotic inventory and analysis of sites within the Southern Unit of the Kettle Moraine State Forest are included in the separate, previously published report: Biotic Inventory and Analysis of the Kettle Moraine State Forest (Hyde et al. 2010).

The primary objectives of this project were to collect biological inventory information relevant to the development of a master plan for the SKMR and to analyze, synthesize and interpret this information for use by the master planning team. This effort focused on assessing areas of documented or potential habitat for rare species and identifying natural community management opportunities.

Survey efforts for the SKMR were limited to a “rapid ecological assessment” for 1) identifying and evaluating ecologically important areas, 2) documenting rare species occurrences, and 3) documenting occurrences of high quality natural communities. This report can serve as the “Biotic Inventory” document used for master planning, although inventory efforts were reduced compared to similar projects conducted on much larger properties such as state forests. This report provides much of the same information as in “Biotic Inventory” reports, although, the inventory was limited to a “rapid ecological assessment.” There will, undoubtedly be gaps in our knowledge of the biota of this property, especially for certain taxa groups; these groups have been identified as representing either opportunities or needs for future work.

Overview of Methods

The Wisconsin Natural Heritage Inventory (NHI) program is part of the Wisconsin DNR’s Bureau of Endangered Resources and a member of an international network of natural heritage programs representing all 50 states, as well as portions of Canada, Latin America, and the Caribbean. These programs share certain standardized methods for collecting, processing, and managing data for rare species and natural communities. NatureServe, an international non-profit organization (see www.NatureServe.org for more information), coordinates the network.

Natural heritage programs track certain *elements* of biological diversity: rare plants, rare animals, high-quality examples of natural communities, and other selected natural features. The NHI Working List

contains the elements tracked in Wisconsin; they include endangered, threatened, and special concern plants and animals, as well as the natural community types recognized by NHI. The NHI Working List is periodically updated to reflect new information about the rarity and distribution of the state's plants, animals, and natural communities. Species Listing Status referenced in this report is based on NHI Working List published April 2009. The most recent Working List is available from the Wisconsin DNR Web site (*Wisconsin Natural Heritage Working List*).

The Wisconsin NHI program uses standard methods for biotic inventory to support master planning (Appendix A). Our general approach involves collecting relevant background information, planning and conducting surveys, compiling and analyzing data, mapping rare species and high quality natural community locations into the NHI database, identifying ecologically important areas, and providing interpretation of the findings through reports and other means.

Existing NHI data are often the starting point for conducting a biotic inventory to support master planning. Prior to this project, NHI data for the SKMR were limited to: 1) the Statewide Natural Area Inventory, a county-by-county effort conducted by WDNR's Bureaus of Research and Endangered Resources between 1969 and 1984 that focused on natural communities but included some surveys for rare plants and animals, 2) breeding bird surveys on State Natural Areas, 3) surveys conducted for the *Biodiversity in Selected Natural Communities Related to Global Climate Change* (Anderson et al. 2008), 4) surveys conducted for *A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin* (SEWRPC 1997, SEWRPC 2007), and 5) taxa specific surveys.

The most recent taxa-specific field surveys for the study area were conducted during 2010. Surveys were limited in scope and focused on documenting high quality natural communities, rare plants, breeding birds, herptiles, and, for some properties, the State Endangered swamp metalmark butterfly (*Calephelis muticum*). The collective results from all of these surveys were used, along with other information, to identify ecologically important areas (Primary Sites) in the SKMR.

Survey locations were identified or guided by using recent aerial photos, USGS 7.5' topographic maps, various Geographic Information System (GIS) sources, information from past survey efforts, discussions with property managers, and the expertise of several biologists familiar with the properties or with similar habitats in the region. Based on the location and ecological setting of properties within the SKMR, key inventory considerations included the identification of high quality wetland communities, such as ecologically significant Wet Prairie, Calcareous Fen, Southern Sedge meadow, Emergent Marsh, and the location of habitats that had the potential to support rare species.

Scientific names for all species mentioned in the text are included in a list on page 40.



Black-crowned night heron occurs in Emergent Marshes in the study area. Photo by Laura Erickson.

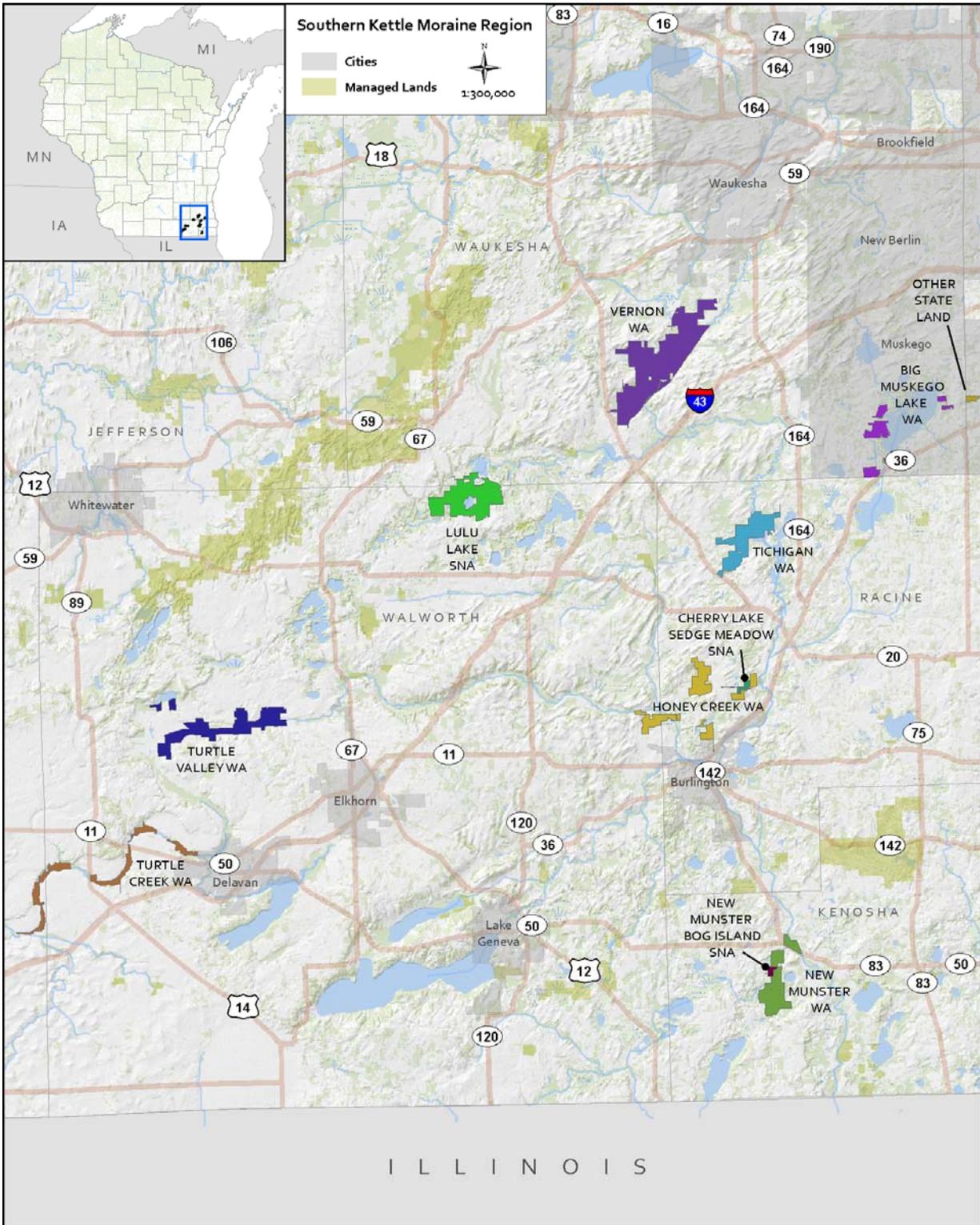


Figure 1: Location of Properties in the Southern Kettle Moraine Region Planning Group.

Background on Past Efforts

Various large-scale research and planning efforts have identified a number of locations within the SKMR as being ecologically significant. The following are examples of such projects and the significant features identified.

The **Land Legacy Report** (WDNR 2006a) was designed to identify Wisconsin's most important conservation and recreation needs for the next 50 years. Lulu Lake SNA and Vernon Wildlife Area are part of the Mukwonago River and Jericho Creek Land Legacy site that was assigned a score of five points on their five-point scale, meaning it possesses "outstanding ecological qualities, is of adequate size to meet the needs of the critical components, and/or harbors natural communities or species of global or continental significance." Big Muskego Lake Wildlife Area was recognized as a Land Legacy site that was assigned a score of three points on their five-point scale meaning it possess "very good ecological qualities, is of adequate size to meet the needs of some of the critical components, and /or harbors natural communities or species of state significance." Turtle Creek Wildlife Area, as part of the Southern Kettle Moraine: Whitewater Lake to Turtle Creek Land Legacy Site was assigned a score of two points on their five-point scale, meaning it possesses "good ecological qualities, may be of adequate size to meet the needs of some of the critical components, and /or harbors natural communities or species of state or ecological landscape significance. Restoration efforts are likely needed."

The **NHI Peatlands project** (Anderson et al. 2008) was a five-year statewide study conducted by the Bureau of Endangered Resources. The primary goals of the project were 1) to obtain baseline data on the presence/absence, abundance, and distribution of species in multiple taxon groups associated with peatland communities in Wisconsin, and 2) to document selected biotic and abiotic variables that could potentially influence the organisms being studied. The surveys were designed to be replicated in 5-10 years and used to detect changes in biota related to climate change. The project included sites at four properties within the SKMR (Honey Creek Wildlife Area, Lulu Lake SNA, Tichigan Wildlife Area, and Vernon Wildlife Area). All sites were evaluated in the field for inclusion in the Peatlands project, but only the site at Lulu Lake SNA met the criteria for the project.

Important Bird Areas (IBA) are critical sites for the conservation and management of Wisconsin's birds. Lulu Lake SNA, as part of the Southern Kettle Moraine State Forest IBA (WDNR 2007) was recognized because it contains important habitat for both breeding and migrating birds. Grassland birds, forest birds, and birds associated with savannas all breed in the Southern Kettle Moraine. Migrating landbirds also use this area as a stopover site.

The **Wisconsin Ephemeral Ponds Project** (WEPP, Bernthal et al. 2009) developed methods to map Ephemeral Ponds in southeastern Wisconsin. This project identified potential Ephemeral Ponds within the study area, including at Lulu Lake SNA, Honey Creek Wildlife Area, and New Munster Wildlife Area. Future surveys are needed to verify these areas as Ephemeral Ponds.

The Wisconsin Wildlife Action Plan (WAP) recognized one terrestrial **Conservation Opportunity Area** (COA) and two aquatic COAs within the SKMR. Conservation Opportunity Areas are places in Wisconsin that contain ecological features, natural communities, or Species of Greatest Conservation Need (SGCN) habitat for which Wisconsin has a unique responsibility for protection when viewed from the global, continental, upper Midwest, or state perspective (WDNR 2006b)

- Lulu Lake SNA, as part of the Southern Kettle Moraine COA, was recognized for its globally significant bur oak (*Quercus macrocarpa*) openings.
- Turtle Creek Wildlife Area, as part of the Turtle Creek COA, was recognized for having a medium-sized river with Upper Midwest/Regional significance

- Honey Creek Wildlife Area, as part of the Sugar Creek COA, was recognized as having diverse aquatic communities of statewide significance.

The Nature Conservancy’s (TNC) **Prairie-Forest Border Ecoregion Conservation Plan** recognized two “Functional Sites” within the SKMR: Cherry Lake and Kettle Moraine (TNC 2001). Functional Sites are defined as sites that contain one or more small-patch or large-patch plant communities and may or may not include rare species targets. The Cherry Lake site encompasses several floristically rich, large, highly significant wetlands associated with the Fox River System in heavily developed central Racine County. The Southern Kettle Moraine site contains a regionally high concentration of calcareous fens, remnant prairies, oak openings, and forest. It is one of a very small number of sites within the Prairie-Forest Border Ecoregion where restoration of some of the matrix and large patch communities such as oak opening, oak woodland, and prairie is feasible.

Special Management Designations

State Natural Areas are places on the landscape that protect outstanding examples of native natural communities, significant geological formations, and archaeological sites. They harbor natural features essentially unaltered by human-caused disturbances or that have substantially recovered from disturbance over time. Designation confers a significant level of land protection through state statutes, administrative rules, and guidelines. State Natural Areas within the SKMR include Cherry Lake Sedge Meadow SNA, Lulu Lake SNA, and New Munster Bog Island SNA.

Outstanding Resource Waters (ORW) are officially designated (NR 102.11) waters that provide outstanding recreational opportunities, support fish and wildlife habitat, have good water quality, and are not significantly impacted by human activities. Lulu Lake is a designated Outstanding Resource Water. Outstanding Resource Waters typically do not have any point sources discharging pollutants directly to the water (for instance, no industrial sources or municipal sewage treatment plants) and no increases of pollutant levels are allowed. Of Wisconsin’s 15,000 lakes and impoundments, 103 are designated as ORW—fewer than 1%. The Mukwonago River, which flows through Lulu Lake SNA, is also a designated Outstanding Resource Water.

Wetland Gems are designated by the Wisconsin Wetlands Association (WWA) to denote high quality wetland habitats. Critically important to Wisconsin’s biodiversity, these natural treasures also provide our communities with valuable functions and services as well as recreational and educational opportunities. Lulu Lake SNA has been designated a WWA Wetland Gem.

