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# **The Fox River Headwaters Ecosystem: An Ecological Assessment for Conservation Planning**

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PUB-ER-804 2002



# Acknowledgements

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Funding for this project was provided by the Great Lakes Protection Fund and the Endangered Resources Fund. We thank Chuck Ledin, Wisconsin Department of Natural Resources, for facilitating the Great Lakes Protection Fund work.

This project would not have been possible without the joint efforts between DNR staff at the Endangered Resources Program and the Northeast, West Central and South Central Regions. We extend special thanks to the Northeast Region's Upper Fox Basin Team and especially to Tom Nigus for his consistent support and dedication to this project. Thanks to the following DNR regional staff that assisted with the design and coordination of the Fox River Headwaters Workshop:

- Ellen Barth, WDNR-NER
- Linda Hyatt, WDNR-NER
- Becky Isenring, WDNR-WCR
- Greg Moeller, WDNR-NER
- Jill Mrotek, WDNR-NER
- Judi Nigbor, WDNR-NER
- Tom Nigus, WDNR-NER
- Ted Pyrek, WDNR-SCR

We also thank the following individuals that conducted inventory work or provided other support to complete this project:

- Craig Anderson, WDNR-BER
- Julie Bleser, WDNR-BER
- Nancy Cervantes, WDNR-NER
- Andy Clark, WDNR-BER
- Fred Clark, Clark Forestry Inc.
- Tim Cooke, WDNR-BER
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- Drew Feldkirchner, WDNR-BER
- Anne Forbes, Partners in Place
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Special appreciation is due to the many participants who provided information and/or participated in the Fox River Headwaters Workshop, March 8, 2002. Contributor names and their affiliations are listed in Appendix E.

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# Table of Contents

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<b>HIGHLIGHTS .....</b>	<b>1</b>
<b>INTRODUCTION.....</b>	<b>3</b>
<b>ECOLOGICAL OVERVIEW .....</b>	<b>5</b>
Where is the Fox River Headwaters Ecosystem?.....	5
Geology and Soils.....	5
Waters and Wetlands .....	5
Ecological Landscapes.....	7
Vegetation and Land Cover .....	7
Natural Heritage Inventory Data.....	8
Public Conservation Lands .....	12
Previous Assessments of Significant Ecological Landscapes .....	14
<b>IDENTIFICATION OF SIGNIFICANT ECOLOGICAL SITES .....</b>	<b>18</b>
Approach and Methods Used to Identify Significant Ecological Sites .....	18
The Final List of Significant Ecological Sites .....	19
Site Analysis Considerations .....	25
Sites Lacking Adequate Information .....	25
<b>OPPORTUNITIES FOR CONSERVATION .....</b>	<b>26</b>
Significant Ecological Sites .....	26
Potential State Natural Areas.....	26
Species/Natural Communities of Significance.....	27
Restoration Opportunities .....	28
Invasive Species Management.....	29
Issues Affecting the FRHE .....	30
<b>FUTURE INFORMATION NEEDS .....</b>	<b>31</b>
Need for Boundary Revisions.....	31
Significant Ecological Sites .....	31
Status Survey Needs for Species and Natural Communities.....	32
Rare Species Occurrences Not Included Within Significant Ecological Sites.....	33
<b>ADDITIONAL RESOURCES .....</b>	<b>34</b>
Ecological Issues and Conservation Planning within the FRHE .....	34
Endangered Resources within the FRHE.....	34
Web Sites Links with Additional Information .....	35
<b>REFERENCES.....</b>	<b>36</b>

## List of Figures

---

<b>Figure 1.</b> The Fox River Headwaters Ecosystem Study Area .....	3
<b>Figure 2.</b> Watersheds of the FRHE .....	6
<b>Figure 3.</b> Ecological Landscapes of the FRHE .....	7
<b>Figure 4.</b> State Natural Areas of the FRHE.....	12
<b>Figure 5.</b> State and Federal Wildlife and Fishery Areas within the FRHE .....	14
<b>Figure 6.</b> The Nature Conservancy’s Ecologically Significant Areas within the FRHE.....	16
<b>Figure 7.</b> Ecologically Significant Sites of the FRHE.....	<i>following page 18</i>

## List of Tables

---

<b>Table 1.</b> Rare Plants of the FRHE.....	9
<b>Table 2.</b> Rare Animals of the FRHE.....	10
<b>Table 3.</b> Significant Ecological Sites. ....	20
<b>Table 4.</b> Priority Sites for Future Inventory .....	31

## List of Appendices

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- A.** Background Information On The Fox River Headwaters Ecosystem
- B.** Coarse Filter Analysis For The Fox River Headwaters Ecosystem
- C.** State Natural Area Descriptions For The Fox River Headwaters Ecosystem
- D.** The Fox River Headwaters Ecosystem (FRHE) Workshop
- E.** Fox River Headwaters Ecosystem Workshop Materials
- F.** List of Significant Ecological Sites and Element Occurrences

# Highlights

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The Fox River Headwaters Ecosystem, located in the “sand counties” of central Wisconsin, is home to a remarkable variety of high quality natural communities and rare plants and animals. These are situated within the area’s landscape of expansive wetlands, productive farm fields, abundant surface waters, diverse forests, and growing human communities. As the sites where these significant ecological resources are located are mapped and studied, the results provide a sort of blueprint to communicate the highest priority needs for conservation planning in the future. Some of the most significant sites are found within the existing boundaries of public properties or are otherwise protected by groups or individuals. However, many others lack adequate long-term protection.

This report presents the results of a one-year assessment of the significant ecological resources of the Fox River Headwaters Ecosystem. It covers what is currently known about the most significant ecological resources to help guide future conservation strategies by public, nonprofit, and private land managers and landowners. The following are highlights of the report:

- ❖ **The Significant Ecological Areas Workshop**, the second of its kind, again showed the value of harnessing the collective knowledge of local observers who shared their expertise of the natural environment and commitment to conservation. Thirty-seven individuals provided information on over 192 locations, and over 60 people attended the workshop to discuss the values and conservation needs of each site.
- ❖ **A final set of 86 Significant Ecological Sites** are identified. Each Site is placed within one of 4 categories of ecological significance based on current knowledge. Significant Sites are distributed among many community types; however, their overall relative significance relates in large part to their size, buffering from adjacent land uses, and other aspects related to their potential for successful long term protection.
- ❖ **Twenty-five of the Significant Ecological Sites meet the criteria for State Natural Areas designation.**
- ❖ **Many rare natural communities and plant and animal species** exist in the study area, including some of state and national significance:
  - Karner blue butterfly, listed as endangered by the Federal government
  - Fifteen species (4 plants and 11 animals) listed as endangered by the State of Wisconsin
  - Twenty-three species (8 plants and 14 animals) listed as threatened by the State of Wisconsin
  - 36 natural community types, including 11 of particular significance to the region or state
- ❖ **Ecological Restoration Opportunities** are identified for a variety of habitat and natural community types, including grasslands, oak savannas, wetlands, lakes, rivers and streams.
- ❖ **Information needs** and data gaps are identified to support effective conservation planning, including inventory recommendations and guidance for Site boundary review.



# Introduction

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Figure 1. Fox River Headwaters Ecosystem Study Area

One of the fundamentals of conservation planning for any geographic region is an ecological assessment of the sites that are candidates for protection, restoration, or enhancement. This type of assessment for the western portion of the Upper Fox River watershed, known as the Fox River Headwaters Ecosystem (FRHE), is needed by resource planners and citizens to participate in discussions and decisions about future conservation programs and priorities.

Successful, long-term conservation in the FRHE area depends on collaboration between many partners. We hope that many groups and individuals, including local, county, and federal governments; conservation and environmental organizations; and private landowners will use the results of this ecological assessment to communicate and make decisions to conserve the high quality ecological resources in the area.

The FRHE is a geographic area encompassing the upper reaches of the Fox River watershed. The north, west and south boundaries of the study area are outlined by the Fox River watershed. The eastern boundary is the ecological separation between the upper and lower reaches of the larger watershed, here described as the boundary between the Central Sand Hills and the Southeast Glacial Plains ecological landscapes<sup>1</sup>. Within these boundaries, a variety of spring-fed and warm water streams, seepage and drainage lakes, and impoundments converge to form the channel of the circuitous Fox River, as it makes its way from the FRHE area into Lake Butte des Morts then Lake Winnebago and, ultimately, Green Bay. Along the route, expansive wetlands, productive farm fields, and varied forest and woodland types surround this network of surface waters. Scattered throughout the FRHE are many high-quality and rare natural communities, including various types of marshes, fens, wet prairies, and oak barrens that are home to at least 100 species of rare plants and animals that depend on these unique habitats. Some of the state's finest and most popular trout streams originate in the prolific springs that flow out of the western edge of the sand hills. In addition to the high quality and rare habitats that exist, this area offers very good opportunities to protect and restore habitat for the federally endangered Karner blue butterfly.

Although the ecological significance of the FRHE and the opportunities for conservation and restoration have long been appreciated, specific supporting documentation has continued to mount through studies conducted over the past decade. A statewide evaluation of high-quality landscapes rated the White River/Upper Fox River watershed portion of the FRHE high in terms of ecological representation, biological diversity, urgency of threats, and restoration potential (Randy Hoffman, State Natural Areas Program, personal communication). The White River Marsh area also contains the highest quality lowland grassland site in the state (Sample and Mossman 1997). In addition, four of the state's top six potential oak barrens restoration sites occur within the FRHE (Krause 1995). The area is also home to a high concentration of rare natural communities and plant and animal species, including 38 listed as State Threatened or Endangered.

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<sup>1</sup> See Appendix A for further explanation of ecoregion boundaries.

This assessment of the FRHE is the result of a year-long effort to gather and summarize existing information on the ecologically important resources in the area, including natural communities, critical habitats, populations of rare plants and animals, and other unique landscape features. The primary impetus for the project was to prepare for an upcoming Wisconsin Department of Natural Resources (WDNR) Feasibility Study that will examine the boundaries of properties currently in state ownership and report on the feasibility of the purchase of new land parcels over 500 acres for State Natural Areas and other conservation and recreation purposes. However, the assessment was also designed to be of value for conservation planning by all types of land managers and landowners, whether their purview is public, nonprofit, or private and to support these conservation efforts for years to come.