Forest Certification is established on all DNR-managed lands, including state parks, wildlife and fishery areas, and natural areas. Certified forests are recognized by the Forest Stewardship Council and the Sustainable Forestry Initiative as being responsibly managed (WDNR 2009). This certification emphasizes the state’s commitment to responsibly managing and conserving forestlands, supporting economic activities, protecting wildlife habitat, and providing recreational opportunities.

Regional Ecological Context

Southeast Glacial Plains Ecological Landscape

This section is largely reproduced from the Ecological Landscapes of Wisconsin Handbook (WDNR In Prep.). This Handbook was developed by the WDNR Ecosystem Management Planning Team (EMPT) and identifies the best areas of the state to manage for natural communities, key habitats, aquatic features, native plants, and native animals from an ecological perspective.

The WDNR has mapped the state into areas of similar ecological potential and geography called Ecological Landscapes. The Ecological Landscapes are based on aggregations of smaller ecoregional units (Subsections) from a national system of delineated ecoregions known as the National Hierarchical Framework of Ecological Units (NHFEU) (Cleland et al. 1997). These ecoregional classification systems delineate landscapes of similar ecological pattern and potential for use by resource administrators, planners, and managers.

The majority of the SKMR properties are located in the Southeast Glacial Plains Ecological Landscape (WDNR In Prep.), while a small portion (Big Muskego Lake Wildlife Area) is located on the edge of the Southern Lake Michigan Coastal Ecological Landscape (Figure 2). The Southeast Glacial Plains Ecological Landscape borders the Illinois border and covers a large area of southeastern Wisconsin. This ecological landscape is home to some of the world's best examples of continental glacial activity. Drumlins, eskers, kettle lakes, kames, ground and end moraines, and other glacial features are evident throughout the entire area (WDNR 2006a). Most of this Ecological Landscape is composed of glacial materials deposited during the Wisconsin Ice Age (WDNR In Prep.). One area of interest is the interlobate moraine, a long "ridge" that formed between the Green Bay and Lake Michigan lobes during the Wisconsin Glaciation (WDNR 2006a). Other portions of this region offer very moderate relief, with glacial deposits forming the greatest irregularities (Martin 1965). Soils in this landscape vary from poorly drained clayey to well drained loamy soils with a silt loam surface over calcareous loam till.

Historically, vegetation in the Southeast Glacial Plains Ecological Landscape consisted of a mix of prairie, oak forests and savanna, and maple (*Acer* spp.)-basswood (*Tilia americana*) forests. Wet-mesic Prairies, Southern Sedge Meadows, Emergent Marshes, Calcareous Fens, and tamarack swamps were found in poorly drained, wetter portions of the Landscape. End moraines and drumlins supported savannas and forests. Agricultural and urban land use practices have drastically changed the land cover of the landscape since Euro-American settlement. The current vegetation is primarily agricultural cropland. Forests currently occupy only about 10% of the land area, and dominant cover types include oak (*Quercus* spp.), maple-basswood, and lowland hardwoods. No large areas of contiguous forest exist today except within the Kettle Moraine State Forest on the Kettle Interlobate Moraine, which has relatively rugged topography that is often ill-suited for row-crop agriculture.

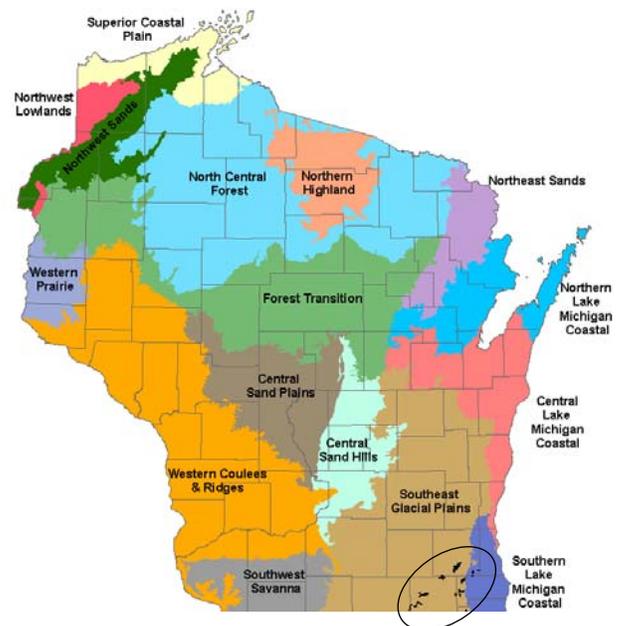


Figure 2: Ecological Landscapes of Wisconsin and the study area.

Regional Biodiversity Needs and Opportunities

Opportunities for sustaining natural communities in the Southeast Glacial Plains Ecological Landscape were developed by the Ecosystem Management Planning Team (2007) and are presented in the Wisconsin Wildlife Action Plan (WDNR 2006b). The goal of sustaining natural communities is to manage for natural community types that historically occurred in a given landscape and have a high potential to maintain its characteristic composition, structure, and ecological function over a long period of time (e.g., 100 years). This list can help guide land and water management activities so that they are compatible with the local ecology of the Ecological Landscape while maintaining important components of ecological diversity and function. These are the most appropriate community types that could be considered for management activities within the Southeast Glacial Plains Ecological Landscape.

There are management opportunities for 38 natural communities in the Southeast Glacial Plains Ecological Landscape. Of these, 21 are considered “major” opportunities (Table 1). A “major” opportunity indicates that the natural communities can be sustained in the Ecological Landscape, either because many significant occurrences of the natural community have been recorded in the landscape or major restoration activities are likely to be successful in maintaining the community’s composition, structure, and ecological function over a longer period of time. An additional 13 natural communities are considered “important” in this landscape. An “important” opportunity indicates that although the natural community does not occur extensively or commonly in the Ecological Landscape, one to several occurrences do occur and are important in sustaining the community in the state. In some cases, important opportunities may exist because the natural community may be restricted to just one or a few Ecological Landscapes within the state and there may be a lack of opportunities elsewhere.

Table 1. Major Natural Communities Management Opportunities in the Southeast Glacial Plains Ecological Landscape (EMPT 2007 and WDNR 2006b)

Bog Relict	Emergent Marsh	Oak Opening	Southern Sedge Meadow
Calcareous Fen	Floodplain Forest	Oak Woodland	Southern Tamarack Swamp (rich)
	Impoundments/Reservoirs		
Dry Cliff	*	Shrub Carr	Surrogate Grasslands
Dry Prairie	Inland lakes*	Southern Dry Forest	Warmwater rivers*
Dry-mesic Prairie	Mesic Prairie	Southern Dry-mesic Forest	Warmwater streams*
			Wet-mesic Prairie

*Natural Communities that were listed in the Wisconsin Wildlife Action Plan only.



Longear sunfish (State Threatened, SGCN) occurs in pristine streams in the study area. Photo by John Lyons, WDNR.

Rare Species of the Southeast Glacial Plains Ecological Landscape

Numerous rare species are known from the Southeast Glacial Plains Ecological Landscape. “Rare” species include all of those species that appear on the WDNR’s NHI Working List (*Wisconsin Natural Heritage Working List*) classified as “Endangered,” “Threatened,” or “Special Concern.” Table 2 lists the number of species known to occur in the Southeast Glacial Plains Ecological Landscape based on information stored in the NHI database as of November 2009.

Table 2. Rare species in the Southeast Glacial Plains Ecological Landscape by Listing Status as of November 2009 (Listing Status is based on NHI Working List published April 2009).

Listing Status	Birds	Fishes	Herptiles	Invertebrates	Mammals	Plants	Total Fauna	Total Flora	Total Rare
WI Endangered	8	4	7	11		10	30	10	40
WI Special Concern	19	10	6	61	5	71	101	71	172
WI Threatened	10	6	3	5		28	24	28	52
U.S. Candidate			1				1	0	1
U.S. Endangered				2			2	0	2
U.S. Threatened						2	0	2	2

The Wisconsin Wildlife Action Plan denoted Species of Greatest Conservation Need (SGCN). Species of Greatest Conservation Need are animals that have low and/or declining populations that are in need of conservation action. They include various birds, fish, mammals, reptiles, amphibians, and invertebrates (e.g. dragonflies, butterflies, and freshwater mussels) that are:

- Already listed as threatened or endangered;
- At risk because of threats to their life history needs or their habitats;
- Stable in number in Wisconsin, but declining in adjacent states or nationally;
- Of unknown status in Wisconsin and suspected to be vulnerable.

SGCN status is independent of State Listing Status and the NHI Working List. Most but not all SGCNs are on the NHI Working List (published April 2009); in addition, the NHI Working List also includes rare species that are not designated as SGCN. There are 62 vertebrate SGCN significantly associated with the Southeast Glacial Plains Ecological Landscape (Appendix E). This means that the species is (and/or historically was) significantly associated with the Ecological Landscape, and restoration of natural communities this species is associated with in the Ecological Landscape would significantly improve conditions for the species.

Description of the Study Area

Location and Size

The SKMR is a cluster of Wildlife Areas and State Natural Areas located in Kenosha, Racine, Rock, Walworth, and Waukesha counties (Figure 1). Comprising ca. 12,623 acres, the properties occur around and along several regionally significant water bodies including Big Muskego Lake, Mukwonago River, Lulu Lake, Honey Creek, Turtle Creek, Tichigan Lake, Turtle Lake, and the Fox River.

Properties included in the SKMR are:

- **Big Muskego Lake Wildlife Area** (480 acres) is located in southeast Waukesha County around Big Muskego Lake, just southwest of Milwaukee and northwest of STH 36.
- **Honey Creek Wildlife Area** (1,070 acres), including Cherry Lake Sedge Meadow SNA, is located in western Racine County, north of the city of Burlington and northwest of STH 36.
- **Lulu Lake State Natural Area** (1,521 acres) is located on the border of Walworth and Waukesha counties, about 3 miles northwest of the village of East Troy.
- **New Munster Wildlife Area** (1,283 acres), including New Munster Bog Island SNA, is located in western Kenosha County about 6 miles west of the Village of Paddock Lake off of HWY KD.
- **Tichigan Wildlife Area** (1,341 acres) is located in northwest Racine County about 4 miles northwest of the village of Waterford off of Marsh Road.
- **Turtle Creek Wildlife Area** (731 acres) is located in western Walworth and eastern Rock Counties and snakes along 10 miles of Turtle Creek.
- **Turtle Valley Wildlife Area** (1,852 acres) is located in western Walworth County, northwest of the city of Elkhorn.
- **Vernon Wildlife Area** (4,345 acres) is located just north of the village of Mukwonago in eastern Waukesha County.

Ecoregion

Nested hierarchically within each Ecological Landscape are Subsections derived from the NHFEU and each Subsection is further divided into Landtype Associations (LTAs) (Cleland et al. 1997). The Subsections most relevant to this study are Rock River Old Drift County, Geneva/Darien Moraines and Till Plains, and Kenosha/Lake Michigan Plain and Moraines. Nested within these Subsections are seven LTAs, which typically represent an area of 10,000 – 300,000 acres and contain similarities of landform, soil, and vegetation. The following LTAs are within the study area (Figure 3):

- **Heart Prairie-Burlington Plains (222Kf03)**. The characteristic landform pattern is undulating outwash plain with kames, lake plains, remnant moraines, and swamps common. Soils are predominantly well drained loam over calcareous gravelly sandy outwash. This LTA comprises 72% of the SKMR.
- **East Troy Lakes (222Kf05)**. The characteristic landform pattern is rolling pitted outwash plain with many lakes. Soils are predominantly well drained loam over calcareous gravelly sandy outwash. This LTA comprises 14% of the SKMR.
- **Rock River Prairies (222Kh03)**. The characteristic landform pattern is nearly level outwash plain. Soils are predominantly well drained silt over calcareous gravelly sandy outwash or silty and sandy lacustrine. This LTA comprises 5% of the SKMR.
- **Muskego Lowlands (222Kg03)**. The characteristic landform pattern is nearly level lake plain and marsh. Soils are predominantly poorly drained silt or muck over calcareous silty and clayey lacustrine. This LTA comprises 4% of the SKMR.

- Geneva Moraines (222Kf01). The characteristic landform pattern is undulating till plain with hummocky moraines, scattered lake plains, and low drumlins. Soils are predominantly well drained silt and loam over calcareous sandy loam till. This LTA comprises 2% of the SKMR.
- Waukesha Drumlins (222Kf02). The characteristic landform pattern is rolling till plain with drumlins, swamps and kame terraces common. Soils are predominantly well drained loam and silt over calcareous loam till. This LTA comprises 1% of the SKMR.
- Wheatland Prairies (222Kf04). Landforms are nearly level alluvial plain with old swales, levees, fans, terraces, and swamps common. Soils are predominantly moderately well drained loam and clay over calcareous silty and clayey alluvium, lacustrine, or sandy outwash. This LTA comprises 1% of the SKMR.
- Racine-Kenosha Prairie and Savanna (222Kg01). The characteristic landform pattern is undulating till plain and hummocky moraines with stream terraces, floodplains, and lake plains common. Soils are predominantly moderately well drained silt and clay over calcareous silty clay loam till. This LTA comprises <1% of the SKMR.



The Mukwonago River meanders through Southern Sedge Meadow and Emergent Marsh toward Lulu Lake and distant Oak Woodland in the East Troy Lakes (222Kf05) LTA within the Geneva/Darien Moraines and Till Plains Subsection. Photo by Ryan P. O'Connor, WDNR.