This assessment was designed to answer the following basic questions:

- *What are the most significant ecological resources in the area?*
- *Why are they considered significant?*
- *What sites warrant consideration for protection, or improved protection, by the state or other entities?*
- *What additional field inventory or other information is needed to more completely answer the above questions for all potential sites?*

The remainder of this report is divided into these sections:

- ❖ The **Ecological Overview** provides a summary of the descriptive aspects of the ecology of the FRHE area, including geology and soils, waters and wetlands, ecological landscapes, vegetation and land cover, currently protected conservation lands, and information on rare species and natural communities from the Natural Heritage Inventory (NHI) database.
- ❖ The **Identification of Significant Ecological Sites** presents 86 sites of significance and the methods used to identify them, including:
  - 1) A Coarse Filter Screening analysis designed to identify potential high-quality natural communities throughout the entire area using GIS and aerial photography.
  - 2) A compilation of on-the-ground records of actual or potential high quality ecological sites, based on Contributor Records collected from individual scientists, resource managers, conservation enthusiasts, and amateur naturalists.
  - 3) The results of a workshop where individuals with local knowledge of the area worked in teams to score potential high quality sites, using a set of ecological attributes that indicate the sites' values for conservation efforts.
  - 4) Analysis and finalization of the Significant Ecological Sites that drew upon all of the above information.
- ❖ **Opportunities for Conservation** discusses the current status and significance of the ecological resources of the FRHE area and provides considerations for how this information can be used to support effective conservation planning.
- ❖ **Future Information Needs** outlines NHI priorities for future biotic inventory efforts within the FRHE study area based on information submitted for the workshop, current NHI data, and subsequent interpretation.

# Ecological Overview

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## Where is the Fox River Headwaters Ecosystem?

The Fox River Headwaters Ecosystem (FRHE) lies in the western half of the WDNR's Upper Fox Geographic Management Unit (GMU). Its boundaries enclose 823,558 acres or 2.3 percent of the total area of Wisconsin and include parts of these counties: Marquette (296,632 acres), Green Lake (212,801), Waushara (127,468), Columbia (118,128), Adams (53,503), Winnebago (12,023), Fond du Lac (2,302), and Dodge (697).

Resource planners and managers often divide landscapes into geographic areas using different systems of classification for different purposes. A *watershed* is a geographic area with topography that drains to a particular river or lake system. An *ecoregion* is a geographic area that is defined by a relatively consistent pattern of geology, soils, vegetation, natural processes, and climate in addition to topography. For the FRHE, the southern, western, and northern boundaries follow those of the upper Fox River *watershed*. The eastern boundary follows Landtype Associations<sup>2</sup> 222Kd02 (Green Lake Moraines) and 222Kc07 (Redgranite Lake Plain) (see Figures 2 and 3) and represent an ecological divide between the upper and lower reaches of the larger Fox River basin. The White River Marsh Wildlife Area is an exception to this divide, being located in the Southeast Glacial Plains.

What follows is an introduction to the ecological features of the FRHE, including summary information from the Natural Heritage Inventory (NHI) database on rare natural communities, plants, and animals. More detailed information regarding the ecological features of the FRHE can be found in Appendix A ("Ecological Overview: Background Information on the Fox River Headwaters Ecosystem") and the *State of the Upper Fox River Basin* Report (WDNR 2001).

## Geology and Soils

The present-day topography and soils of the FRHE are legacies of Wisconsin's most recent glacial period. During a period lasting from 15,000 to 11,000 years ago, the Green Bay Lobe of the Wisconsin stage of glaciation melted and receded northeast towards present Green Bay. In its wake, it discharged huge volumes of outwash rock, gravel, and sand, leaving a large terminal moraine in the northwest part of the area as well as numerous smaller ground moraines. Giant blocks of ice left behind embedded in the outwash material melted slowly, creating what we now call kettle lakes.

The resulting FRHE is generally low and relatively flat. Bedrock outcrops are rare due to deep layers of sandy soil, typical of Aldo Leopold's aptly named "sand counties" of central Wisconsin. While these soils have been called the "Golden Sands" for their ability to produce high crop yields when irrigated (Hole 1976), they have relatively low moisture-holding capacity and are susceptible to drought.

## Waters and Wetlands

The drainage area for the upper Fox River is made up of a number of watersheds (Figure 2). Watersheds present, at least in part, in the FRHE include the Fox River - Rush Lake (UF-05), Fox River - Berlin (UF-

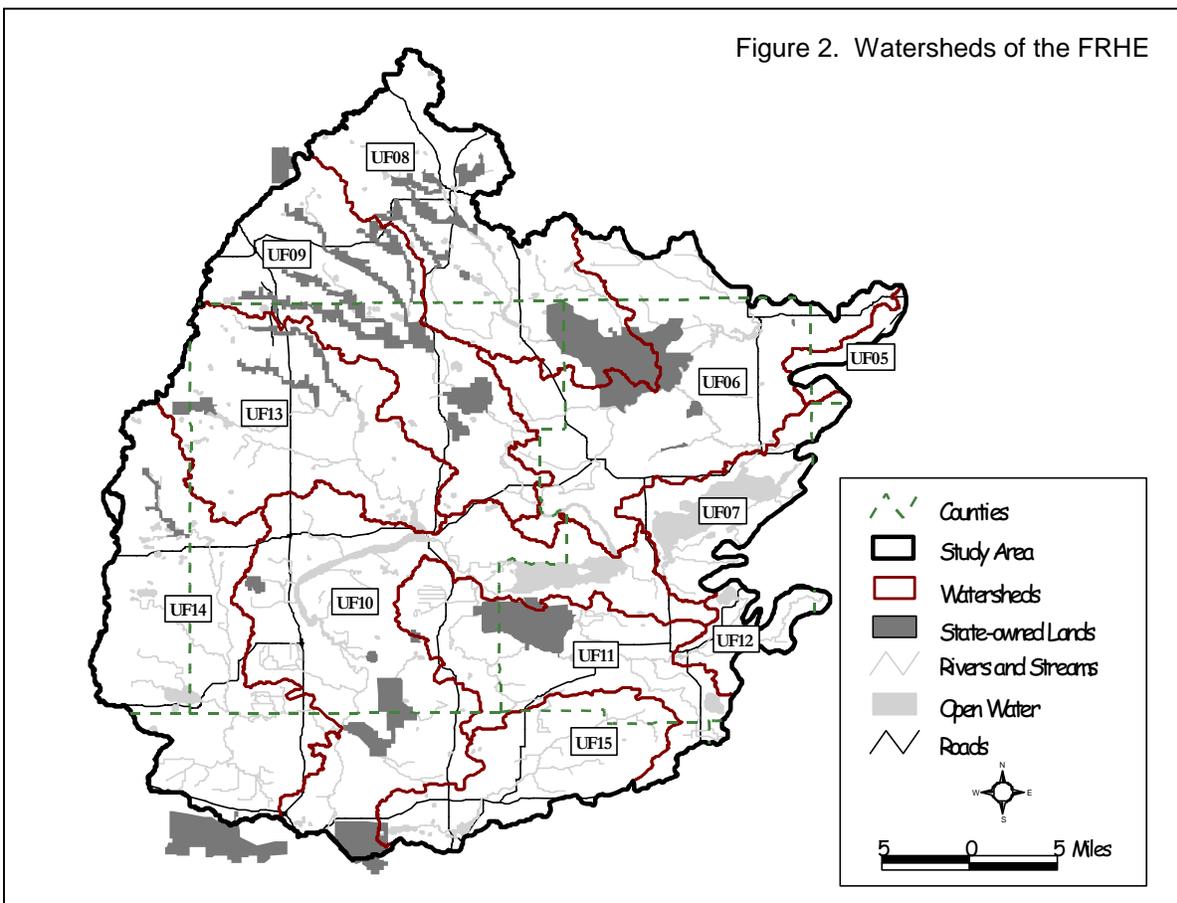
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<sup>2</sup> Landtype Associations (LTA's) are part of an ecoregional classification based on the National Hierarchical Framework of Ecological Units (Bailey 1995 and Keys 1995).

06), Big Green Lake (UF-07), White River (UF-08), Mekan River (UF-09), Buffalo and Puckaway Lakes (UF-10), Lower Grand River (UF-11), Upper Grand River (UF-12), Montello River (UF-13), Neenah Creek (UF-14), and Swan Lake (UF-15). For more information on current conditions for each of these watersheds, see the *State of the Upper Fox River Basin Report* (WDNR 2001).

Approximately 4 percent, or 30,212 acres, of the FHRE is open water. Of the approximately 218 lakes, Green Lake (7,346 acres) is the largest in the area and, at 236 feet, is the deepest natural lake in the state. The FRHE has 16 lakes listed as rare natural communities by the NHI, including excellent examples of both deep and shallow hard water lakes.

Extensive wetlands occupy about one-fifth (161,252 acres) of the FRHE. About 34,000 acres, representing 17 percent of the total wetland area in the FRHE, is currently under state ownership. A few of the largest wetland areas, including the White River, Germania, and Grand River Marshes, are partially protected as State Wildlife Areas.

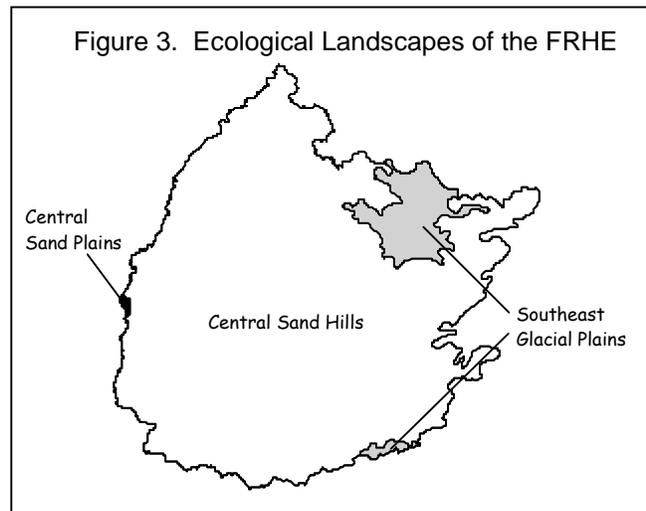


The Fox River is the major warm water stream in the area and flows through two large impoundments, Buffalo Lake and Lake Puckaway. The White River is a significant warmwater stream below the dam in Neshkoro. Numerous cool to coldwater streams, including the Upper White and Mekan rivers, and Wedde, Chaffee, Tagatz and Caves Creeks, originate from the terminal moraine in the northwest portion of the area. Most of these headwater areas are partially protected by one of five State Fishery Areas that occupy some 20,000 acres.