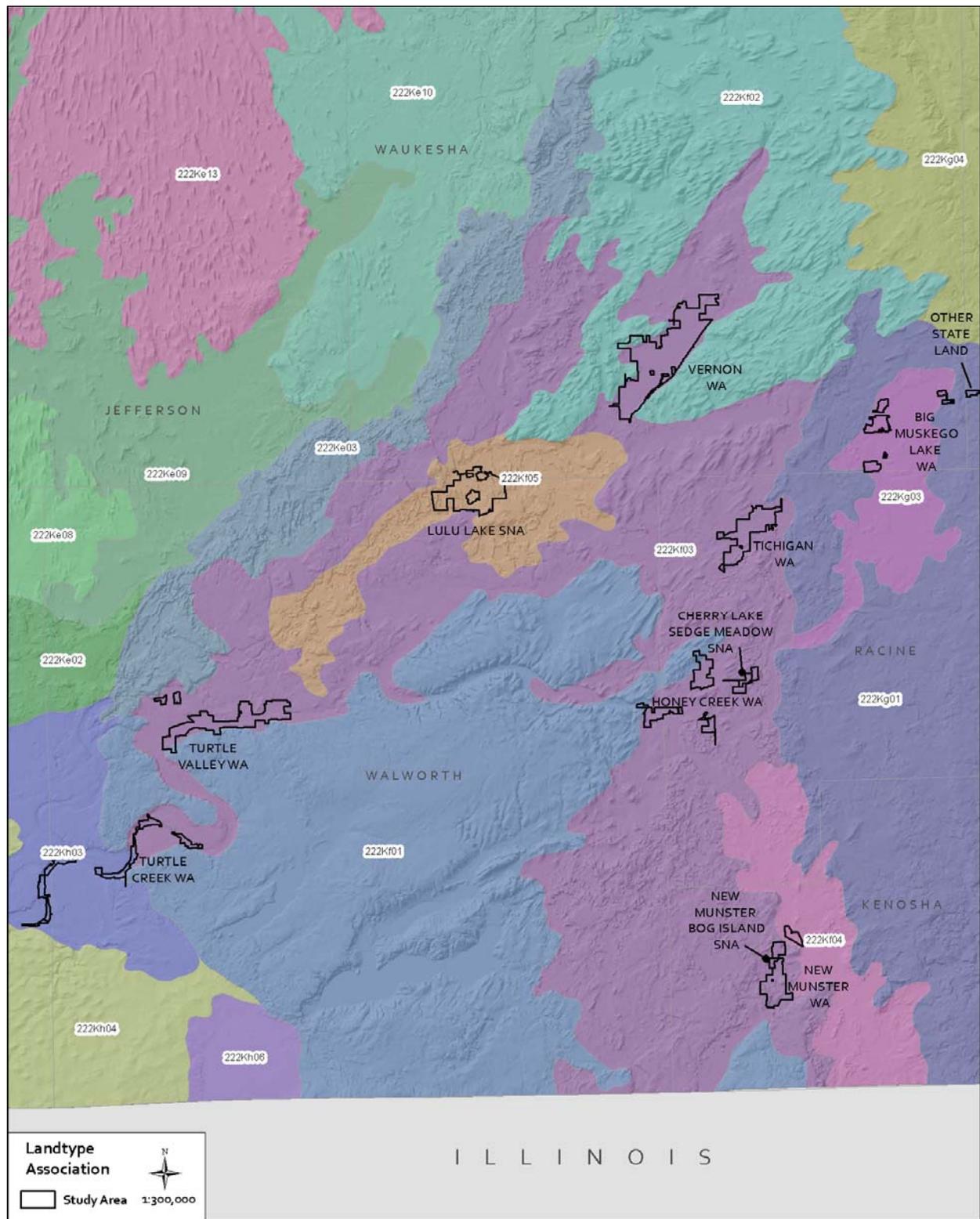


Figure 3: Landtype Associations of the study area.

Physical Environment

Geology and Geography

The SKMR is underlain by Silurian dolomite of the Niagara Formation (WDNR In Prep.) with a bedrock depth that is between 50 and over 100 feet. Turtle Creek Wildlife Area is located in the outwash plain south of the late Wisconsin maximum of the Green Bay and Lake Michigan Lobes (Dott and Attig 2004). The rest of the SKMR is located just east of the interlobate region of the Green Bay and Lake Michigan lobes in a till plain deposited by several glaciations that is 300 feet thick at one location (Dott and Attig 2004).

Soils

The majority of the soils of the SKMR are hydric soils. Properties within the landscape formed by the Lake Michigan Lobe, can be calcareous loamy till, outwash, or loamy lacustrine material (WDNR In Prep.). Moraine uplands have soils formed in brown calcareous sandy loam to loam till. They range from well drained to somewhat poorly drained and generally have silt loam surface textures, moderate to slow permeability, and moderate to high available water capacity.

The outwash plains have upland soils formed in loamy alluvium or loess surfaces over calcareous outwash sand and gravel (WDNR In Prep.). They range from well drained to somewhat poorly drained and generally have silt loam to loam surface textures, moderately rapid to moderate permeability, and moderate available water capacity.

The lake plains have soils formed in calcareous loamy to silty lacustrine (WDNR In Prep.). They range from well drained to somewhat poorly drained and generally have silty loam surface textures, moderate to slow permeability, and moderate to very high available water capacity. Most lowland soils are very poorly drained non-acid muck, but include silty and clayey lacustrine and loamy till.

Hydrology

All of the SKMR is within the Mississippi River Basin, and, with the exception of Turtle Creek and Turtle Valley Wildlife Areas, is within the Southeast Fox River Basin. Turtle Creek and Turtle Valley Wildlife Areas are within the Lower Rock River Basin. Other important rivers and streams of this region include the Fox, Mukwonago, and Turtle Creek.

The Fox River is a relatively undeveloped river corridor that passes through several medium and small cities, but for the most part flows through farmlands and wetlands as it meanders south into Illinois and eventually the Illinois River. The river, whose headwaters drain off the Southern Unit of the Kettle Moraine State Forest, supports a fairly good fishery consisting of channel catfish (*Ictalurus punctatus*), yellow bass (*Morone mississippiensis*), white bass (*Morone chrysops*), smallmouth bass (*Micropterus dolomieu*), northern pike (*Esox lucius*), walleye (*Sander vitreus*) and panfish. Its ecological significance is highlighted by the fact that it provides habitat for at least seven endangered or threatened species of birds, fish and mussels in Wisconsin. (WDNR 2006a).

The Mukwonago River, which flows through Lulu Lake SNA and is within the Southeast Fox River Basin, is a very high quality stream containing an enormous diversity of aquatic species. It is fed by a complex of lakes and springs and flows through a scenic area of hilly, glacial moraine topography. The watershed is home to 40 species of fish and is believed to harbor the largest assemblage of native mollusk species in the state. Three of the fish species and three of the mussel species are either endangered or threatened. About eight miles of the Mukwonago River, upstream from Phantom Lake and within Lulu Lake SNA, are Class I or Class II trout stream. Sedge meadows and cattail marshes border the

Mukwonago River in many places and are important in maintaining water quality and flow. Oak savanna, prairie, bog relicts and springs are also found adjacent to the stream corridor. (WDNR 2006a).

Turtle Creek, a major tributary to the Lower Rock River, is an Area of Special Natural Resource Interest (ASNRI) because it supports rich and diverse mussel and fish populations and populations of rare species. Turtle Creek's cobble-lined bed harbors one of the best smallmouth bass populations in southern Wisconsin. (WDNR 2006a).

Lakes are uncommon in the SKMR, with Lulu Lake being the only natural lake. Impoundments are located on a few properties, creating open water habitat used by some species, and include Tichigan Lake and Big Muskego Lake .

Vegetation

Historical Vegetation

Data from Wisconsin's original Public Land Surveys are often used to infer vegetation cover types prior to widespread Euro-American settlement. The purpose of examining historical conditions is to identify ecosystem factors that formerly sustained species and communities that are now altered in number, size, or extent, or which have been changed functionally (for example, by constructing dams, or suppressing fires). Although data are limited to a specific snapshot in time, they provide valuable insights into Wisconsin's ecological capabilities. Maintaining or restoring some lands to more closely resemble historic systems and including some structural or compositional components of the historic landscape within actively managed lands can help conserve important elements of biological diversity (WDNR In Prep.).

Public Land Surveys for the SKMR were completed between 1836 and 1840. Finley's (1976) map of the Early Vegetation of Wisconsin (Figure 4) identifies the study areas as being dominated by marsh, sedge meadow, wet prairie, and lowland shrubs with oak forests [white oak (*Quercus alba*), black oak (*Q. velutina*), and bur oak] and Oak Openings (bur oak, white oak, and black oak). Also present were prairie and hardwood forests [sugar maple (*Acer saccharum*), basswood, red oak (*Quercus rubra*), white oak, and black oak].



A massive, open grown white oak bears witness to presettlement savanna at Tichigan Wildlife Area. Photo by Ryan P. O'Connor, WDNR.

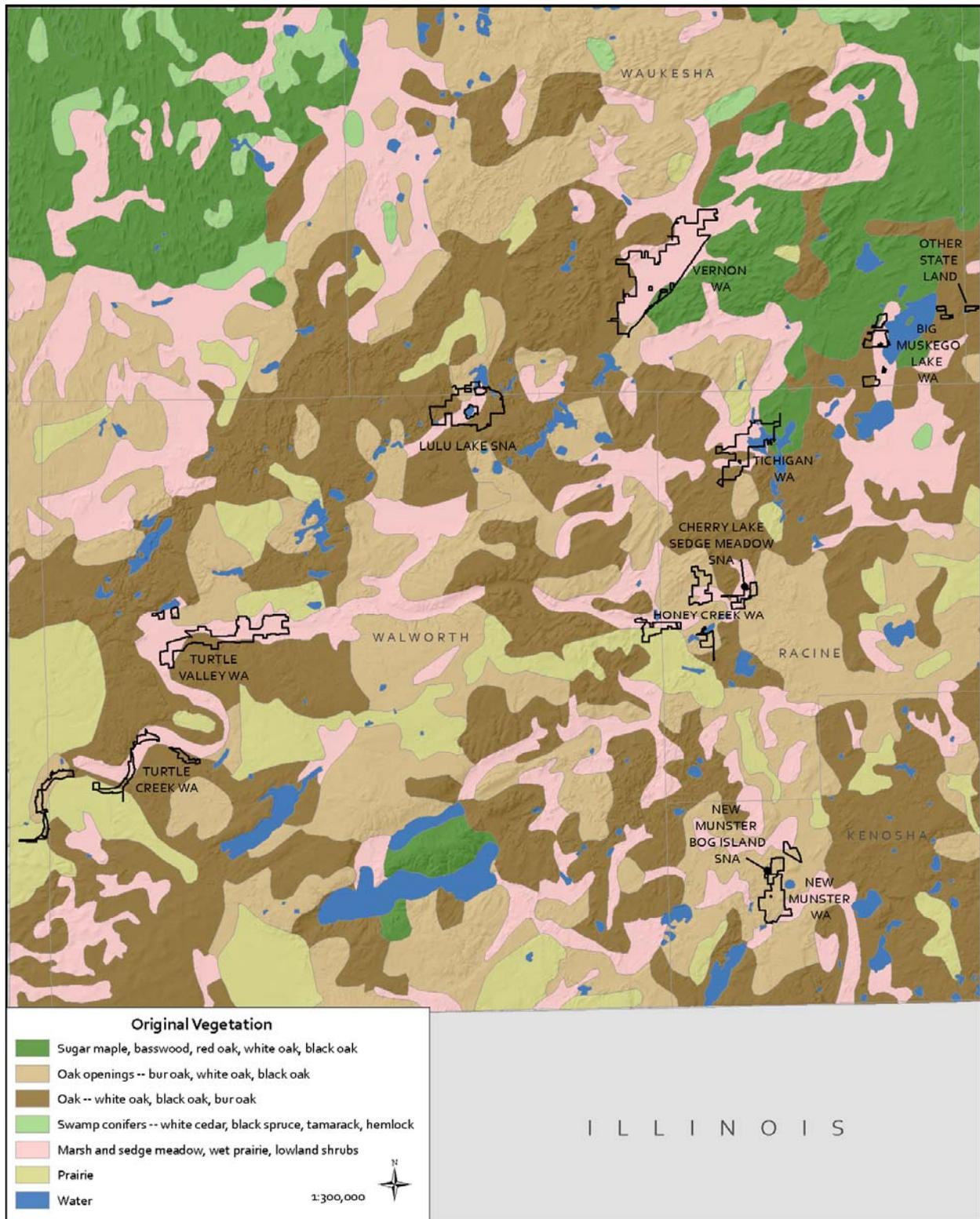


Figure 4: Vegetation of the study area prior to Euro-American settlement (Finley 1976).

Current Vegetation

Current vegetation of the SKMR has been influenced by many historical factors including grazing, homesteads, unregulated logging during the “cutover” period, and wildfires; as well as current factors including fire suppression, non-native invasive species, forest management, ecological restoration, and recreation; and environmental factors including geology, soils, hydrology, and climate. The landscape surrounding the SKMR is largely agriculture, large metropolitan areas, and scattered small woodlots (Figure 5).