## Ecological Landscapes

As mentioned above, an ecoregion is a geographic area that has a relatively consistent pattern of topography, geology, soils, vegetation, natural processes, and climate. In order to provide Wisconsin resource managers with a simple ecoregion classification customized for the state, WDNR used the U.S. Forest Service's National Hierarchical Framework of Ecological Units (Avers et al. 1994) to create a system of 17 distinct "Ecological Landscapes" (EL's)<sup>3</sup>, each composed of groupings of subsections from the NHFEU.

The FRHE consists of three EL's: the Central Sand Hills, the Southeast Glacial Plains, and the Central Sand Plains. Ninety-three percent, or about 766,000 acres, of the FRHE lies within the Central Sand Hills EL that is composed of two Subsections: a broad kettle moraine in the west (subsection 222Kb) and a relatively flat area of pitted outwash in the east (subsection 222Kd). The Southeast Glacial Plains and Central Sand Plains EL's occupy the remainder of the FRHE, occupying 50,000 acres and 1,000 acres, respectively (Figure 3). For more information on the Ecological Landscapes system and descriptions of the 5 subsections that occur in the FRHE, see Appendix A.



## Vegetation and Land Cover

Resource managers and planners use information about what the land was like before European settlement as a measure of the ecological capability of the land, to understand changes in the landscape over the past 150 years, and as a guide for understanding what our management choices are today. During the mid-1800s the U.S. General Land Office performed the surveys in the FRHE area that make this analysis possible. In 1976, R.W. Finley used the General Land Office records to produce a 1:500,000-scale map entitled "Original Vegetation Cover of Wisconsin." This information has since been digitized and stored in a database so that the presettlement land cover can be more completely studied.

Based on Finley's analysis, nearly three-quarters of the FRHE, including all of the uplands, were covered in some type of oak - dominated community in the mid-1800's. These natural communities ranged along a continuum from forest to oak openings to barrens. Other less fire-tolerant tree species persisted only where topography or hydrologic features protected them from fire. In lowland areas, open wetlands covered almost one-fifth of the FHRE; forested wetlands were much less common.

Between 1991 and 1993, the Wisconsin Initiative for Statewide Cooperation on Landscape Analysis and Data (WISCLAND) collected and analyzed land cover data for the entire state using Landsat Thematic Mapper (TM) satellite imagery. Analysis of this information, along with other sources like aerial photographs, enables us to describe current land uses and land cover in the FHRE area.

The conversion of pre-settlement oak forests and oak openings to what is now agriculture and pasture led to an overall decrease in forest cover from about three-quarters before settlement to less than one-quarter

<sup>3</sup> A Wisconsin DNR Ecological Landscapes Handbook is currently in preparation.

today. Prairies in this landscape were historically significant but are now reduced to a few generally small remnants. The percentage of wetland has remained relatively constant at about 20 percent. However, drainage, grazing, and the spread of invasives have altered many, if not most, of the FRHE wetlands. For more information on the pre-settlement land surveys and the WISCLAND current land cover database, see Appendix A.

## Natural Heritage Inventory Data

The WDNR Bureau of Endangered Resources (BER) maintains an extensive database of occurrences of rare natural communities, plants, and animals through the Wisconsin Natural Heritage Inventory program, which is part of an international network of Heritage programs initiated by the Nature Conservancy and now coordinated by NatureServe<sup>4</sup>. The database is composed of "elements," which are 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 and mussel beds. "Element occurrences" (EO's) are areas of land and/or water in which a rare species or natural community is, or was, present (NatureServe 2002). A search of the NHI database for the FRHE study area yielded 138 elements and 473 element occurrences.

### Natural Communities<sup>5</sup> within the FRHE

Of the 36 natural community elements within the FRHE, the following are especially significant because of their high frequency within the FRHE or rarity on a statewide level:

- coastal plain marsh (3 element occurrences, 50% of statewide total)
- oak woodland (2, 33%)
- calcareous fen (23, 28%)
- wet-mesic prairie (18, 24%)
- southern tamarack swamp (rich) (4, 18%)
- oak barrens (5, 14%)
- wet prairie (3, 13%)
- southern dry forest (13, 13%)
- southern sedge meadow (21, 12%)
- lake--shallow, hard, seepage (6, 11%)
- springs and spring runs, hard (7, 10%)

The following natural communities have also been documented within the FRHE, but each represents less than 10 percent of the statewide total number of element occurrences:

- emergent aquatic (13 element occurrences)
- northern wet forest (11)
- northern sedge meadow (11)
- shrub-carr (9)
- dry prairie (8)
- alder thicket (5)
- northern dry-mesic forest (5)
- lake--shallow, soft, seepage (4)
- northern dry forest (3)
- floodplain forest (3)
- mesic prairie (3)
- southern dry-mesic forest (3)
- lake--deep, hard, drainage (2)
- lake--deep, hard, seepage (2)
- lake--shallow, hard, drainage (2)
- open bog (2)
- sand barrens (2)
- spring pond (2)
- stream--fast, hard, cold (2)
- oak opening (1)
- bedrock glade (1)
- cedar glade (1)
- inland beach (1)
- moist cliff (1)
- southern mesic forest (1)

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<sup>4</sup> See <http://www.natureserve.org>

<sup>5</sup> See the Bureau of Endangered Resources website (<http://www.dnr.state.wi.us/org/land/er/>) for descriptions of these natural communities

## Plants

The Wisconsin NHI database lists 34 rare plant species in the FRHE (Table 1). These include 4 State Endangered (END), 9 State Threatened (THR), and 21 State Special Concern (SC) species. There are no federally listed plant species recorded within the study area.

**Table 1. Rare Plants of the FRHE<sup>6</sup>**

Scientific Name	Common Name	Last Obs.	State Status	Federal Status
<i>Catabrosa aquatica</i>	brook grass <sup>^</sup>	1993	END	
<i>Fuirena pumila</i>	dwarf umbrella-sedge <sup>^</sup>	1992	END	
<i>Muhlenbergia richardsonis</i>	Soft-leaf muhly	1989	END	
<i>Scirpus cespitosus</i> var <i>callosus</i>	Tussock bulrush <sup>^</sup>	1986	END	
<i>Asclepias lanuginosa</i>	wooly milkweed	1999	THR	
<i>Cypripedium candidum</i>	Small white lady's-slipper <sup>^</sup>	1986	THR	
<i>Gentiana alba</i>	yellow gentian	1990	THR	
<i>Opuntia fragilis</i>	brittle prickly-pear	1991	THR	
<i>Platanthera flava</i> var <i>herbiola</i>	pale green orchid	2000	THR	
<i>Poa paludigena</i>	bog bluegrass <sup>^</sup>	1987	THR	
<i>Polytaenia nuttallii</i>	prairie parsley	1986	THR	
<i>Psilocarya scirpoides</i>	Long-beaked baldrush <sup>^</sup>	1998	THR	
<i>Tofieldia glutinosa</i>	Sticky false-asphodel <sup>^</sup>	1986	THR	
<i>Aster dumosus</i> var <i>strictior</i>	bushy aster	1990	SC	
<i>Cardamine pratensis</i>	Cuckooflower	1971	SC	
<i>Carex livida</i> var <i>radicaulis</i>	Livid sedge <sup>^</sup>	1979	SC	
<i>Cypripedium parviflorum</i>	Small yellow lady's-slipper <sup>^</sup>	1986	SC	
<i>Cypripedium reginae</i>	Showy lady's-slipper <sup>^</sup>	1971	SC	
<i>Deschampsia cespitosa</i>	Tufted hairgrass <sup>^</sup>	1978	SC	
<i>Eleocharis compressa</i>	Flat-stemmed spike-rush <sup>^</sup>	1995	SC	
<i>Eleocharis quinqueflora</i>	Few-flower spikerush <sup>^</sup>	2000	SC	
<i>Eleocharis robbinsii</i>	Robbins spikerush <sup>^</sup>	1990	SC	
<i>Epilobium strictum</i>	downy willow-herb <sup>^</sup>	1992	SC	
<i>Equisetum variegatum</i>	variegated horsetail <sup>^</sup>	2000	SC	
<i>Gentianopsis procera</i>	lesser fringed gentian <sup>^</sup>	1987	SC	
<i>Polygala cruciata</i>	crossleaf milkwort <sup>^</sup>	1990	SC	
<i>Rhexia virginica</i>	Virginia meadow-beauty <sup>^</sup>	1995	SC	
<i>Scleria triglomerata</i>	whip nutrush <sup>^</sup>	1980	SC	
<i>Scleria verticillata</i>	low nutrush <sup>^</sup>	1989	SC	
<i>Talinum rugospermum</i>	prairie fame-flower	1995	SC	
<i>Triglochin maritima</i>	common bog arrow-grass <sup>^</sup>	1986	SC	
<i>Triglochin palustris</i>	slender bog arrow-grass <sup>^</sup>	2000	SC	
<i>Utricularia purpurea</i>	purple bladderwort <sup>^</sup>	1993	SC	
<i>Utricularia resupinata</i>	northeastern bladderwort <sup>^</sup>	1976	SC	

<sup>^</sup> = species that are typically found in aquatic habitats

<sup>6</sup> This table represents rare plants documented within the FRHE at the time of this writing. New records likely exist that are not reflected here.

## Animals

The WNHI database lists 66 animal species (and one "other," a migratory bird concentration site) within the FRHE (Table 2). Eleven of these species are State Endangered (END) and 12 are State Threatened (THR). The animal with the highest number of element occurrences within the FRHE, the Karner blue butterfly, is also the only federally listed species, although the massasauga rattlesnake is a candidate for federal listing. Over 80 percent of the rare animals documented within the study area are associated with aquatic habitats.