Currently most of the properties are comprised of wetlands, including Emergent and Submergent Marsh, Southern Sedge Meadow, Southern Hardwood Swamp, Southern Tamarack Swamp (rich), Shrub-carr, and Wet Prairie. Several areas of Calcareous Fen and Springs and Spring Runs add to the overall diversity of the wetlands. The uplands are comprised of Southern Dry-mesic Forest, old fields, prairie plantings, pine and spruce plantations, farmland, and occasional small areas of Dry Prairie. Current vegetation is described by property, listed alphabetically.

Big Muskego Lake Wildlife Area

The most significant natural community at Big Muskego Lake Wildlife Area is the large Emergent Marsh that surrounds the lake.

In the Emergent Marsh, open water grades into floating vegetation islands that are ideal habitat for colonial nesting water birds. This transitions into dense cattail marsh dominated by broad-leaved cat-tail (*Typha latifolia*) and narrow-leaved cat-tail (*T. angustifolia*) with some reed canary grass (*Phalaris arundinacea*) and common reed grass (*Phragmites australis*) mixed in.

The uplands surrounding the site are a mix of disturbed Shrub-carr, Southern Mesic Forest, small overgrown bur oak groves with a dense understory of common buckthorn (*Rhamnus cathartica*), small areas of Mesic Prairie plantings, active agriculture, fallow fields, and rural and suburban residential areas.

Honey Creek Wildlife Area

The highest quality natural communities at Honey Creek Wildlife Area are located in and adjacent to the Cherry Lake Sedge Meadow SNA. This area includes Southern Sedge Meadow, Emergent Marsh, Southern Tamarack Swamp, and, just outside the current SNA boundary, an Oak Woodland.

This property primarily consists of large glacial outwash basins and channels dominated by Emergent Marsh, Southern Sedge Meadow, and Southern Tamarack Swamp bordered by degraded Southern Dry-mesic Forest on adjacent coarse-textured moraines and eskers. The nicest wetlands occur in the eastern-most portion and are part of the Cherry Lake Sedge Meadow SNA, which include Southern Sedge Meadow dominated by sedges [common lake sedge (*Carex lacustris*), woolly-fruit sedge (*C. lasiocarpa*), and water sedge (*C. aquatilis*)] and contains plants that tolerate both alkaline and acid soil conditions. Large portions are also dominated by narrow-leaved cat-tail. The area north of the Sedge Meadow historically supported a small Calcareous Fen. However, this area is now completely dominated by glossy buckthorn (*Rhamnus frangula*). Also part of the SNA is a Southern Tamarack Swamp (rich), dominated by tamarack (*Larix laricina*) with a dense understory of glossy buckthorn. Adjacent uplands are outside the current SNA boundary and include an esker that runs along the west boundary of the site and a moraine to the south. These areas have been grazed in the past and support restorable Oak Woodland dominated by red oak, white oak, and bur oak as well as small degraded Dry-mesic Prairie. However, non-native invasive shrubs are common throughout most of the understory of the forest and 95% of the former prairie/savanna areas, creating impenetrable thickets in places.

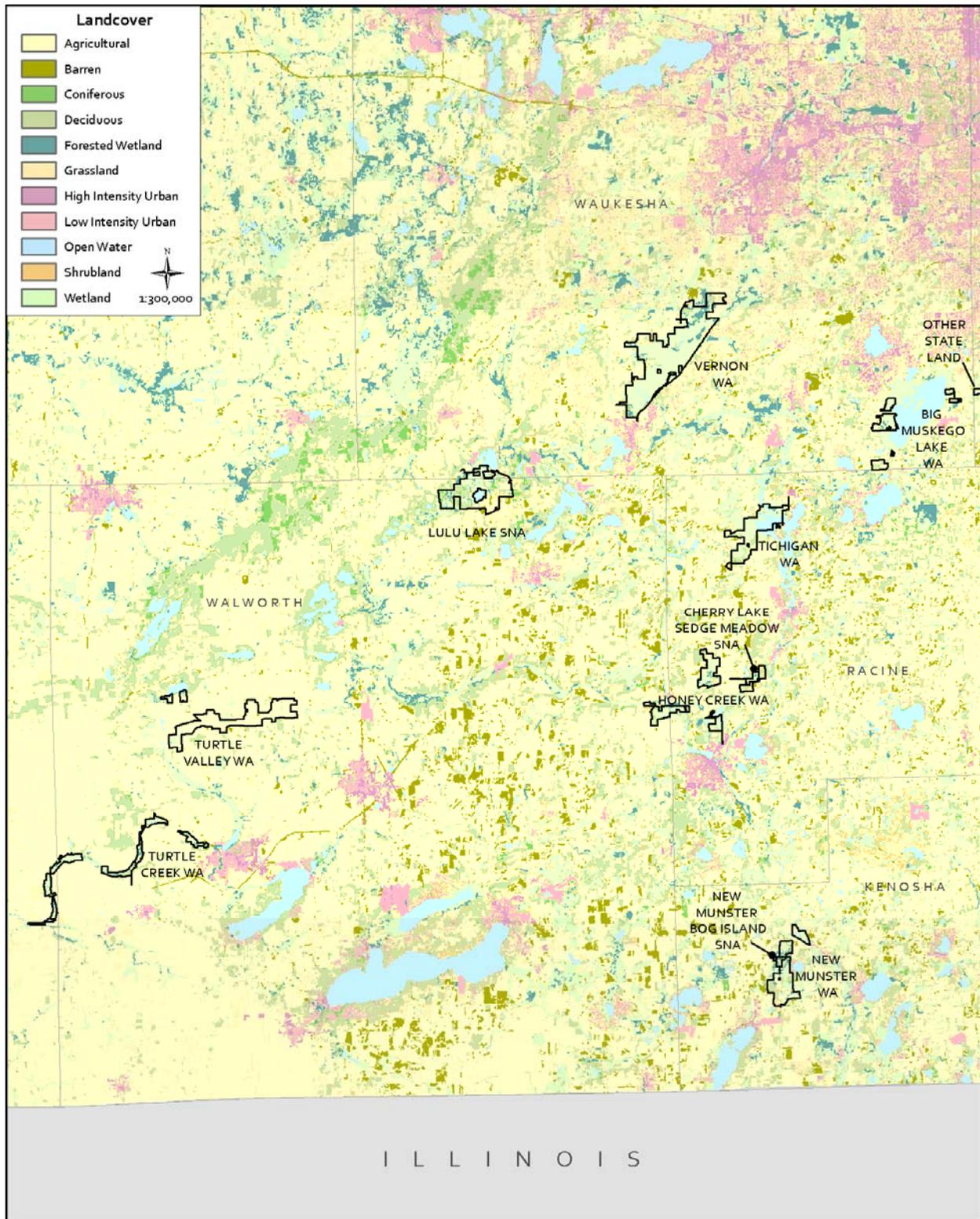


Figure 5: Landcover for the SKMR from the Wisconsin DNR Wisland GIS coverage (WDNR 1993).

The

east-central portion of Honey Creek Wildlife Area is made up of a very large Emergent Marsh dominated by hybrid cat-tail (*Typha X glauca*) and narrow-leaved cat-tail and young, highly degraded lowland and upland forest dominated by early successional trees such as aspen (*Populus* spp.) and boxelder (*Acer negundo*). A very small Wet-mesic Prairie is also present. The west-central portion is similar, with a large wetland complex including Southern Sedge Meadow and Shrub-carr grading into a large Emergent Marsh dominated by narrow-leaved cat-tail. Uplands consist of moderate quality Southern Dry-mesic Forest. Finally, the western-most portion consists of a large Emergent Marsh, again dominated by narrow-leaved and hybrid cattail.

Lulu Lake State Natural Area

Lulu Lake SNA supports numerous high-quality natural communities of particular importance including savannas such as Oak Woodland and globally significant Oak Openings. Wetland complexes are also of exceptional quality and include Calcareous Fen, Southern Sedge Meadow, Shrub-carr, and Bog Relict. Lulu Lake supports at least ten rare animals including a rare bird, a rare reptile, and several rare fishes as well as rare invertebrates. This area is also tremendously rich floristically and supports 25 rare plant species.

Oak Woodland is dominated by red, white, and bur oaks with a moderate shrub layer and a moderately dense herbaceous ground layer of both forest and savanna species. Oak Openings are dominated by bur oak and contain a dense herbaceous ground layer dominated by savanna species such as shooting-star (*Dodecatheon meadii*), Carolina vetch (*Vicia caroliniana*), sunflowers (*Helianthus* spp.), and tick-trefoils (*Desmodium* spp.). Oak-dominated uplands grade into high-quality open-canopied wetland complexes with patches of Calcareous Fen and Shrub-carr embedded within a Southern Sedge Meadow matrix surrounding the Mukwonago River and the 95-acre, 40-foot deep Lulu Lake. Calcareous Fen is limited to small areas of groundwater upwelling and is dominated by sedges [fen star sedge (*Carex sterilis*), common stiff sedge (*C. tetanica*), tussock sedge (*C. stricta*), Buxbaum's sedge (*C. buxbaumii*), etc.] and shrubby cinquefoil (*Potentilla fruticosa*). Shrub-carr is dominated by Bebb's willow (*Salix bebbiana*), pussy willow (*S. candida*), bog birch (*Betula pumila*) and poison sumac (*Toxicodendron vernix*) with a tussock sedge ground layer. Southern Sedge Meadow is dominated by sedges [tussock sedge, water sedge, and prairie sedge (*C. prairea*)] and bluejoint grass (*Calamagrostis canadensis*).

East of Lulu Lake lies a small but significant Bog Relict surrounding a small kettle lake. The bog is dominated by leatherleaf (*Chamaedaphne calyculata*), poison sumac, Bebb's willow, bog birch, blueberry (*Vaccinium* sp.), bog rosemary (*Andromeda glaucophylla*), woolly-fruit sedge and Sphagnum moss. Tamarack is also locally dominant. As with other wetland communities, the Bog Relict is surrounded by moderate to high-quality Oak Woodland as well as old fields, prairie remnants, and prairie plantings.

New Munster Wildlife Area

The highest quality natural communities at the New Munster Wildlife Area are the Southern Dry-mesic Forest island that forms the centerpiece of the New Munster Bog Island SNA and the surrounding Shrub-carr and Southern Sedge Meadow.

This site occupies a broad wetland basin between upland moraines. The small but significant Southern Dry-mesic Forest occurs on a kame, surrounded by Shrub-carr, and is the main feature of the New Munster Bog Island SNA. The forest is dominated by large old-growth red and white oaks, including some up to 40 inches dbh, and a dense shrub layer of non-native invasive and native species. The remainder of the SNA is comprised of thick Shrub-carr dominated by a dense tangle of willow, dogwood (*Cornus* spp.), common buckthorn, and Bell's honeysuckle (*Lonicera X bella*), as well as scattered tamarack, yellow birch (*Betula alleghaniensis*) and Purpus' birch [*B. X purpusii* (= *B. alleghaniensis X B. pumila*)]. Shrub-carr extends significantly outside the current SNA boundary and transitions into

Southern Sedge Meadow with pockets of Calcareous Fen and narrow-leaved cat-tail-dominated Emergent Marsh. These open wetlands include areas of invasive reed canary grass and scattered common reed grass. A small share-cropped agricultural field occurs on a small upland ridge surrounded by Shrub-carr just east of the SNA boundary.

The northern-most and southern portion of the property contain formerly grazed uplands with disturbed Southern Dry-mesic Forest dominated by large oaks and eastern red cedar (*Juniperus virginiana*), and conifer plantations, all with a dense understory of non-native invasive shrubs. A small Oak Woodland is located in the southwest corner of the property interspersed with small prairie remnants and old fields replanted to prairie.

Tichigan Wildlife Area

The highest quality natural communities at Tichigan Wildlife Area are Wet Prairie, Calcareous Fen, and Springs and Spring Runs. Large areas of Emergent Marsh are also important for wildlife species.

Wet Prairie occurs at the north portion of the property just west of where the Fox River enters Tichigan Lake, and is embedded in a wetland complex that includes Shrub-carr and Southern Sedge Meadow. The Wet Prairie is dominated by a dense herb layer of big bluestem (*Andropogon gerardii*) along with giant goldenrod (*Solidago gigantea*), prairie cordgrass (*Spartina pectinata*), Virginia mountain mint (*Pycnanthemum virginianum*), prairie loosestrife (*Lysimachia quadriflora*), and Joe-pye-weed (*Eupatorium maculatum*) interspersed with shrubs such as silky dogwood (*Cornus amomum*), glossy buckthorn and shrubby cinquefoil. Southern Sedge Meadow pockets include tussock sedge-dominated areas with a moderate to sparse shrub layer of silky dogwood and red osier dogwood (*C. stolonifera*). Narrow-leaved cat-tail is scattered throughout the wettest portions of the site, and several excavated wildlife ponds are also present.

In the southern portion of the Wildlife Area, an area of high-quality Calcareous Fen and Springs and Spring Runs occur in wetlands maintained by groundwater emanating from the base of a gravelly moraine and esker. Both seeps and bubbling springs are present and are often surrounded by sparsely vegetated marl flats. Springs and Calcareous Fen occur on both the east and west sides of the esker, with those on the east side being larger and higher in quality. Large portions of the site have been invaded by glossy buckthorn and are succeeding to low-quality Shrub-carr, while narrow-leaved cat-tail has invaded wet areas in the far eastern portions of the site. Characteristic species of the Calcareous Fen include shrubby cinquefoil, Virginia mountain-mint, grass-of-Parnassus (*Parnassia glauca*), big bluestem, Kalm's lobelia (*Lobelia kalmii*), Riddell's goldenrod (*Solidago riddellii*), and numerous fen sedges [tussock sedge, bristle-stalked sedge (*C. leptalea*), common stiff sedge, fen star sedge, and prairie sedge]. The esker and moraine supports Oak Openings dominated by large (over 24 inches dbh) bur oak, white oak, red oak, and black oak along with American basswood and shagbark hickory (*Carya ovata*), with a dense understory of common buckthorn, gray dogwood (*Cornus racemosa*), and prickly-ash (*Zanthoxylum americanum*).

Extensive Emergent Marshes on the property are dominated by narrow-leaved cat-tail and have experienced significant hydrologic alteration from ditching and excavation of ponds. Also present on the property are a Southern Hardwood Swamp, small pockets of Wet-mesic Prairie, and areas of old fields and prairie plantings.

Turtle Creek Wildlife Area

The highest quality natural communities in the Turtle Creek Wildlife Area are comprised of wetland complexes of Calcareous Fen, Shrub-carr, Southern Sedge Meadow, and Emergent Marsh. The best of these complexes occurs in the western portion of the property near the Rock/Walworth County line, with a smaller wetland complex dominated by Southern Sedge Meadow occurring in the eastern part of the

property about 2.5 miles northwest of the village of Delavan. Turtle Creek Wildlife Area supports several rare animals including rare fishes, mussels, and reptiles, as well as several rare plants.

The property occurs along approximately 10 miles of a narrow corridor along Turtle Creek, with the property ranging from 50 meters to 500 meters in width. Wetland communities dominate the property, much of which is low to moderate quality, with locally abundant reed canary grass, especially along the creek margins and adjacent low-lying silt deposits.

The high-quality wetland complex on the Walworth-Rock County line centered around CTH C includes a mosaic of Calcareous Fen, Spring and Spring Runs, Shrub-carr, Southern Sedge Meadow, and Emergent Marsh. Areas with active groundwater flow are highest in quality with hanging fens occurring on short slopes interspersed with numerous small Springs and Spring Runs. Below the slope, communities grade into Shrub-carr and Southern Sedge Meadow, and in the wettest areas, Emergent Marsh dominated by cat-tail. In addition, a small but unplowed bluff prairie is present on an east-facing slope overlooking Turtle Creek. Otherwise, the uplands are very degraded with second- and third-growth hardwoods, including many weedy species such as black locust (*Robinia pseudoacacia*). Non-native invasive shrubs and garlic mustard (*Alliaria petiolata*) are abundant in the uplands in both forested and non-forested habitats. Much of the wetlands and adjacent uplands were heavily grazed prior to state acquisition.

A relatively large Southern Sedge Meadow mixed with Shrub-carr occurs on the north side of Turtle Creek about 2.5 miles northwest of the village of Delavan. The sedge meadow is fed hydrologically by a small unnamed creek and several small seeps. Dominant species include tussock sedge, shining aster (*Aster firmus*), giant goldenrod, Joe-pye-weed, and silky dogwood. Shrub-carr-dominated areas are characterized by tussock sedge beneath scattered Bebb's willow, silky dogwood, bog birch, trembling aspen saplings (*Populus tremuloides*), and glossy buckthorn.

Turtle Valley Wildlife Area

The highest quality natural communities at Turtle Valley Wildlife Area comprise a small wetland complex of Southern Sedge Meadow and Shrub-carr southwest of Turtle Lake.

The calcareous Southern Sedge Meadow is dominated by tussock sedge and bluejoint grass, and grades into Shrub-carr dominated by shrubby cinquefoil, bog birch, willows and common buckthorn. Other indicator graminoids and forbs present include narrow-leaved cotton-grass (*Eriophorum angustifolium*), asters (*Aster* spp.), and goldenrods including giant goldenrod (*Solidago gigantea*), Riddell's goldenrod (*S. riddellii*), and Ohio goldenrod (*S. ohioensis*). Reed canary grass is also common. Elsewhere, Turtle Valley is largely dominated by old fields, prairie plantings, common buckthorn thickets, and cat-tail-dominated Emergent Marsh.

Vernon Wildlife Area

The highest quality natural community at Vernon Wildlife Area is the Calcareous Fen (Vernon Fen) located at the southern edge of the property. Several rare plants occur on the Wildlife Area.

Calcareous Fen occurs in an area of hydrologic upwelling on the southern portion of the property. This upwelling has created hanging fens, areas with peat soils on moderate slopes, which occur just above springs that emerge from the base of the slopes. Braided spring runs and bubbling springs coalesce into a small but clear, fast-flowing stream. The fen is densely vegetated with a sparse to moderate shrub layer of glossy buckthorn and shrubby cinquefoil, and gives way to herb-dominated marl flats near the spring runs. Characteristic species here include hair beak-rush (*Rhynchospora capillacea*), short-headed rush (*Juncus brachycephalus*), Joe-pye-weed, glossy buckthorn, and several species of spikerush (*Eleocharis* spp.).

The remainder of Vernon Wildlife Area is centered around the Fox River, which is surrounded by an extensive Emergent Marsh dominated by narrow-leaved and hybrid cat-tails with reed canary grass and common reed grass also present. Vernon Marsh has 5 flowages where water level is managed by control structures. Water level management is used to achieve the goal of hemimars conditions (50% emergent vegetation; 50% open water). During migration at least one flowage is drawn down and maintained as mud flats for migrating shorebirds. Occasionally water levels are completely drawn down for carp control (B. Glenzinski, pers. com.). Emergent Marsh gives way to a wetland complex of varying quality Wet-mesic Prairie, Southern Sedge Meadow, Southern Tamarack Swamp (rich) and Shrub-carr. Frequently, small patches of native species like big bluestem, prairie cordgrass, woolly-fruit sedge, bluejoint grass, slender willow (*Salix petiolaris*) and pussy willow intergrade with reed canary grass and common reed grass. The presence of these two invasive grasses limits the overall quality of the site. Past hydrologic disturbance in the form of ditching is evident and likely contributes to the wide distribution of non-native invasive species.

Small areas of Southern Dry-mesic Forest also occur in the northeast portion of the property, and are dominated by 12-18 inch dbh white oak along with lesser amounts of red oak, white ash (*Fraxinus americana*), black cherry (*Prunus serotina*), American basswood, sugar maple, shagbark hickory, hop-hornbeam (*Ostrya virginiana*), common buckthorn, and prickly-ash. Prairie plantings are also scattered among old fields across the property.



Globally rare Oak Openings at Lulu Lake SNA support a carpet of shooting-star in spring.
Photo by Ryan P. O'Connor, WDNR.

Rare Species and High Quality Natural Communities of the Southern Kettle Moraine Region Planning Group

Numerous rare species and high-quality examples of native communities have been documented within the SKMR. Table 3 shows the rare species and high-quality natural communities currently known from the SKMR and listed by property. For summary descriptions for the species and natural communities that occur on the SKMR, see Appendix C. For an explanation of state and global ranks, as well as state status, see Appendix D.

Table 3. Documented rare species and high-quality natural communities for the Southeast Kettle Moraine Region Planning Group (State Rank and Listing Status is based on NHI Working List published April 2009).

Common Name	Scientific Name	Last Observed Date	State Rank	Global Rank	State Status	Federal Status	SGCN	Tracked by NHI
Animal								
A Crawling Water Beetle	<i>Haliplus canadensis</i>	2010	S2	GNR	SC/N		Y	Y
A Long-horned Casemaker Caddisfly	<i>Oecetis nocturna</i>	2010	S1S3	G5	SC/N		Y	Y
A Water Scavenger Beetle	<i>Laccobius agilis</i>	2010	S2S3	GNR	SC/N		Y	Y
Acadian Flycatcher	<i>Empidonax virescens</i>	2009	S3B	G5	THR		Y	Y
American Bittern	<i>Botaurus lentiginosus</i>	2010	S3B	G4	SC/M		Y	Y
American Bullfrog	<i>Lithobates catesbeianus</i>	2010	S3	G5	SC/H		N	Y
Bald Eagle	<i>Haliaeetus leucocephalus</i>	2008	S4B,S2N	G5	SC/P		Y	Y
Banded Killifish	<i>Fundulus diaphanus</i>	1978	S3	G5	SC/N		Y	Y
Barn Owl	<i>Tyto alba</i>	1975	S1B,S1N	G5	END		Y	Y
Black Tern	<i>Chlidonias niger</i>	2010	S2B	G4	SC/M		Y	Y
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>	1890	S2B	G5	SC/M		N	Y
Blanding's Turtle	<i>Emydoidea blandingii</i>	2010	S3	G4	THR		Y	Y
Bobolink*	<i>Dolichonyx oryzivorus*</i>	2010*	S4B	G5	SC/M		Y	N
Broad-winged Skipper	<i>Poanes viator</i>	1993	S3	G5	SC/N		N	Y
Butler's Gartersnake	<i>Thamnophis butleri</i>	2004	S3	G4	THR		Y	Y
Cerulean Warbler	<i>Dendroica cerulea</i>	2010	S2S3B	G4	THR		Y	Y
Common Moorhen	<i>Gallinula chloropus</i>	2008	S2B	G5	SC/M		N	Y
Eastern Massasauga	<i>Sistrurus catenatus catenatus</i>	1999	S1	G3G4T3T4Q	END	C	Y	Y
Eastern Meadowlark*	<i>Sturnella magna*</i>	2010*	S4B	G5	SC/M		Y	N
Elfin Skimmer	<i>Nannothemis bella</i>	2006	S2S3	G4	SC/N		Y	Y
Elktoe	<i>Alasmidonta marginata</i>	2009	S4	G4	SC/P		N	Y

Common Name	Scientific Name	Last Observed Date	State Rank	Global Rank	State Status	Federal Status	SGCN	Tracked by NHI
Ellipse	<i>Venustaconcha ellipsiformis</i>	2001	S2	G4	THR		Y	Y
Forster's Tern	<i>Sterna forsteri</i>	2009	S1B	G5	END		Y	Y
Franklin's Ground Squirrel	<i>Spermophilus franklinii</i>	1980	S2	G5	SC/N		Y	Y
Grasshopper Sparrow*	<i>Ammodramus savannarum*</i>	2010*	S4B	G5	SC/M		Y	Y
Gravel Chub	<i>Erimystax x-punctatus</i>	2003	S1	G4	END		Y	Y
Henslow's Sparrow	<i>Ammodramus henslowii</i>	2010	S3B	G4	THR		Y	Y
King Rail	<i>Rallus elegans</i>	2008	S1B	G4	SC/M		Y	Y
Lake Chubsucker	<i>Erimyzon sucetta</i>	1978	S3	G5	SC/N		Y	Y
Least Bittern	<i>Ixobrychus exilis</i>	2010	S3B	G5	SC/M		N	Y
Least Darter	<i>Etheostoma microperca</i>	2006	S3	G5	SC/N		Y	Y
Lilypad Forktail	<i>Ischnura kellicotti</i>	1990	S1	G5	SC/N		Y	Y
Longear sunfish	<i>Lepomis megalotis</i>	1978	S2	G5	THR		Y	Y
Mulberry Wing	<i>Poanes massasoit</i>	1992	S3	G4	SC/N		N	Y
Northern Pintail	<i>Anas acuta</i>	2010	S1B	G5	SC/M		N	Y
Osprey	<i>Pandion haliaetus</i>	2008	S4B	G5	SC/M		Y	Y
Ozark Minnow	<i>Notropis nubilus</i>	2006	S2	G5	THR		Y	Y
Pickereel Frog*	<i>Lithobates palustris*</i>	2010*	S3S4	G5	SC/H		Y	Y
Plains Gartersnake*	<i>Thamnophis radix*</i>	2009*	S2	G5	SC/H		N	Y
Prairie Crayfish	<i>Procambarus gracilis</i>	1984	S2?	G5	SC/N		Y	Y
Pugnose Minnow	<i>Opsopoeodus emiliae</i>	2000	S3	G5	SC/N		N	Y
Pugnose Shiner	<i>Notropis anogenus</i>	1978	S2	G3	THR		Y	Y
Pygmy shrew*	<i>Sorex hoyi*</i>	2010*	S3S4	G5	SC/N		N	Y
Queensnake	<i>Regina septemvittata</i>	2008	S1	G5	END		Y	Y
Redhead	<i>Aythya americana</i>	2005	S2B	G5	SC/M		Y	Y
River Redhorse	<i>Moxostoma carinatum</i>	1994	S2	G4	THR		Y	Y
Swamp Metalmark	<i>Calephelis muticum</i>	1973	S1	G3	END		Y	Y
Two-spotted Skipper	<i>Euphyes bimacula</i>	1977	S3	G4	SC/N		N	Y
Upland Sandpiper	<i>Bartramia longicauda</i>	2006	S2B	G5	SC/M		Y	Y
Willow Flycatcher*	<i>Empidonax traillii*</i>	2010*	S4B	G5	SC/M		Y	N
Wilson's Phalarope	<i>Phalaropus tricolor</i>	2004	S1B	G5	SC/M		Y	Y