**Table 2. Rare Animals of the FRHE<sup>7</sup>**

Scientific Name	Common Name	Group	Last Obs.	State Status	Federal Status
<i>Podiceps grisegena</i>	red-necked grebe	bird^	1997	END	
<i>Sterna caspia</i>	Caspian tern	bird^	1990	END	
<i>Sterna forsteri</i>	Forster's tern	bird^	1996	END	
<i>Tyto alba</i>	Barn owl	bird^	1980	END	
<i>Calephelis muticum</i>	Swamp metalmark	butterfly^	1998	END	
<i>Oarisma powesheik</i>	Powesheik skipperling	butterfly^	2000	END	
<i>Acris crepitans blanchardi</i>	Blanchard's cricket frog	frog^	1988	END	
<i>Aflexia rubranura</i>	red-tailed prairie leafhopper	Leafhopper	1997	END	
<i>Ophisaurus attenuatus</i>	western slender glass lizard	lizard	1991	END	
<i>Plethobasus cyphus</i>	bullhead	mussel^	1993	END	
<i>Sistrurus catenatus catenatus</i>	eastern massasauga	snake^	1977	END	C
<i>Ammodramus henslowii</i>	Henslow's sparrow	bird^	1986	THR	
<i>Buteo lineatus</i>	red-shouldered hawk	bird^	1983	THR	
<i>Dendroica cerulea</i>	cerulean warbler	bird^	1988	THR	
<i>Empidonax virescens</i>	Acadian flycatcher	bird^	1988	THR	
<i>Pandion haliaetus</i>	osprey	bird^	1981	THR	
<i>Tympanuchus cupido</i>	greater prairie-chicken	bird^	1981	THR	
<i>Vireo bellii</i>	Bell's vireo	bird^	1985	THR	
<i>Aeshna mutata</i>	spatterdock darner	Dragonfly^	1989	THR	
<i>Moxostoma valenciennesi</i>	greater redhorse	fish^	1988	THR	
<i>Notropis anogenus</i>	pugnose shiner	fish^	1978	THR	
<i>Tritogonia verrucosa</i>	buckhorn	mussel^	1997	THR	
<i>Emydoidea blandingii</i>	Blanding's turtle	turtle^	1997	THR	
<i>Cicindela patruela huberi</i>	a tiger beetle	beetle	2000	SC/N	
<i>Hygrotus sylvanus</i>	sylvan hygrotus diving beetle	beetle^	1990	SC/N	
<i>Aechmophorus occidentalis</i>	western grebe	bird^	1990	SC/M	
<i>Ammodramus savannarum</i>	grasshopper sparrow	bird^	1986	SC/M	
<i>Chlidonias niger</i>	black tern	bird^	1990	SC/M	
<i>Gallinula chloropus</i>	common moorhen	bird^	1990	SC/M	
<i>Ixobrychus exilis</i>	least bittern	bird^	1990	SC/M	
<i>Mergus serrator</i>	red-breasted merganser	bird^	1998	SC/M	
<i>Nycticorax nycticorax</i>	black-crowned night-heron	bird^	1988	SC/M	
<i>Chlosyne gorgone</i>	gorgone checker spot	butterfly	1985	SC/N	
<i>Lycaeides melissa samuelis</i>	Karner blue butterfly	butterfly	2001	SC/N	LE
<i>Poanes viator</i>	broad-winged skipper	butterfly	1997	SC/N	
<i>Euphyes bimacula</i>	two-spotted skipper	butterfly^	1996	SC/N	
<i>Lycaena epixanthe</i>	bog copper	butterfly^	2001	SC/N	
<i>Poanes massasoit</i>	mulberry wing	butterfly^	1999	SC/N	
<i>Crangonyx richmondensis</i>	a side-swimmer	crustacean^	1994	SC	
<i>Aeshna tuberculifera</i>	black-tipped darner	dragonfly^	1989	SC/N	

<sup>7</sup> This table represents rare animals documented within the FRHE at the time of this writing. New records likely exist that are not reflected here.

Scientific Name	Common Name	Group	Last Obs.	State Status	Federal Status
<i>Ischnura hastata</i>	citrine forktail	dragonfly^	1989	SC/N	
<i>Lestes eurinus</i>	amber-winged spreadwing	dragonfly^	1989	SC/N	
<i>Lestes inaequalis</i>	elegant spreadwing	dragonfly^	1989	SC/N	
<i>Lestes vigilax</i>	swamp spreadwing	dragonfly^	1989	SC/N	
<i>Neurocordulia molesta</i>	smoky shadowfly	dragonfly^	1994	SC/N	
<i>Stylurus notatus</i>	elusive clubtail	dragonfly^	1991	SC/N	
<i>Acipenser fulvescens</i>	lake sturgeon	fish^	1991	SC/H	
<i>Aphredoderus sayanus</i>	pirate perch	fish^	1985	SC/N	
<i>Erimyzon sucetta</i>	lake chubsucker	fish^	1991	SC/N	
<i>Etheostoma clarum</i>	western sand darter	fish^	1994	SC/N	
<i>Fundulus diaphanus</i>	banded killifish^	fish^	1995	SC/N	
<i>Macrhybopsis storeriana</i>	silver chub	fish^	1993	SC/N	
<i>Rana catesbeiana</i>	bullfrog	frog^	1984	SC/H	
<i>Paracloeodes minutus</i>	a small minnow mayfly	mayfly^	no data	SC/N	
<i>Grammia phyllira</i>	phyllira tiger moth	moth	1999	SC/N	
<i>Macrochilo bivittata</i>	an owlet moth	moth	1996	SC/N	
<i>Meropleon ambifusca</i>	Newman's brocade	moth	1998	SC/N	
<i>Papaipema beeriana</i>	liatris borer moth	moth	1996	SC/N	
<i>Alasmidonta marginata</i>	elktoe	mussel^	1997	SC/H	
<i>Pleurobema sintoxia</i>	round pigtoe	mussel^	1997	SC/H	
NA	migratory bird concentration site	other	1979	SC	
<i>Catinella exile</i>	Pleistocene catinella	snail	1997	SC/N	
<i>Strobilops affinis</i>	eightfold pinecone	snail	1997	SC/N	
<i>Vertigo elatior</i>	tapered vertigo	snail	1997	SC/N	
<i>Vertigo morsei</i>	six-whorl vertigo	snail	1997	SC/N	
<i>Hemileuca maia</i>	buck moth	moth	1997	no data	

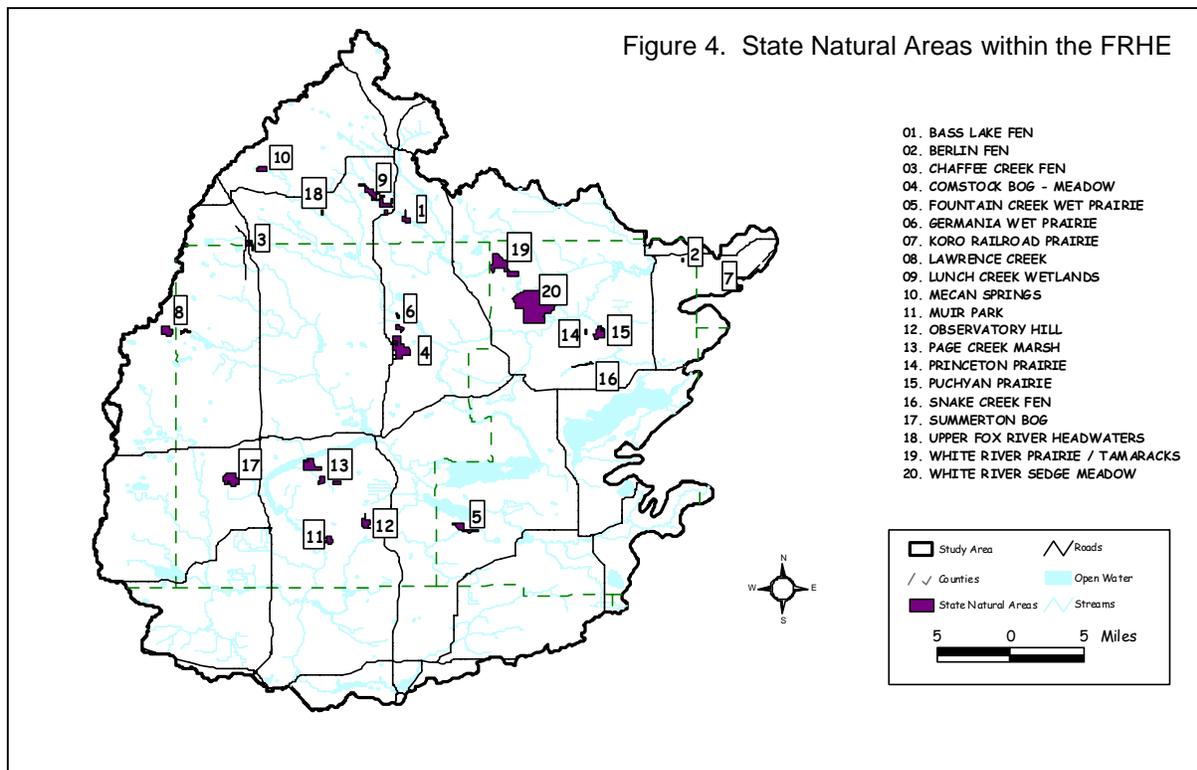
^ = species that are typically found in aquatic habitats

## Public Conservation Lands

Approximately 7.5 percent of the study area is currently in public ownership for conservation, recreation and aesthetic purposes. The public entities include the WDNR, the United States Fish and Wildlife Service (USFWS), and local governments. In addition, private conservation organizations are actively managing lands to protect and enhance ecological attributes. Figures 4 and 5 illustrate the distribution of the various publicly owned properties throughout the study area.

## State Natural Areas

State Natural Areas (SNAs) are formally designated sites devoted to scientific research, the teaching of conservation biology, and, especially, to the preservation of natural values and genetic diversity for future generations. There are currently 19 designated SNAs within the FRHE study area (Figure 4). Although formally designated by the WDNR, ownership is not restricted to the WDNR and often includes other governmental agencies, private land trusts (e.g., The Nature Conservancy), and individual landowners.



The purpose of the State Natural Areas program is to locate and preserve a system of State Natural Areas harboring all types of biotic communities, rare species, and other significant natural features native to Wisconsin. Thus, a variety of natural features occur within the SNAs in the study area and capture significant examples of the native species and natural communities representative of the study area and the state. A description of each of the following SNAs is located in Appendix C.

- Bass Lake Fen (77 acres)
- Berlin Fen (22)
- Comstock Bog-Meadow (632)
- Fountain Creek Wet Prairie (145)
- Germania Wet Prairie – within Germania SWA (95)
- Koro Prairie (3)
- Lawrence Creek (295)

- Lunch Creek Wetlands (457)
- Muir Park (150)
- Observatory Hill (100)
- Page Creek Marsh (392)
- Princeton Prairie (20)
- Puchyan Prairie (169)
- Silver Lake (official project area)
- Snake Creek Fen (31)
- Summerton Bog (428)
- Upper Fox Headwaters
  - Caves Creek Unit (70)
  - Chaffee Creek Unit (60)
  - Zinke Lake Unit (25)
- White River Prairie/Tamaracks – within White River Marsh SWA (780)
- White River Sedge Meadow – within White River Marsh SWA (3300)

### **State Wildlife and Fisheries Areas**

There are four WDNR-managed State Fishery Areas (SFA) and part or all of nine State Wildlife Areas (SWA) within the FRHE, covering a total of 57,250 acres within the FRHE (Figure 5). These properties are managed to provide habitat for native fish and wildlife and recreational opportunities for the public. Ecological significance varies a great deal among properties and within individual properties, depending upon the natural features present, property size and context, and past and current management. Greenwood SWA and Pine Island SWA are located outside of the FRHE study area boundary but are included in the study area due to their size, diversity, and because they were immediately adjacent to the FRHE.