Common Name	Scientific Name	Last Observed Date	State Rank	Global Rank	State Status	Federal Status	SGCN	Tracked by NHI
Animal Assemblage								
Bird Rookery	<i>Bird Rookery</i>	2010	SU	G5	SC		NA	Y
Herp Hibernaculum	<i>Herp Hibernaculum</i>	1988	SU	GNR	SC		NA	Y
Plant								
Adder's-tongue	<i>Ophioglossum pusillum</i>	1941	S2	G5	SC		NA	Y
Autumn Coral-root*	<i>Corallorhiza odontorhiza</i> *	2001*	S3	G5	SC		NA	Y
Beaked Spike-rush	<i>Eleocharis rostellata</i>	2010	S2	G5	THR		NA	Y
Butternut	<i>Juglans cinerea</i>	2010	G4	S3?	SC		NA	N
Capitate Spike-rush	<i>Eleocharis olivacea</i>	1934	S2	G5	SC		NA	Y
Common Bog Arrow-grass*	<i>Triglochin maritima</i> *	2000*	S3	G5	SC		NA	Y
Crawe's Sedge*	<i>Carex crawei</i> *	1992*	S3	G5	SC		NA	Y
Downy Willow-herb	<i>Epilobium strictum</i>	1999	S2S3	G5?	SC		NA	Y
Dwarf Milkweed	<i>Asclepias ovalifolia</i>	2010	S3	G5?	THR		NA	Y
Few-flowered Spike-rush	<i>Eleocharis quinqueflora</i>	1996	S2	G5	SC		NA	Y
Flat-stemmed Spike-rush	<i>Eleocharis compressa</i>	2010	S2	G4	SC		NA	Y
Forked Aster	<i>Aster furcatus</i>	2010	S3	G3	THR		NA	Y
Kitten Tails	<i>Besseyia bullii</i>	2010	S3	G3	THR		NA	Y
Leafy White Orchid	<i>Platanthera dilatata</i>	1996	S3	G5	SC		NA	Y
Lesser Fringed Gentian	<i>Gentianopsis procera</i>	2001	S3	G5	SC		NA	Y
Low Nutrush	<i>Scleria verticillata</i>	2010	S2	G5	SC		NA	Y
Many-headed Sedge	<i>Carex sychnocephala</i>	1976	S2	G4	SC		NA	Y
Marsh Blazing Star	<i>Liatris spicata</i>	2010	S3	G5	SC		NA	Y
Narrow-leaved Vervain	<i>Verbena simplex</i>	1890	S1	G5	SC		NA	Y
Northern Yellow Lady's-slipper	<i>Cypripedium parviflorum var. makasin</i>	2010	S3	G5T4Q	SC		NA	Y
Ohio Goldenrod*	<i>Solidago ohioensis</i> *	2000*	S3	G4	SC		NA	Y
Pale Green Orchid	<i>Platanthera flava var. herbiola</i>	2008	S2	G4T4Q	THR		NA	Y
Pale Purple Coneflower	<i>Echinacea pallida</i>	2010	S3	G4	THR		NA	Y
Prairie Indian Plantain	<i>Cacalia tuberosa</i>	1925	S3	G4G5	THR		NA	Y
Purple Milkweed	<i>Asclepias purpurascens</i>	2009	S3	G5?	END		NA	Y
Showy Lady's-slipper*	<i>Cypripedium reginae</i> *	1993*	S3	G4	SC		NA	Y
Slender Bog Arrow-grass	<i>Triglochin palustris</i>	2010	S3	G5	SC		NA	Y

Common Name	Scientific Name	Last Observed Date	State Rank	Global Rank	State Status	Federal Status	SGCN	Tracked by NHI
Small White Lady's-slipper	<i>Cypripedium candidum</i>	2010	S3	G4	THR		NA	Y
Soft-leaf Muhly	<i>Muhlenbergia richardsonis</i>	2010	S1	G5	END		NA	Y
Sticky False-asphodel	<i>Tofieldia glutinosa</i>	2010	S2S3	G4G5	THR		NA	Y
Swamp Agrimony	<i>Agrimonia parviflora</i>	2010	S1S2	G5	SC		NA	Y
Swamp-pink*	<i>Arethusa bulbosa*</i>	1996*	S3	G4	SC		NA	Y
Swan Sedge	<i>Carex swanii</i>	2010	S1	G5	SC		NA	Y
Tufted Bulrush	<i>Scirpus cespitosus</i>	2010	S2	G5	THR		NA	Y
Wafer-ash	<i>Ptelea trifoliata</i>	1992	S2	G5	SC		NA	Y
White Camas	<i>Zigadenus elegans var. glaucus</i>	2010	S2S3	G5T4T5	SC		NA	Y
Wilcox's Panic Grass	<i>Panicum wilcoxianum</i>	1970	SH	G5	SC		NA	Y
Yellow Evening Primrose	<i>Calylophus serrulatus</i>	1970	S2	G5	SC		NA	Y
Yellow Gentian	<i>Gentiana alba</i>	1938	S3	G4	THR		NA	Y
Natural Community								
Bog Relict*		1987*	S3	G3	NA		NA	Y
Calcareous Fen		2010	S3	G3	NA		NA	Y
Dry Prairie		2010	S3	G3	NA		NA	Y
Emergent Marsh		2010	S4	G4	NA		NA	Y
Lake--Deep, Hard, Drainage		1988	S3	GNR	NA		NA	Y
Oak Opening*		1993*	S1	G1	NA		NA	Y
Shrub-carr		2010	S4	G5	NA		NA	Y
Southern Dry Forest		1992	S3	G4	NA		NA	Y
Southern Dry-mesic Forest		2010	S3	G4	NA		NA	Y
Southern Hardwood Swamp		1993	S2	G4?	NA		NA	Y
Southern Sedge Meadow		2010	S3	G4?	NA		NA	Y
Southern Tamarack Swamp (Rich)		2010	S3	G3	NA		NA	Y
Springs and Spring Runs, Hard		2010	S4	GNR	NA		NA	Y
Wet Prairie		2010	SU	G3	NA		NA	Y

*Records for this element have not yet been mapped in the NHI database or the last observation date is more recent than what is currently in the NHI database.

Management Considerations and Opportunities for Biodiversity Conservation

Breeding Birds and Marsh Birds

The wide range of habitats in the SKMR including grasslands, large open marshes, wet meadows, oak savanna and forest, and aquatic areas offer important resources for numerous bird groups. Many rare birds are found during the breeding season throughout the SKMR. Likely the most important habitats for breeding birds (present on all of the properties) are the open marshes and wet meadows. Excellent diversity and high species richness of rare and common marsh and waterbirds are found as summer residents in the SKMR. Emergent marshes are among the most productive of all habitats for waterfowl and other waterbirds (Eldridge 1990). The emergent marsh and wet meadows on the properties provide excellent habitat for American bittern [*Botaurus lentiginosus*, Special Concern (SC)], least bittern (*Ixobrychus exilis*, SC), black-crowned night-heron (*Nycticorax nycticorax*, SC), king rail (*Rallus elegans*, SC), Virginia rail (*Rallus limicola*), sora rail (*Porzana carolina*), common moorhen (*Gallinula chloropus*, SC), yellow-headed blackbird (*Xanthocephalus xanthocephalus*, SGCN), Wilson's phalarope (*Phalaropus tricolor*, SC), Forster's tern [*Sterna forsteri*, State Endangered (END)], and black tern (*Chlidonias niger*, SC).

Habitat structure in Emergent Marshes and Southern Sedge Meadow is critical to many of the species above. Artificial water level manipulations can affect habitat structure, with prolonged high water levels adversely affecting species needing sedge meadows and dense cat-tails, and prolonged low water levels from drawdowns adversely impacting species needing deep marshes. Water level manipulations are particularly a concern at **Big Muskego Lake Wildlife Area** and **Vernon Wildlife Area**. Water level the manipulations are an important management tool in some areas, and impacts to state listed species and SGCNs and their habitat should be considered. Long-term monitoring to document how periodic water level manipulations affect rare and declining species over time would be beneficial.

In addition, consideration should be given to placement of an osprey nesting platform at **Vernon Wildlife Area**. Osprey have been observed in this area and are expanding their range into southern Wisconsin. Vernon Wildlife Area offers excellent potential habitat for this species.

Grassland habitats within SKMR include remnant prairie, old or fallow fields, and planted prairie areas and support good numbers of obligate grassland birds. Grassland bird species are exhibiting one of the most significant declines of any suite of bird species in Wisconsin and across the Midwest (Herkert 1995). The major cause for this decline has been the alteration and loss of breeding habitat (Robbins et al. 1996). The SKMR presents opportunities for addressing the habitat requirements of several area sensitive bird species that need large grassland patches or a matrix of treeless meadows, marshes, and grasslands. Good numbers of Henslow's sparrow [*Ammodramus henslowii*, State Threatened (THR)], eastern meadowlark (*Sturnella magna*, SGCN), bobolink (*Dolichonyx oryzivorous*, SGCN), upland sandpiper (*Bartramia longicauda*, SC), sedge wren (*Cistothorus platensis*), and savanna sparrow (*Passerculus sandwichensis*) were noted during limited breeding bird survey efforts. Continued restoration, expansion, and connection of various open grassland types would be beneficial, with the best opportunities existing at **Tichigan, Turtle Creek, and Turtle Valley Wildlife Areas**.

Rare Herpetofauna: Frogs, Turtles, and Snakes

Wetland habitats in the SKMR provide excellent habitat for several rare and declining frogs, turtles, and snakes. Open wetlands with high water quality and spring-fed fens and sedge meadows are important

habitat for adult pickerel frogs (*Lithobates palustris*, SC) which require cold water habitats for much of their life cycle including hibernation. Northern cricket frogs (*Acris crepitans*, END), common in southern Wisconsin until the 1970's, also have the potential to occur in these types of habitats. Recently, there have been some reports of Northern cricket frogs from elsewhere in southeast Wisconsin, and further investigation of wetlands in the SKMR may be warranted.

Rare turtles present on the study area include the semi-aquatic Blanding's turtle (*Emydoidea blandingii*, THR), particularly in wetland complexes that may include marshes, shallow bays of lakes, streams, and sedge meadows. Having suitable nesting habitat (open sandy soils) nearby to wetlands is also critical. Thus, the landscape context and juxtaposition of wetlands to relatively open, non-agricultural uplands is crucial for this species.

In addition, several rare snakes are known from the SKMR, including queensnake (*Regina septemvittata*, END) and eastern Massasauga (*Sistrurus catenatus catenatus*, END, Federal Candidate). Queensnakes require cold, clear streams and prefer wetlands near woodland edges without full canopy cover where they spend the majority of their time basking in grasses or in shoreline brush and foraging in water or along the shoreline. This species overwinters in crayfish burrows as well as in artificial structures such as cracked bridge abutments and old dams. The eastern Massasauga also requires groundwater-fed wetland complexes adjacent to open uplands. Finally, a preliminary observation of the rare plains garter snake (SC) was recently reported from the study area. Similar to other species of rare herptiles, the plains garter snake is found in open-canopy wetlands and adjacent open to semi-open canopy uplands like savanna, prairie, and old field.

Management that supports rare herps includes maintaining water quality and restoring or maintaining natural springs and seeps. In addition, managing wetland complexes to maintain a variety of natural community types and combating non-native invasive species will help support these species. Finally, restoring and maintaining adjacent uplands to prairie or savanna may help provide critical basking and nesting habitat.

Calcareous Fens, Springs and Spring Runs, and Streams

Calcareous Fens, Springs and Spring Runs, and streams in the SKMR represent an important opportunity for biodiversity conservation and water quality protection. Calcareous Fens have always been rare in Wisconsin due to their unique requirements and likely currently comprise less than 1,000 acres in the state (Hoffman 2002). They are considered the rarest wetland plant community in Wisconsin and Minnesota and possibly one of the rarest in North America (Eggers and Reed 1997). In addition, they support over a dozen rare plants and animals in the SKMR, many of which are found exclusively in these natural communities. Many are small in size and are threatened by the encroachment of trees, shrubs, and non-native invasive herbaceous plants; altered hydrology; and sedimentation. Protecting, managing, and restoring the remaining fens within a matrix of open wetlands types would benefit the many plant and animal species requiring these habitats. Calcareous Fens are present at **Lulu Lake SNA, Tichigan Wildlife Area, Vernon Wildlife Area, Turtle Valley Wildlife Area**, and historically at **Honey Creek Wildlife Area**.

Unique aquatic resources present in the SKMR also include Springs and Spring Runs. These often form headwater streams and contribute significantly to high water quality. Springs typically have high water clarity, low sedimentation, and are a stable system with very little change in water temperature, water flow, or chemical composition. These features are highly susceptible to damage, and land use practices (e.g., grazing, ditching, etc.) that lead to soil or hydrological disturbance should be avoided. Recharge areas need to be identified and managed carefully if the springs and seeps are to remain functional.

Springs and Spring Runs are found at **Lulu Lake SNA, Tichigan Wildlife Area, Vernon Wildlife Area, and Turtle Creek Wildlife Area.**

Streams in the SKMR support several rare species of fish in the upper reaches of warm water streams at **Lulu Lake SNA, Turtle Creek Wildlife Area,** and the Fox River between **Vernon Wildlife Area and Tichigan Wildlife Area.** These include the pugnose shiner (*Notropis anogenus*, THR), which requires shoals of glacial lakes and low-gradient streams over bottoms of mud, sand, cobble, silt, and clay; the longear sunfish (*Lepomis megalotis*, THR), found in clear, quiet, shallow streams; and the least darter (*Etheostoma microperca*, SC), found in clear streams with dense vegetation along with gravel, sand, and boulders. Many of the spring areas are relatively fish-free except for the very small central mudminnow (*Umbra limi*) and brook stickleback (*Culaea inconstans*) (pers. comm. J. Lyons). These fishless aquatic areas would make them attractive to wood frogs (*Lithobates sylvatica*), chorus frogs (*Pseudacris* sp.), and spring peepers (*Pseudacris crucifer*) for breeding. Invertebrate species likely to be found in these aquatic habitats include crayfish, freshwater shrimp, diving beetles, mayflies, stoneflies, caddisflies, dragonflies, and damselflies. Springs and streams are likely also important feeding areas for many bat species.

Both rare plants and animals are strongly associated with Calcareous Fen and Springs and Spring Runs. Rare animals known from the SKMR found within these communities include mulberry wing, (*Poanes massasoit*, SC), broad-winged skipper (*Poanes viator*, SC), and an historical record for swamp metalmark (END). Rare plants known from the study site associated with these communities in the SKMR include soft-leaf muhly (*Muhlenbergia richardsonis*, END), small white lady's-slipper (*Cypripedium candidum*, THR), beaked spikerush (*Eleocharis rostellata*, THR), tufted bulrush (*Scirpus cespitosus*, THR), sticky false-asphodel (*Tofieldia glutinosa*, THR), Ohio goldenrod (*Solidago ohioensis*, SC), common bog arrow-grass (*Triglochin maritima*, SC), slender bog arrow-grass (*T. palustris*, SC), lesser fringed gentian (*Gentianopsis procera*, SC), marsh blazing star (*Liatris spicata*, SC), few-flowered spikerush (*Eleocharis quinqueflora*, SC), and low nutrush (*Scleria verticillata*, SC).

Threats to these aquatic communities include hydrological alterations associated with groundwater withdrawal for commercial or industrial development, or agricultural irrigation systems. Changes to hydrology can facilitate non-native invasive plant infestations, increased sedimentation, and poor water quality, thereby changing the conditions necessary for the continued health of rare species populations and some natural communities (WDNR 2002). Other concerns include nutrient loading from agricultural or urban runoff, road construction and road salt, and incompatible forestry practices or recreational activities such as off-road vehicle use. Water quality and water levels should be one of the primary considerations when management is planned near these areas. Also particularly problematic are non-native shrubs such as glossy buckthorn and common buckthorn which convert diverse, open, graminoid-dominated wetlands to low-quality shrub thickets. Infestations of buckthorn have likely caused the local extirpation of rare plants and animals at sites such as the Cherry Lake Sedge Meadow SNA. Reed canary grass and the non-native narrow-leaved cat-tail and hybrid cat-tail also pose a threat to these communities, particularly in niche habitats like marl flats. Management to reduce non-native invasive species in these areas is critical. Monitoring of invasive species before and after management would be beneficial to ensure activities are helping to meet overall restoration objectives.

Prairie Remnants/Small Scale Savanna Restoration

Prairies, Oak Openings, and Oak Woodlands were historically common in Wisconsin but are now rare throughout the state. Restoration of these globally rare natural communities is critical to the survival of many rare plants and animals that depend on them. Small-scale preservation and restoration of remnant prairies and savannas in the SKMR would also directly complement initiatives to promote these communities within the larger Southern Kettle Moraine landscape. In particular, the Southern Unit of the

Kettle Moraine State Forest was identified as one of the best large-scale opportunities for Oak Opening restoration in the state (WDNR 2006b; WDNR In prep.).

Prairie once occupied approximately 2.1 million acres in Wisconsin. Now, approximately 2,000 acres remain – less than 0.1% (Leach and Givnish 1999). Of these, only those prairies that occurred at the wet and dry ends of the soil spectrum survived. Virtually all deep-soil Mesic Prairies were converted to agricultural or residential uses. The surviving remnants are highly degraded due to fire suppression, overgrazing, invasion of woody species, non-native invasive species and, in the case of Wet Prairies, ditching, and tiling.

Historically, Oak Openings were abundant in Wisconsin, covering approximately 5.5 million acres (Curtis 1959) south of the Tension Zone. Review of historic literature indicates that Oak Openings once supported an exceptionally diverse flora, about 25% of the entire native flora of Wisconsin (Leach and Givnish 1999). Of the about 75,000 acres (Hoffman 2009) of Oak Opening remaining in Wisconsin, many of these are highly degraded or have succeeded to closed-canopy oak forests. The few extant remnants are mostly on drier sites, with the mesic and wet-mesic Oak Openings almost totally destroyed by conversion to agricultural or residential uses and by the encroachment of other woody plants due to fire suppression.

Oak woodland once occupied approximately 1.4 million acres (Curtis 1959) in Pre-European settlement Wisconsin. Today, it is extraordinarily rare – only about 140,000 acres remain in the state (Hoffman 2009). Most of these remnants are highly degraded and have converted to closed-canopy oak forest.

Lulu Lake SNA presents the greatest opportunity in the SKMR for managing a mosaic of Dry Prairie, Oak Opening and Oak Woodland. A small area of restorable Oak Woodland also occurs at **Tichigan Wildlife Area** and at **Honey Creek Wildlife Area** just outside of the Cherry Lake Sedge Meadow SNA boundary.

Non-native Invasive Plants

Non-native invasive species thrive because they establish quickly, tolerate a wide range of conditions, are easily dispersed, and are no longer limited by the diseases, predators, and competitors that kept their populations in check in their native range. As a result, non-native invasive plants can kill and out-compete native plants by monopolizing light, water, and nutrients and by altering soil chemistry and mycorrhizal relationships. In situations where non-native invasive plants become dominant, they may even alter ecological processes by limiting the use of prescribed fire and by modifying hydrology. In addition to the threats on native communities and native species diversity, invasive species negatively impact forestry (by reducing tree regeneration, growth and longevity), recreation (by degrading fish and wildlife habitat and limiting access), agriculture, and human health (by causing skin rashes or blisters).

Reed canary grass is dominant in some of the open wetlands, particularly along streams at **Turtle Creek Wildlife Area** and portions of **Vernon Wildlife Area**, **Turtle Valley Wildlife Area**, and **Tichigan Wildlife Area**. Southern Sedge Meadow was once much more widespread in southeast Wisconsin and throughout the entire state but land conversion, including to reed canary grass meadows, has degraded much of this important wetland type and resulted in declines in habitat quality for plants and animals. Narrow-leaved cat-tail and hybrid cat-tail are widespread in the SKMR and are particularly problematic where they have invaded Wet Prairie and Calcareous Fen at **Tichigan Wildlife Area**. Cat-tails are a concern particularly because prescribed fire, often used as a management tool to restore prairies and fens, does not effectively control cat-tail and may even lead to increase in cover (Beule 1979, Mallik and Wein 1986). Common reed grass is also beginning to establish in portions of the SKMR and may be

associated with hydrologic alteration (past ditching, etc.). It was noted in Emergent Marshes at **New Munster Wildlife Area**, **Big Muskego Lake Wildlife Area**, and **Vernon Wildlife Area**.

Both common buckthorn and glossy buckthorn are problematic throughout the SKMR. Common buckthorn threatens the Shrub-carr at **New Munster Wildlife Area**, once one of the highest quality Shrub-carr sites in southeast Wisconsin. Common buckthorn is also problematic to the forested uplands at **Tichigan Wildlife Area** and **Honey Creek Wildlife Area** and in portions of the **Turtle Valley Wildlife Area**. Both common buckthorn and glossy buckthorn threaten the wetland complexes at **Turtle Creek Wildlife Area**, where they have severely altered Shrub-carr and are invading surrounding high-quality habitats. Glossy buckthorn invasion in the Calcareous Fen at the Cherry Lake Sedge Meadow SNA at **Honey Creek Wildlife Area** has led to the suspected extirpation of half a dozen rare plants and animals at the site. Glossy buckthorn is also a major threat at **Vernon Wildlife Area**. Though there has been some control efforts on the property, more is needed. Finally, long-term buckthorn control efforts at **Lulu Lake SNA** have been very successful and should be continued there and expanded to other properties to preserve biotic integrity.

Other non-native invasive plants of concern at the SKMR include oriental bittersweet (*Celastrus orbiculata*), a very problematic vine in portions of **New Munster Wildlife Area**. Because this species is not yet widespread geographically in the SKMR, it should be evaluated as a management priority to halt or slow its spread throughout the region. Autumn-olive (*Elaeagnus umbellata*) and Bell's honeysuckle are also present in old fields and open canopied-forests, especially at **Honey Creek Wildlife Area** and **New Munster Wildlife Area**. Japanese knotweed (*Polygonum cuspidatum*) was discovered in two areas immediately adjacent to state property at **New Munster Wildlife Area** and **Turtle Creek Wildlife Area**. Due to the ability of this species to spread aggressively, impact riparian areas, and the difficulty of controlling large infestations, management should be pursued as a high priority. Finally, garlic mustard is widespread in uplands at **Honey Creek Wildlife Area**, **Turtle Creek Wildlife Area** and many other sites throughout the SKMR.

Other less widespread but problematic species in the SKMR include:

- spotted knapweed (*Centaurea biebersteinii*)
- Japanese hedge parsley (*Torilis japonica*)
- black swallow-wort (*Vincetoxicum nigrum*)
- white sweet clover and yellow sweet clover (*Melilotus alba*, *M. officinalis*)
- wild parsnip (*Pastinaca sativa*)
- purple loosestrife (*Lythrum salicaria*)

The primary need is for a comprehensive non-native invasive species management plan at each property. Each species should be evaluated in the context of the overall management goals for the property. High quality areas should be prioritized for invasive species removal. It may be more feasible to focus control efforts on species with relatively small or isolated populations before they spread and become more difficult to manage. This can be evaluated on the scale of the entire SKMR, an individual property, and an individual site. Similarly, it may be more feasible to control isolated satellite populations and keep relatively pristine areas free of non-native invasive species than to tackle large-scale infestations. Typically, by the time a species is widespread, only control in localized areas is feasible (Figure 6).

For recommendations on controlling specific invasive species consult with DNR staff; refer to websites on invasive species, such as the DNR invasive species website ("Invasive Species") and the website of the Invasive Plants Association of Wisconsin ("Invasive Plants Association of Wisconsin"); and seek assistance from the local invasive species group: the Southeastern Wisconsin Invasive Species Consortium ("SEWISC"). Invasive species best management practices for forestry, recreation, urban

forestry, and rights-of-way have also been developed by the Wisconsin Council on Forestry (“Invasive Species Best Management Practices”).

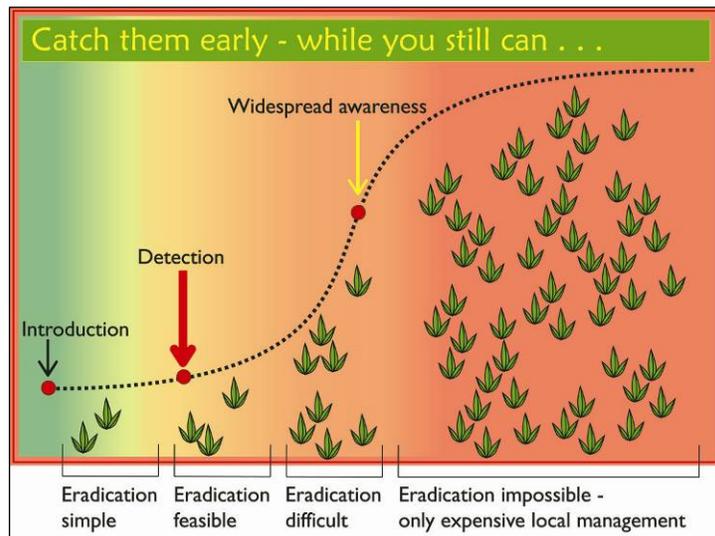


Figure 6. Abundance of non-native invasive species and the relative feasibility of control (figure courtesy Phyllis Higman and Suzan Campbell, Michigan Natural Features Inventory and Ellen Jacquart, The Nature Conservancy).

Ecological Priorities for SGCN

The Wisconsin Wildlife Action Plan identifies ecological priorities in each Ecological Landscape. Ecological priorities are the natural communities in each Ecological Landscape that are most important to the Species of Greatest Conservation Need. Appendix D highlights the Ecological Priorities for vertebrate SGCN on the SKMR. Note that these Ecological Priorities include all of the natural communities determined to provide the best opportunities for management on the SKMR from an ecological and biodiversity perspective.

Natural Community Management Opportunities

The Wisconsin Wildlife Action Plan (WDNR 2006b) identifies 34 natural communities for which there are “Major” or “Important” opportunities for protection, restoration, or management in the Southeast Glacial Plains Ecological Landscape. Sixteen of these natural communities are present on the SKMR:

- Calcareous Fen
- Coolwater Streams
- Emergent Marsh
- Floodplain Forest
- Inland Lakes
- Northern Sedge Meadow
- Northern Wet Forest
- Northern Wet-mesic Forest
- Shrub-carr
- Southern Dry-mesic Forest
- Southern Hardwood Swamp
- Southern Mesic Forest
- Southern Sedge Meadow
- Southern Tamarack Swamp (rich)
- Warmwater Rivers
- Warmwater Streams

Primary Sites: Site-specific Opportunities for Biodiversity Conservation

Ten ecologically important sites were identified in the SKMR. These “Primary Sites” were delineated because they generally encompass the best examples of 1) rare and representative natural communities, 2) documented occurrences of rare species populations, and/or 3) opportunities for ecological restoration or connections. These sites warrant high protection and/or restoration consideration during the development of the property master plan. This report is meant to be considered along with other information when identifying opportunities for various management designations during the master planning process.

Descriptions for each of the Primary Sites can be found in Appendix F (available for internal DNR use only). Information provided in the summary paragraphs includes location information, a site map, a brief summary of the natural features present, the site’s ecological significance, and management considerations.