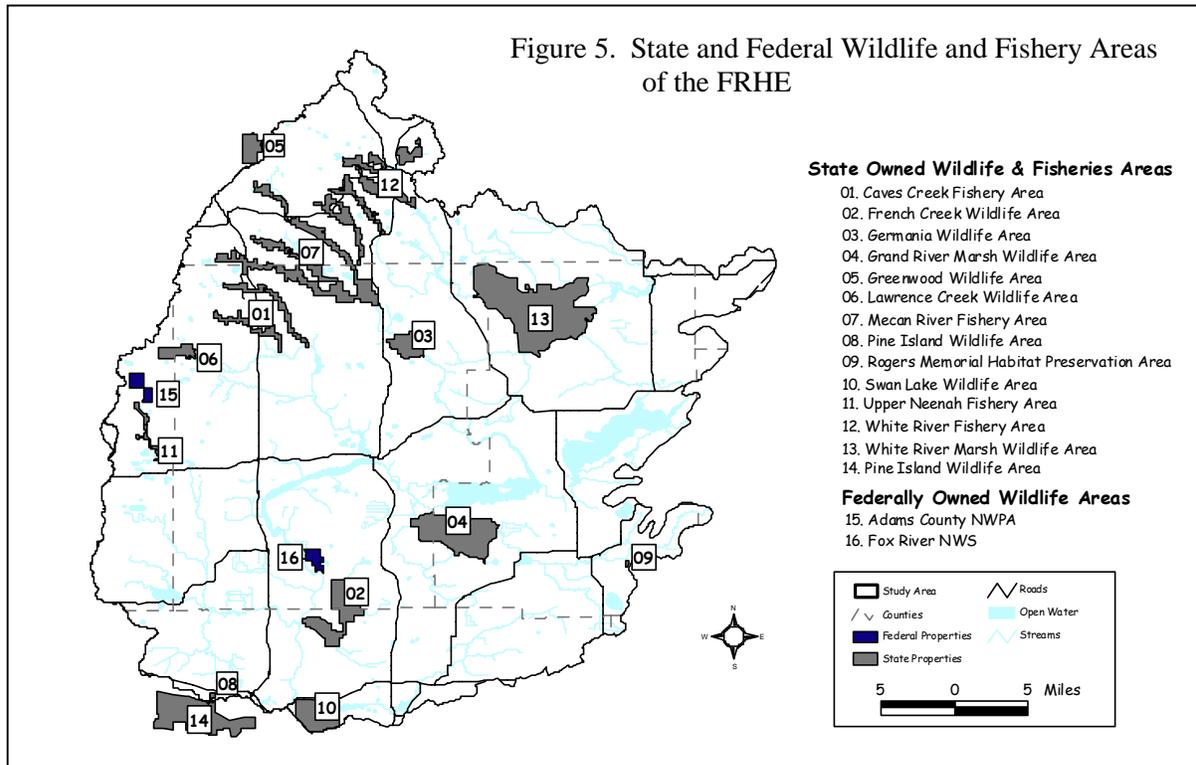
- Caves Creek SFA (2,981 acres)
- French Creek SWA (4,675)
- Germania SWA (2,485)
- Grand River Marsh SWA (7,737)
- Greenwood SWA (1,441)
- Lawrence Creek SWA (1,156)
- Mecan River System SFA (11,202)
- Pine Island SWA (7,271)
- Rogers Memorial Habitat Preservation Area (75)
- Swan Lake SWA (4,416)
- Upper Neenah SFA (935)
- White River Marsh SWA (17,235)
- White River System SFA (5,024)

### **Federal Properties**

Two federal conservation properties are located within the study area (Figure 5):

- Fox River National Wildlife Refuge (1001 acres) – established in 1978 to protect the area known as the Fox River Sandhill Crane Marsh. The refuge preserves wetland and upland habitat along the Fox River in order to support wildlife communities significantly different from other habitats within the region, as well as protect an important breeding and staging area for the greater sandhill crane. The Refuge contains 10 distinct plant communities ranging from upland coniferous and deciduous woodlands to five wetland communities. There are about 150 species of wildlife known from the Refuge.
- New Chester Waterfowl Production Area - Adams County (344) – Owned and managed by the U.S. Fish and Wildlife Service as part of the National Wildlife Refuge System, the property consists of approximately 80 acres of wetland with the balance being grassland and woodland. The site provides habitat for waterfowl, other migratory birds, and resident wildlife. The New Chester WPA is open to hunting, trapping, fishing, wildlife observation, hiking, cross-country skiing, nature study, and photography, subject to all applicable federal and state laws. Local coordination and management is the responsibility of the Leopold Wetland Management District office at Portage, WI.

Figure 5. State and Federal Wildlife and Fishery Areas of the FRHE



## Previous Assessments of Significant Ecological Landscapes

Various large-scale research and planning efforts have identified a number of locations within the FRHE as being ecologically significant. The following are examples of such studies and the sites that were identified.

### ❖ Potential Landscape Scale Management Opportunities For Southern Wisconsin’s Most Threatened Landscapes: Open grassland/Prairie, Upland Interior Forest, & Savanna and Prairie/Forest Ecotone

In 1994-1995, the WDNR’s Bureau of Research (now known as Integrated Science Services) conducted a study to identify the State’s most critically threatened landscape types and locate opportunities for cooperative and integrated landscape-scale management of these types (Krause 1995). The report identified three major landscape types (savanna/prairie-forest ecotone, grassland/prairie, and upland interior forest) that were determined to be priorities for protection in order to conserve important elements of Wisconsin’s natural biological diversity. The report culminates with a description of specific sites that offered management and conservation opportunities for each of the critically threatened landscapes.

Three sites within the FRHE were identified as statewide critical management areas for the **Savanna and Prairie/Forest Ecotone** – specifically for oak barrens (no jack pine component). They include:

- Oxford Oak Barrens
- Germania/Comstock Oak Barrens
- Thompson Lakes Oak Barrens

Two lowland sites included in the FRHE were identified as statewide critical management areas for the **Open Grassland/Prairie landscape**, including

- Puchyan-White River/Princeton Marsh
- Pine Island

#### ❖ **The Wisconsin Grassland Bird Study**

The WDNR Bureau of Integrated Science Services (formerly Bureau of Research) conducted the Wisconsin Grassland Bird Study from 1985-1997. The study focused on grassland bird distribution and abundance, community composition, habitat preferences, habitat requirements, population trends, and response to land use changes. A report was published (Sample and Mossman 1997) for natural resource managers that identified *Priority Landscapes* and *Priority Sites* for grassland bird habitat. The *Priority Landscapes* detailed in the report represented “unique opportunities for landscape-scale grassland management that should not be missed.”

The White River Marsh complex, located within the FRHE, was ranked as the number five *Priority Landscape* in the state. In addition, the following sites, located within the White River Marsh complex were listed as *Priority Sites* for management focus:

- Puchyan Prairie SNA
- White River Marsh Wildlife Area
- Comstock Bog - Meadow SNA
- Germania Wildlife Area

Four additional locations within the FRHE but outside of the White River Marsh complex were listed as *Priority Sites* in the report.

- Fox River Crane Marsh<sup>8</sup>
- French Creek Wildlife Area
- Greenwood Wildlife Area
- Grand River Marsh Wildlife Area
- Lunch Creek Wetlands
- Pine Island Wildlife Area

#### ❖ **Nature Conservancy Ecoregional Planning**

The Nature Conservancy (TNC) completed an ecoregional plan for the Prairie-Forest Border Ecoregion for most of southern Wisconsin and portions of Minnesota, Iowa, and Illinois (TNC 2001). The resulting portfolio of Ecologically Significant Areas represents viable natural community types, globally rare native species, and other selected features. Eight of these areas are located within the FRHE (Figure 6), and all were included in the final list of sites for this report.

Five of TNC’s Ecologically Significant Areas were listed as *functional sites* (meaning that they were “selected for one or more small-patch or large-patch plant communities, or an aquatic ecological system target. Rare species targets may or may not also be present”):

- Bass Lake Fen
- Berlin Fen
- Ennis Lake-Muir Park
- Lunch Creek
- Summerton Bog

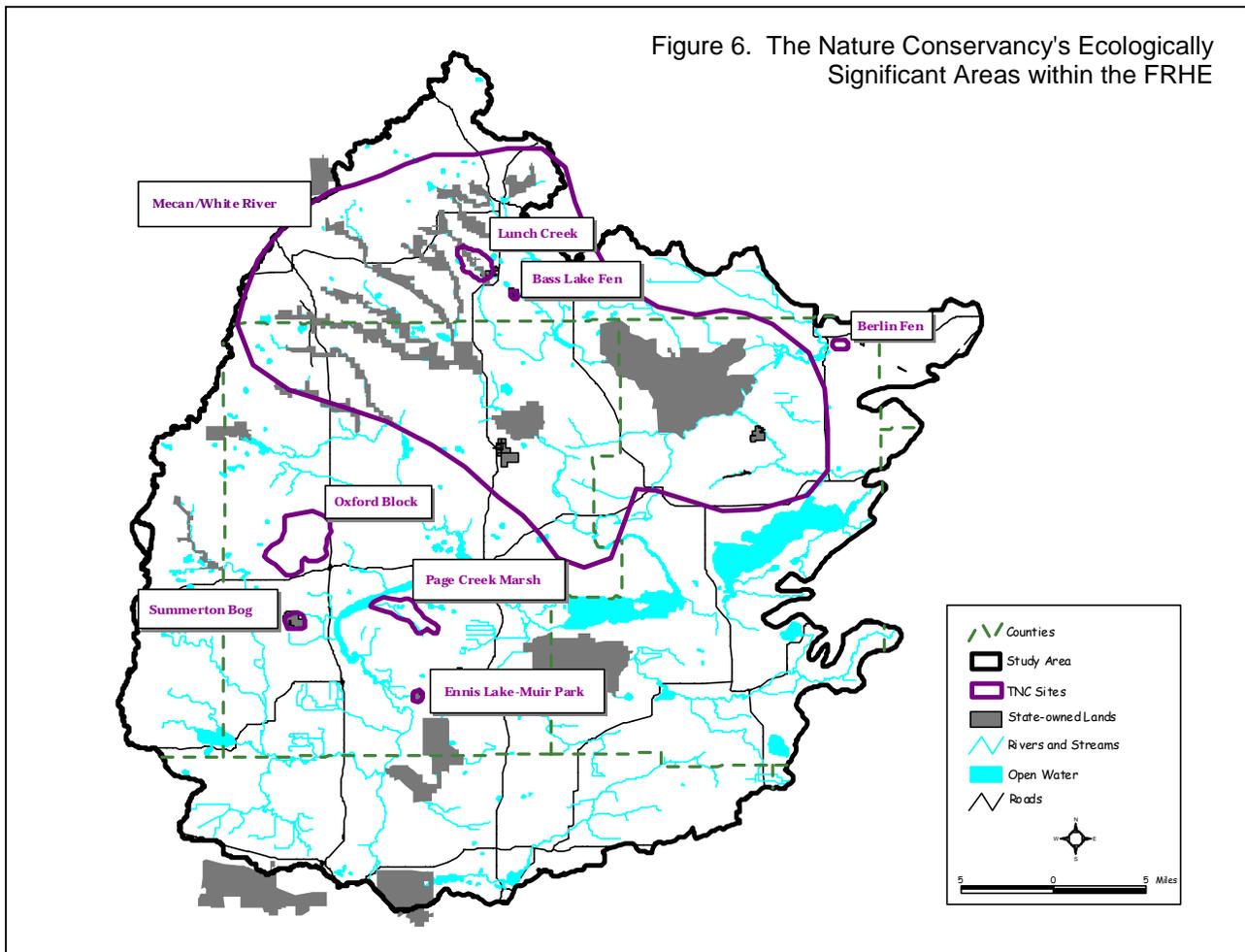
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<sup>8</sup> note: this site is within the boundary of the Grand River Marsh Wildlife Area site from the workshop

The **Mecan/White River** site was considered a *Functional Landscape*, indicating that it was “selected for both coarse-scale plant community and aquatic ecological system targets.” *Functional Landscapes* may also include rare species targets. Many of the targets represented at these types of areas are viable, but some degree of restoration activity may be required to perpetuate them and ensure their future viability.

Two other TNC sites were listed as *Restoration Landscapes* - sites that are “selected for both coarse-scale plant community and aquatic ecological system targets.” *Restoration Landscapes* are generally significantly degraded by past land use, fire suppression, hydrologic alteration, or other factors, so conservation strategies are primarily focused on restoration activities:

- Oxford Block
- Page Creek Marsh



❖ **Land Legacy Study**

At the request of the Wisconsin Natural Resources Board, the WDNR undertook a study, entitled the Land Legacy Study, to identify places that will be critical in meeting both conservation and recreation needs over the next fifty years. Over the past three years, public meetings and staff workshops have been held throughout the state to gather opinions and local knowledge about the lands and waters of the state. Several people involved with the FRHE assessment also contributed input to the Land Legacy Study. Although the Land Legacy Study's criteria for identifying critical places are broader than those used in the FRHE (and cover recreation aspects), it is expected that there will be some overlap in the important places identified in each report. The Land Legacy Report is scheduled for release in mid to late November 2002.

# Identification of Significant Ecological Sites

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## Approach and Methods Used to Identify Significant Ecological Sites

Building on the information compiled for the above Ecological Overview, the following steps were taken between June 2001 and June 2002 to determine the most significant ecological features of the FRHE study area and to provide some considerations for conservation attention.

1. A limited field inventory of areas with high potential for rare plants and natural communities was conducted during the summer of 2001. BER staff used NHI county inventory files from the late 1970s, information from the 1996 White River Feasibility Study, and suggestions from local experts to develop a list of 27 potential inventory sites. Rapid field surveys were conducted for 22 of these sites to assess their overall condition and ecological quality, and to determine future inventory needs. New data from the inventory effort were compiled, and existing records in the NHI database were updated. A copy of the inventory report is available from the Bureau of Endangered Resources.
2. A coarse filter inventory, using GIS database queries, aerial photographs, and limited ground surveys, identified 48 locations with potential to provide quality habitat or restoration opportunities (see Appendix B).
3. Knowledgeable local individuals were solicited for information about the FRHE area resulting in the identification of 192 records of natural communities, critical habitats, populations of rare plants and animals, and other unique features (see Appendices D and E).
4. The 48 coarse filter locations and the 192 records from individual contributors were combined into 83 sites based on the similarity of their ecological characteristics and proximity to each other.
5. People who contributed information about the FRHE area were invited to attend a workshop where small groups discussed and scored the Sites, using pre-determined ecological criteria. Sites were ranked of high, medium, or low priority for conservation based on the knowledge of the participants in each group. The scores were then averaged to provide an indication of conservation priority (see Appendix D).
6. BER identified 86 Significant Ecological Sites grouped into 4 categories of ecological significance (Figure 7 and Table 3). This was accomplished using the workshop results, updated NHI data, and aerial photographs of the sites and surrounding landscapes. In some cases, the placement of Significant Ecological Sites did not directly correspond to the scores generated from the Workshop.

## The Final List of Significant Ecological Sites

The 86 Sites that resulted from the above process are presented in Table 3 and arranged according to their ecological significance based on currently available inventory and ecological information. The Sites are organized by the four categories below. In addition, an acreage estimate, the approximate acreage of each site in public ownership, and a site summary is provided. The site summary was extracted directly from each Workshop Contributor's site information and has not been revised or confirmed. See Figure 7 for the general location of the Sites within the FRHE. A list of documented NHI elements by site, where applicable, is provided in Appendix F.

- **High Sites** are of statewide significance and contain excellent examples of natural communities and/or rare plants or animals, which are believed to be among the best remaining examples in the study area. Such Sites are large enough to support the resources of significance without major restoration efforts and are buffered by compatible land uses in the surrounding landscape.
- **Medium-High Sites** contain some plant or animal feature of statewide significance but are somewhat compromised by surrounding land uses or past use. In some cases, Medium-High Sites contain small areas of "High" value located within a larger area of clearly "Medium" value.
- **Medium Sites** are of more regional than statewide importance and contain good or excellent examples of communities or rare plants or animals but are somewhat compromised by human disturbance, incompatible surrounding land uses, or small size. In many cases, a lack of adequate information prevented the Site from being given a higher significance.
- **Low Sites** are generally of local significance and may contain good or excellent examples of communities or rare plants or animals but are substantially compromised by human disturbance, small size, surrounding land uses, invasive species, or other significant ecological constraints. In some cases, inventory is lacking such that a higher significance could not be assigned without additional information. Future inventory could clarify the ecological significance of a Site.

Eighteen of the Significant Ecological Sites are ranked High, 9 are Medium-High, 32 are Medium, and 27 are Low. The placement of the Sites within these categories is somewhat arbitrary – although there is a wide variation of significance between "high" and "low" Sites, all of the Sites contain features considered ecologically significant. Sites are not further prioritized within each category, so the relative significance of Sites within each group is the same. Opportunities for conservation are discussed in the next section.

Some generalizations can be made about the categories to provide a broad overview of the conservation potential within the FHRE area. "High" Sites tend to represent large, unfragmented areas with a varied complex of high quality natural communities and/or rare species populations. "Medium-High" Sites are similar to the above, but tend to be somewhat smaller in size and may include fewer occurrences of rare species. Many Sites in both categories have a portion of their area under some kind of public protection.

The 32 "Medium" Sites, the largest number in any of the four categories, tend to be smaller in size than the higher priority Sites and have lower concentrations of rare species. The 27 "Low" Sites are typically very small size, and many are without documented element occurrences. Many of the Sites in both categories are currently in private ownership. It should be noted that placement in the "Medium" or "Low" categories does not mean that sites are of low value. Again, all of the sites were identified through this analysis because they contained some natural resource(s) of ecological significance. As such, they contain ecological values that may warrant conservation at some level. In addition, there may be other sites not included within these sites that are important in their own right but adequate information does not currently exist.

**Table 3. Significant Ecological Sites**

Site Name	Size <sup>1</sup> (acres)	% public ownership <sup>2</sup>	Abbreviated summary of Contributor's Site records
<b>Sites of High Ecological Significance</b>			
Caves / Tagatz Fisheries	18,854	13	High quality cold water stream with varied uplands, including oak savanna, dry prairie, jack pine barrens, and numerous springs and spring seepages.
French Creek Wetland	3,529	70	Large, open wetland with sedge meadow and emergent aquatics. Important for numerous rare fish species. Conservation priority reflects the need to revise the boundary to include French Creek up to the dam.
FRNW Refuge / Packwaukee	2,298	33	Fox River National Wildlife Refuge with river, wetland, grassland, woods, and nearby spring-fed kettle lake.
Germania Wildlife Area	17,666	3	Extensive tamarack fen and sedge meadow. Cold water streams grading to warm water stream systems. Intact wetland complex. Many impoundments.
Grand River Wildlife Area	23,857	32	Extensive lake, wetland, and wet prairie complexes.
Lawrence Creek	6,964	14	Large cold water complex of springs, spring-fed tributaries, ephemeral ponds, wetlands, seepage lakes, and Lawrence Creek. Site may also have good upland restoration potential.
Mecan River Fisheries Area	29,204	26	High quality cold water stream with varied uplands, including sand prairie, savanna, and oak barrens.
Mecan Springs	3,559	--	Springs and streams. Includes lakes with undeveloped shorelines.
Mitchell's Glen	611	--	Spring forested limestone gorge with springs, maple-basswood forest, and oak savanna.
Mud Lake	2,358	--	Originally included in the "Fluctuating Shoreline Lakes" workshop site that was subsequently divided. Undeveloped area under single ownership. Site includes the southern extension of northern bog communities.
Neenah Creek Valley	7,159	--	Large complex of springs with associated wetlands, fens, and sedge meadows.
Oxbo Wetlands	337	--	Lowland hardwoods, marsh, and river bayous. Current or historic walleye and lake sturgeon spawning habitat. Has globally rare fish and is relatively intact.
Puckaway Critical Habitat	147		Originally the Puckaway Lake Work shop site. The site does not include the entire lake.
Puckaway Flatwoods	8,061	--	Disturbed but relatively large, intact complex of dry to wet oak, pine, and red maple forest.
Silver and Mud Lakes	813	--	Silver Lake is a shallow groundwater lake that contains documented occurrences of several rare species. Mud Lake is a big lake surrounded by tamarack forest.
Steuck's Pond	850		Originally included in the "Fluctuating Shoreline Lakes" workshop site that was subsequently divided. Undeveloped area under single ownership.
White River Fisheries	12,755	22	Large complex of springs and cold water streams, with adjacent high quality prairie.
White River Marsh Area	95,565	18	Very extensive complex of high quality wetland communities, including sedge meadows and wet prairies. Also includes a stretch of significant warm water stream with intact aquatic fauna and rare species.
<b>Sites of Medium-High Ecological Significance</b>			
Bass Lake	5,283	2	Undeveloped complex of wetlands, flowages and an undeveloped deep water lake. Contains several rare species.