Southern Kettle Moraine Region Planning Group Primary Sites

- SKMR01. Vernon Fen
- SKMR02. Big Muskego Marsh
- SKMR03. Lulu Lake SNA
- SKMR04. Tichigan Wet Prairie
- SKMR05. Tichigan Springs and Fen
- SKMR06. Cherry Lake Sedge Meadow SNA
- SKMR07. Turtle Lake Sedge Meadow
- SKMR08. Delavan Marsh
- SKMR09. Turtle Creek Springs
- SKMR10. New Munster Bog Island SNA



A high-quality Southern Sedge Meadow at the Turtle Creek Springs Primary Site, located at Turtle Creek Wildlife Area. Photo by Ryan P. O’Connor, WDNR.

Future Needs

This project was designed to provide a rapid assessment of the biodiversity values for the SKMR. Although the report should be considered adequate for master planning purposes, additional efforts could help to inform future adaptive management efforts, along with providing useful information regarding the natural communities and rare species contained in the SKMR.

- Establishing a non-native invasive species monitoring protocol is critical for the SKMR. State wildlife areas and many other public lands throughout Wisconsin are facing major management problems because of serious infestations of highly invasive species such as garlic mustard, reed canary grass, common and glossy buckthorn, and Eurasian honeysuckles (*Lonicera X bella*, *L. tatarica*, etc.). Some of these species are easily dispersed by humans and vehicles; others are spread by birds, mammals, insects, water, or wind. In order to protect the important biodiversity values of the SKMR, a comprehensive plan will be needed for detecting and rapidly responding to new threats from non-native invasive species. Citizens, such as trail users or hunters, could be encouraged to report new sightings of invasive plants and animals and, perhaps, cooperate with property managers in control efforts.
- Vegetation plot data should be collected from the Calcareous Fens, Wet Prairies, and the Southern Hardwood Swamp in this region. Establishing baseline vegetation transects will help to better understand these unique and diverse natural communities, identify how non-native invasive species are impacting these communities, and determine if management is meeting restoration goals.
- Targeted surveys for the eastern massasauga rattlesnake should be conducted at Turtle Creek and Turtle Valley Wildlife Areas
- Locations and likely habitats should be identified for conducting additional rare plant and animal surveys during appropriate seasons. This should include additional vertebrate and invertebrate animal taxa groups.
- Inventory work should be conducted on invertebrate assemblages associated with springs, spring runs, seeps, and fens.
- Potential Ephemeral Ponds identified by the Wisconsin Ephemeral Ponds Project (Bernthal et al. 2009) should be targeted for future surveys to verify and document these unique wetlands. The WEPP identified potential ponds at Lulu Lake SNA, Honey Creek Wildlife Area, and New Munster Wildlife Area.
- Additional bird surveys should be conducted focusing on spring and fall migratory bird concentration areas and bird abundance.



Swamp-pink, a rare orchid in the study area. Photo by Ryan P. O'Connor, WDNR.

Glossary

dolomite – a sedimentary, often bedded rock similar to limestone but differing due to the addition of magnesium ions.

drumlin – streamlined, teardrop shaped hills created by glacial action. The long axis parallels the direction of past glacial movement.

Ecological Landscape - landscape units developed by the WDNR to provide an ecological framework to support natural resource management decisions. The boundaries of Wisconsin's sixteen Ecological Landscapes correspond to ecoregional boundaries from the National Hierarchical Framework of Ecological Units, but sometimes combine subsections to produce a more manageable number of units.

element - the basic building blocks of the Natural Heritage Inventory. They include natural communities, rare plants, rare animals, and other selected features such as colonial bird rookeries, bat hibernacula, and mussel beds. In short, an element is any biological or ecological entity upon which we wish to gather information for conservation purposes.

esker – a ridge, commonly sinuous, composed of sand and gravel deposited by a stream that flowed in an ice-walled channel beneath a glacier (Dott and Attig 2004).

fen – wetlands that receive nutrients via direct contact with mineral enriched groundwater and in which peat accumulates. “Rich” fens have relatively high concentrations of nutrients and support an assemblage of plants that often includes calcium-loving species absent from poor fens and bogs.

kame – steep-sided hills or mounds of water-sorted sands and gravels that were built when streams of meltwater draining from stagnant glacial ice dropped their load of sediment as their velocity decreased (Schultz 1986).

kettle lake – lakes formed from a depression caused by a block of buried glacier ice that gradually melted, causing the overlying land surface to collapse downward.

Landtype Association (LTA) - a level in the National Hierarchical Framework of Ecological Units (see next entry) representing an area of 10,000 – 300,000 acres. Similarities of landform, soil, and vegetation are the key factors in delineating LTAs.

moraine – landforms composed of unsorted materials deposited by glaciers. They can cover broad geographic areas of millions of acres. Topography can vary from nearly level “till” plains to rough end moraine landscapes composed of steep dry ridges interspersed with deep kettle holes. These glacial “kettles” are frequent locations for lakes and wetlands.

natural community – an assemblage of plants and animals, in a particular place at a particular time, interacting with one another, the abiotic environment around them, and subject to primarily natural disturbance regimes. Those assemblages that are repeated across a landscape in an observable pattern constitute a community type. No two assemblages, however, are exactly alike.

representative - native plant species that would be expected to occur in native plant communities influenced primarily by natural disturbance regimes in a given landscape - e.g., see Curtis (1959).

SGCN (Species of Greatest Conservation Need) – native wildlife species with low or declining populations that are most at risk of no longer being a viable part of Wisconsin’s fauna (Wisconsin Wildlife Action Plan, WDNR 2006b).

Tension Zone – a narrow region extending from northwest to southeast across Wisconsin. The tension zone separates the mixed conifer-hardwood forests of the north from the prairie/savanna/hardwood forests of the south. Many native plant and animal species occupy ranges roughly delineated by the tension zone.

Species List

The following is a list of species referred by common name in the report.

Common Name	Scientific Name
Animals	
American bittern	<i>Botaurus lentiginosus</i>
black tern	<i>Chlidonias niger</i>
black-crowned night-heron	<i>Nycticorax nycticorax</i>
Northern cricket frog	<i>Acris crepitans</i>
Blanding's turtle	<i>Emydoidea blandingii</i>
bobolink	<i>Dolichonyx oryzivorous</i>
broad-winged skipper	<i>Poanes viator</i>
brook stickleback	<i>Culaea inconstans</i>
central mudminnow	<i>Umbra limi</i>
channel catfish	<i>Ictalurus punctatus</i>
chorus frogs	<i>Pseudacris</i> spp.
common moorhen	<i>Gallinula chloropus</i>
eastern Massasauga	<i>Sistrurus catenatus catenatus</i>
eastern meadowlark	<i>Sturnella magna</i>
Forster's tern	<i>Sterna forsteri</i>
Henslow's sparrow	<i>Ammodramus henslowii</i>
king rail	<i>Rallus elegans</i>
least bittern	<i>Ixobrychus exilis</i>
least darter	<i>Etheostoma microperca</i>
longear sunfish	<i>Lepomis megalotis</i>
mulberry wing	<i>Poanes massasoit</i>
northern pike	<i>Esox lucius</i>
pickerel frog	<i>Lithobates palustris</i>
plains gartersnake	<i>Thamnophis radix</i>
pugnose shinner	<i>Notropis anogenus</i>
queensnake	<i>Regina septemvittata</i>
savannah sparrow	<i>Passerculus sandwichensis</i>
sedge wren	<i>Cistothorus platensis</i>
smallmouth bass	<i>Micropterus dolomieu</i>
sora rail	<i>Porzana carolina</i>
spring peepers	<i>Pseudacris crucifer</i>
swamp metalmark butterfly	<i>Calephelis muticum</i>
upland sandpiper	<i>Bartramia longicauda</i>
Virginia rail	<i>Rallus limicola</i>
walleye	<i>Sander vitreus</i>
white bass	<i>Morone chrysops</i>

Common Name	Scientific Name
Wilson's phalarope	<i>Phalaropus tricolor</i>
wood frogs	<i>Lithobates sylvatica</i>
yellow bass	<i>Morone mississippiensis</i>
yellow-headed blackbird	<i>Xanthocephalus xanthocephalus</i>
Plants	
American basswood	<i>Tilia americana</i>
aspen	<i>Populus</i> spp.
asters	<i>Aster</i> spp.
autumn-olive	<i>Elaeagnus umbellata</i>
beaked spikerush	<i>Eleocharis rostellata</i>
Bebb's willow	<i>Salix bebbiana</i>
Bell's honeysuckle	<i>Lonicera X bella</i>
big bluestem	<i>Andropogon gerardii</i>
black cherry	<i>Prunus serotina</i>
black locust	<i>Robinia pseudoacacia</i>
black oak	<i>Quercus velutina</i>
black swallow-wort	<i>Vincetoxicum nigrum</i>
blueberry	<i>Vaccinium</i> sp.
bluejoint grass	<i>Calamagrostis canadensis</i>
bog birch	<i>Betula pumila</i>
bog rosemary	<i>Andromeda glaucophylla</i>
boxelder	<i>Acer negundo</i>
bristle-stalked sedge	<i>Carex leptalea</i>
broad-leaved cat-tail	<i>Typha latifolia</i>
bur oak	<i>Quercus macrocarpa</i>
Buxbaum's sedge	<i>Carex buxbaumii</i>
Carolina vetch	<i>Vicia caroliniana</i>
common bog arrow-grass	<i>Triglochin maritima</i>
common buckthorn	<i>Rhamnus cathartica</i>
common lake sedge	<i>Carex lacustris</i>
common reed grass	<i>Phragmites australis</i>
common stiff sedge	<i>Carex tetanica</i>
dogwood	<i>Cornus</i> spp.
fen star sedge	<i>Carex sterilis</i>
few-flowered spikerush	<i>Eleocharis quinqueflora</i>
garlic mustard	<i>Alliaria petiolata</i>
giant goldenrod	<i>Solidago gigantea</i>
glossy buckthorn	<i>Rhamnus frangula</i>
grass-of-Parnassus	<i>Parnassia glauca</i>

Common Name	Scientific Name
gray dogwood	<i>Cornus racemosa</i>
hair beak-rush	<i>Rhynchospora capillacea</i>
hop-hornbeam	<i>Ostrya virginiana</i>
hybrid cat-tail	<i>Typha X glauca</i>
Japanese hedge parsley	<i>Torilis japonica</i>
Japanese knotweed	<i>Polygonum cuspidatum</i>
Joe-pye-weed	<i>Eupatorium maculatum</i>
Kalm's lobelia	<i>Lobelia kalmii</i>
leatherleaf	<i>Chamaedaphne calyculata</i>
lesser fringed gentian	<i>Gentianopsis procera</i>
low nutrush	<i>Scleria verticillata</i>
marsh blazing star	<i>Liatris spicata</i>
narrow-leaved cat-tail	<i>Typha angustifolia</i>
narrow-leaved cotton-grass	<i>Eriophorum angustifolium</i>
Ohio goldenrod	<i>Solidago ohioensis</i>
oriental bittersweet	<i>Celastrus orbiculata</i>
poison sumac	<i>Toxicodendron vernix</i>
prairie cordgrass	<i>Spartina pectinata</i>
prairie loosestrife	<i>Lysimachia quadriflora</i>
prairie sedge	<i>Carex prairea</i>
prickly-ash	<i>Zanthoxylum americanum</i>
purple loosestrife	<i>Lythrum salicaria</i>
Purpus' birch	<i>Betula X purpusii</i>
pussy willow	<i>Salix candida</i>
red cedar	<i>Juniperus virginiana</i>
red oak	<i>Quercus rubra</i>
red osier dogwood	<i>Cornus stolonifera</i>
reed canary grass	<i>Phalaris arundinacea</i>
Riddell's goldenrod	<i>Solidago riddellii</i>
shagbark hickory	<i>Carya ovata</i>
shining aster	<i>Aster firmus</i>
shooting-star	<i>Dodecatheon meadia</i>
short-headed rush	<i>Juncus brachycephalus</i>
shrubby cinquefoil	<i>Potentilla fruticosa</i>
silky dogwood	<i>Cornus amomum</i>
slender bog arrow-grass	<i>Triglochin palustris</i>
slender willow	<i>Salix petiolaris</i>
small white lady's-slipper	<i>Cypripedium candidum</i>
soft-leaf muhly	<i>Muhlenbergia richardsonis</i>
sticky false-asphodel	<i>Tofieldia glutinosa</i>

Common Name	Scientific Name
purple loosestrife	<i>Lythrum salicaria</i>
sugar maple	<i>Acer saccharum</i>
tamarack	<i>Larix laricina</i>
tick-trefoils	<i>Desmodium</i> spp.
trembling aspen	<i>Populus tremuloides</i>
tufted bulrush	<i>Scirpus cespitosus</i>
tussock sedge	<i>Carex stricta</i>
Virginia mountain mint	<i>Pycnanthemum virginianum</i>
water sedge	<i>Carex aquatilis</i>
wild parsnip	<i>Pastinaca sativa</i>
white ash	<i>Fraxinus americana</i>
white oak	<i>Quercus alba</i>
white sweet clover	<i>Melilotus alba</i>
willows	<i>Salix</i> spp.
woolly-fruit sedge	<i>Carex lasiocarpa</i>
yellow birch	<i>Betula alleghaniensis</i>
yellow sweet clover	<i>Melilotus officinalis</i>



Threatened by shrub invasion, a small population of pale purple coneflower (State Threatened) persists in a Dry Prairie in the study area. Photo by Ryan P. O'Connor, WDNR.

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