Site Name	Size <sup>1</sup> (acres)	% public ownership <sup>2</sup>	Abbreviated summary of Contributor's Site records
Berlin Fen & Sedge Meadow	721	3	Good quality fen community with numerous rare species. Site compromised by surrounding land uses and unknown hydrologic impacts. Long-term viability is in question.
Corning - Weeting Lakes	2,700	--	Large forested wetland including tamarack swamp, sedge meadow and bog. Contains black spruce at the southernmost edge of its range.
Fluctuating Shoreline Lakes		--	Originally part of the larger "Fluctuating Shoreline Lakes" workshop site that was, subsequently, divided. Undeveloped area under single ownership. Inventory needed.
Klawitter Creek Fen	58	--	High quality, 5-acre prairie fen or calcareous fen consisting of two patches separated by a woody thicket, along the north side of Klawitter Creek, a cold, hard, fast trout stream.
Montello River	2,921	--	High quality warm water river with extensive silver maple floodplain forest (second growth). Lake (Harris Pond) with undeveloped shoreline and wild rice on one side. Locally rare floodplain forest and populations of rare plant species.
Page Creek	1,283	23	(Originally the "Buffalo Lake Area" Workshop site). Contains quality but fragmented occurrences of oak barrens, prairie, savanna, kettle lake, clear water stream, sedge meadow, and shrub-carr. Contains several rare species but is compromised by surrounding agriculture.
Sugar Island Wetlands	89	--	Peninsula and wetlands adjacent to Mitchell's Glenn, includes sugar maple and emergent marsh.
Summerton Bog North/South	1,484	29	Complex of good quality wetland communities including bog, fen, tamarack, and sedge meadow. The northern portion of this site contains several rare elements.
Swamp Lake	623	--	Originally part of the larger "Bog Relicts" workshop site that was, subsequently, divided. Large wetland forest complex including a good quality seepage lake with tamarack on Swamp Lake
<b>Sites of Medium Ecological Significance</b>			
Adams Cty. Waterfowl PA	1,601	2	Kettle lakes and oak barren complex near the Upper Neenah Creek SNA
Becker Waterfowl PA	394	--	Complex of glacial ponds, hilltop savanna, and alder/tamarack wetland.
Bennett Oak Savanna	436	--	Remnant oak savanna currently being restored
East Jordan Woods	86	--	(Originally "Jordan Lake Area" workshop site). Mixed oak and pine woods in undeveloped and older developed areas. Boundary should be modified to include the woods east of the lake.
Greenwood Wildlife Area	10,490	7	Greenwood Wildlife Area and large area of adjacent habitat also suitable for prairie restoration. Site also includes spring-fed and seepage lakes and spring-fed tributaries to the Mecan River.
Grotzke Rd. Area	5,678	--	Complex of dry prairie, oak barrens, northern and southern dry mesic forest and sandstone outcrops.
Harris Marsh	1,290	--	Originally part of the larger "Bog Relicts" workshop site that was, subsequently, divided.
Head of Green Lake	528	--	Marsh and sedge meadows. Good size wetland, more information on status and hydrology needed.
Jackson Kettle Complex	944	--	Degraded oak barren complex with kettles comprises one of the largest forest patches in the area. This site has possible restoration potential and more information is needed about this site.
Jordan's Lake Wetland	809	--	Extensive tamarack forest surrounding lake. Lake edge also includes cattail marsh and shrub/sedge meadow complexes.
Lake Maria	710	--	Open lake contains one rare bird species. Hydrology should be investigated further for possible

Site Name	Size <sup>1</sup> (acres)	% public ownership <sup>2</sup>	Abbreviated summary of Contributor's Site records
			opportunities to restore lake levels. There may be opportunities to control the shoreline and improve habitat.
Lewiston Flatwoods	762	--	Intact sedge meadow with apparent invasion of reed canary grass. Adjacent forest block dominated by mature oak in upland and mixed pine/hardwood in lower areas. Large size and the presence of rare elements led to a medium score.
Lime Kiln Bluff	1,243	--	Dry oak forest on sandy soils and limestone outcrops. Site has restoration potential.
Lower Silver Creek	231	--	Wetland and riparian areas that are likely to harbor uncommon or rare species. More information is needed to accurately rank this site.
Lower White River	1,232	--	Six miles of undisturbed cold water stream.
Lucerne Lake	313	--	Large, contiguous, relatively undeveloped property with a high quality lake with undeveloped shoreline. Fishery apparently good, but more information and inventory are needed for this site.
Marquette Marsh	250	--	Open wetland/hardwood complex, with southern hardwood swamp, sedge meadow, and cattail marsh
Meilke Lake	932	--	Small lake with undeveloped shoreline, waterfowl habitat, remnants suitable for restoration of oak savanna and prairie. Adjacent to incompatible land uses (townhall, road) and set within agricultural matrix. May need to revise boundaries to incorporate buffer and uplands.
Moon-Echo Lakes Area	700		Originally included in the "Fluctuating Shoreline Lakes" workshop site that was, subsequently, divided. Undeveloped area under single ownership. Site represents the southern extension of northern bog communities.
New Haven Woods	2,692	--	Extensive forested (black oak) kettle complex. Unlikely to be high quality, but size and variety of site are significant.
Norwegian Bay Wetlands	245		Sedge meadow, wet prairie, and fen adjoining Green Lake. Although locally important, and a remnant of something more extensive, areas around this site are highly developed and have a number of exotic species. This would probably be a good local project.
Oxford Woods and Savanna	9,947	--	Greenwood Wildlife Area and large area of adjacent habitat also suitable for prairie restoration. Site also includes spring-fed and seepage lakes and spring-fed tributaries to the Mecan River. This site is a large, intact upland site in need of inventory and an excellent restoration opportunity.
Packwaukee Hdwd. Swamp	893	--	Wet forest with tamarack and hardwoods with fen qualities.
Princeton Sturgeon Site	7	--	Current or historic lake sturgeon spawning site; natural riffles and rip-rapped shoreline
Rock Hill Outcrops	472		Complex of rhyolite outcrops with intact cedar glade. Based on aerial photos, the site is fragmented and has no evidence of rare species. Site has a documented past history of grazing.
Soules Creek Area	5,634	9	Wetland headwaters, leading in to high quality cold water streams. More information is needed for this site, as it may harbor rare species
Stone Hill Swamp	725		Originally part of the larger "Bog Relicts" workshop site that was, subsequently, divided. Large tamarack swamp.
Sucker Creek	1,014	--	Class I cold water stream, with wetland headwaters. There is little information on this site, and no known importance from a rare plant or natural community standpoint.
Swan Lake Wildlife Area	3,431	80	Large mostly state-owned marsh including sedge meadow with rare plants and prairie remnants.

Site Name	Size <sup>1</sup> (acres)	% public ownership <sup>2</sup>	Abbreviated summary of Contributor's Site records
Thompson Lakes Area	2,349	8	SNA with rare acid bedrock glade. Adjacent lands with similar attributes - also seepage lakes with surrounding savanna.
Utley Prairie	97	--	Upland prairie on rhyolite-gneiss outcrop
White River - West Branch	1,483	47	Large open-forested wetland complex adjoining the Mecan and White Rivers. Includes extensive agriculture, but could be good upland restoration project connecting adjacent streams.
<b>Sites of Low Ecological Significance</b>			
Bannerman Trail	18	--	Dry prairie.
Beechnut Road Barrens	48	--	Pine barren with pasque flower and prairie smoke.
Blue Lake Marsh	123	--	Marsh located on Blue Lake and the beginning of the Widow Green Creek.
Briggsville Conifer Swamp	273	--	Large, intact conifer swamp with tamarack and black spruce.
Byers Wetland	86	--	Agricultural land restored to grassland and wetland.
Cuff Lake	34	--	Undeveloped seepage lake.
Dreheim / Berndt Restoration	374	--	Two farms with prairie restorations, wet meadows, and ponds.
Fox River Headwaters	247	--	Sedge meadow and cattail wetland bordering the upper Fox River.
Freedom Grasslands	79	--	Grasslands with native grasses.
Grand Lake Wetland	383	--	Extensive open wetland and mesic forest complex adjacent to Grand Lake.
Green Lake Center	203	--	Wooded area on old nursery site that includes American chestnut.
Grn Lk Station Sedge Meadow	35	--	Very small sedge meadow.
Hwy 82 Grasslands	157	--	Grassland with restoration potential for native grasses and grassland birds.
Kolka Property	170	--	Karner Blue butterfly habitat, being protected and restored by owners.
Koro Bog	266	--	Open bog/hardwood complex in depression adjacent to the watershed boundary to Rush Lake
Little Green Lake Mesic Forest	92	--	Small, but high quality, southern mesic forest with exemplary spring ponds.
Lunch Creek	1,553	--	Degraded cold water stream south of the Lunch Creek wetland. This site may represent a good restoration opportunity.
Manchester Woods	160	--	Small mixed mesic woodlot with mature hardwoods.
McCourtney	80	--	5 acre oak savanna remnant and 35 acre prairie restoration
Mitchell Grassland	86	--	Grassland with native grasses and birds.
Mt. Morris Cemetary	30	--	Site is a small remnant with Karner Blue butterfly habitat and possible prairie with prickly pear cactus.
Oxford Correctional Area	341		Grassland and oak savanna. Adjacent to USFWS property.
Patrick Lake	39	--	County park with shoreline restoration on one end with native plants and potential oak savanna restoration.
Roy Creek Forest	154	--	Mixed hardwood (southern mesic) forest, mostly second growth. Possible remnant mesic prairie. Locally important, but small, fragmented and set within an agricultural landscape.
Soo Line Prairie Remnant	1,063	1	Area contains scattered prairie remnants but is narrow and discontinuous.

Site Name	Size <sup>1</sup> (acres)	% public ownership <sup>2</sup>	Abbreviated summary of Contributor's Site records
SR 73 Degraded Wetland	8	--	Drained wetland with easy restoration potential.
Upper Neenah Creek	4,595	18	Cold water stream corridor with variety of riparian habitat including wetlands, oak savanna, pine barren, prairie potholes and bordering Goose Lake.

1. Acreages are approximations based on Site boundaries submitted by workshop contributors.
2. These figures are an approximation based on acreages in (2) and lands in public ownership at the time of this writing.

## Site Analysis Considerations

The final list of the most significant Sites within the FRHE study is not meant to exclude other sites from being protected or restored, but to highlight the Sites that appear to provide the best opportunities based on the information available. As new information becomes available over time, conservation opportunities may change. The amount of detail provided by individual contributors from the FRHE Workshop was highly variable. Although there have been scientific inventories for some of the area, *the coverage among the Sites is not consistent, and some of the existing records are now outdated*. Further inventory is recommended for many Sites with varying scopes and levels of effort.

The boundaries of each Site should be considered drafts and are in need of review. The expertise and accuracy applied to boundary delineation was different for each contributor. Sites were not subsequently reviewed in detail sufficient to delineate an appropriate boundary that reflects the resources of significance. Thus, boundaries may expand or decrease depending upon further analysis.

Finally, many of the Sites are a compilation of smaller Sites of varying degrees of significance. For instance, a Site of medium significance may contain a diverse assemblage of areas of high significance that would not be accurately reflected by the placement of the larger Site in the Medium category (e.g., White River Marsh). Further review of each Site, and in many cases additional inventory, is required to adequately define Site boundaries and designate significance.

## Sites Lacking Adequate Information

Insufficient information is available for the Sites listed below, making additional analysis difficult. Sites followed by an asterisk were identified through the coarse filter process<sup>9</sup>. Most of the Sites have been identified as priorities for future inventory efforts in following sections.

- Blue Lake Marsh
- Briggsville Conifer Swamp \*
- Cuff Lake
- Fox River Headwaters \*
- Freedom Grasslands
- Grand Lake Wetland \*
- Head of the Green Lake
- Hwy 82 Grasslands
- Jackson Kettle Complex \*
- Koro Bog \*
- Lime Kiln Bluff
- Lower Silver Creek
- Manchester Woods \*
- Marquette Marsh \*
- Meilke Lake
- New Haven Woods \*
- Roy Creek Forest \*
- Stone hill swamp \*
- Sucker Creek
- Wood Lake

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<sup>9</sup> See Appendix B for a description of the coarse filter analysis.

# Opportunities for Conservation

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The preceding section describes the relative ecological significance of a group of Sites in the FRHE study area based on our current level of knowledge. Considering the collection of Sites as a whole, there are several broad categories of “ecological opportunities” presented within the FRHE that may be useful for conservation planning. First, Table 3 categorizes the significance of all the Sites based on existing information; second, a subset of Sites are known to contain values sufficient for SNA designation; third, a number of Sites contain specific resources that are critical in themselves to warrant protection; fourth, a number of ecological restoration opportunities of regional and statewide significance exist in the study area and should be explored.

## Significant Ecological Sites

Those Sites in Table 3 ranked high or medium-high appear to have greater ecological significance and may, after further review and analysis, have the highest conservation potential within the study area. Some of these Sites are currently afforded protection through state ownership; others are privately owned and assumed to be at greater risk of loss to development or habitat degradation.

Sites ranked Medium or Low also have conservation potential, but current knowledge suggests that some limitations exist: Sites lack sufficient information on ecological values, are currently degraded but may represent a restoration opportunity appropriate for state action, or contain values that may be more appropriate for local conservation efforts.

## Potential State Natural Areas

The following 25 Sites contain ecological resources values that meet State Natural Areas (SNA) designation criteria and may represent ecological components that are missing or underrepresented from the existing SNAs. Designation as a State Natural Area would occur upon purchase or memorandum of understanding with willing sellers. Some of the areas below cover entire workshop sites, while others are much smaller in size compared to the workshop site. Each site is followed by the Significant Ecological Site number they fall within (see Figure 7).

- Big Spring Fens (part of #60)
- Corning-Weeting Lakes (#14)
- Dalton Wet Prairie (part of #25)
- Fairburn Wet Prairie (part of #89)
- Fluctuating Shoreline Lakes (#17)
- Fox River Crane Marsh (part of #21)
- French Creek Fens (#20)
- Klawitter Creek Fen (#36)
- Liberty Bluff (part of #13)
- Lime Kiln Bluff (#42)
- Mitchell’s Glen (#55)
- Montello River Floodplain (#56)
- Mud Lake Bog (#59)
- Neenah Creek Meadow (part of #60)
- Oxford Woods and Savanna (#65)
- Packwaukee Hardwood Swamp (#66)
- Pine Knob (part of #89)
- Puckaway Flatwoods (part of #69)
- Snake Creek Wetlands (part of #89)
- Stueck’s Pond (#77)
- Summerton Bog South (#81)
- Swader Tamaracks (part of #22)
- Swamp Lake (#82)
- Thompson Lakes Area (#84)
- White River Pines (part of #88)

## Species/Natural Communities of Significance

The FRHE study area is important for many rare plants, animals, and natural communities. Plant species for which the FRHE is particularly important include the State Endangered brook grass (*Catabrosa aquatica*), soft-leaf muhly (*Muhlenbergia richardsonis*), and dwarf umbrella sedge (*Fuirena pumila*), as well as the State Threatened long-beaked bald rush (*Psilocarya scirpoides*) and Special Concern species bushy aster (*Aster dumosus* var. *strictior*). Animal species include the swamp metalmark (*Calephelis muticum*) and powesheik skipperling (*Oarisma powesheik*), both State Endangered and globally rare butterflies. The FRHE also contains a State Threatened dragonfly, the spatterdock darner (*Aeshna mutata*), as well as the State Endangered western slender glass lizard (*Ophisaurus attenuatus*). The FRHE is important for several species of grassland birds such as the State Threatened Henslow's sparrow. Significant populations of Special Concern animals include the Wisconsin endemic tiger beetle (*Cicindela patruela huberi*). The FRHE is an important area for the Federally Endangered Karner blue butterfly (*Lycaeides melissa samuelis*) and contains a number of occurrences of the federal candidate Eastern Massasauga rattlesnake (*Sistrurus catenatus catenatus*).

The **Coastal Plain Marsh** natural community consists of sandy to peaty-mucky lakeshores, pond shores, depressions, and ditches in and around the bed of former glacial Lake Wisconsin. These communities harbor assemblages of wetland species and there is often a well-developed concentric zonation of vegetation with a varying composition and width depending on fluctuations in water levels. Frequent members of this community are sedges in the genera *Cyperus*, *Eleocharis*, *Fimbristylis*, *Hemicarpha*, *Rhynchospora* and *Scirpus*, rushes (*Juncus* spp.), milkwort (*Polygala* spp.), toothcup (*Rotala ramosior*), grass-leaved goldenrod (*Euthamia graminifolia*), hardhack (*Spiraea tomentosa*), lance-leaved violet (*Viola lanceolata*), and yellow-eyed grass (*Xyris torta*).

In addition, the Coastal Plain Marsh contains a number of **Coastal plain disjunct** species – species more commonly found along the Atlantic Coast and thus considered “disjunct” or separate from their home range. The FRHE provides one of the finest areas in the state for Atlantic Coastal Plain disjuncts, including Virginia meadow beauty (*Rhexia virginica*), long-beaked bald rush (*Psilocarpa scirpoides*), dwarf umbrella sedge (*Fuirena pumila*), hidden-fruited bladderwort (*Utricularia geminiscapa*), and crossleaf milkwort (*Polygala cruciata*).

Three of the six documented occurrences of the Coastal Plain Marsh community in Wisconsin are found within the FRHE. Additional inventory efforts could provide a better understanding of the status, condition, and content of these communities. Sites that provide opportunities for conservation of the Coastal Plain Marsh community and Coastal Plain disjuncts include:

- Stueck's Pond
- Silver and Mud Lakes

The FRHE contains nearly one-third of the documented occurrences of the **Calcareous Fen** natural community type in Wisconsin. Calcareous fens are found in southern Wisconsin and are an open wetland type often underlain by a calcareous substrate through which carbonate-rich groundwater percolates. The flora of these fens is typically diverse, and several rare plant species have been documented in these communities within the FRHE, including the State Threatened sticky false-asphodel (*Tofieldia glutinosa*) and the State Endangered soft-leaf muhly (*Muhlenbergia richardsonis*), as well as the Special Concern species common bog arrow-grass (*Triglochin maritima*), slender bog arrow-grass (*Triglochin palustris*), whip nutrush (*Scleria triglomerata*), and low nutrush (*Scleria verticillata*). Also present is a significant population of the State Endangered swamp metalmark butterfly (*Calephelis mutica*).

The FRHE contains examples of the fire-adapted **Oak Barrens** natural community type known to contain State Endangered animal species such as the western slender glass lizard (*Ophisaurus attenuatus*) and Special concern animal species such as the tiger beetle (*Cicindela patruela huberi*). Rare plants found in these communities include the State Threatened species woolly milkweed (*Asclepias lanuginosa*) and brittle prickly pear (*Opuntia fragilis*), as well as the State Special Concern species prairie fame-flower (*Talinum rugospermum*). Examples of Sites that provide opportunities for conservation of this community include:

- Oxford Woods and Savanna
- Lime Kiln Bluff

## Restoration Opportunities

The FRHE study area encompasses a unique landscape that offers many opportunities for habitat and ecosystem restoration. Several restoration efforts, primarily for grasslands (WDNR 2001), have been initiated recently within the FRHE study area. Although detailed analysis has not been completed to evaluate the restoration priorities for any given habitat, there is sufficient knowledge to identify a number of Sites with excellent restoration potential.

The Sites listed below represent the best restoration opportunities based on existing knowledge. In some cases, the Sites currently include partially degraded habitat and most are placed in the medium ecological significance category in Table 3. Better examples of the following community types exist within the study area and are highlighted in Table 3.

### Dry Forest-Oak Savanna-Dry Prairie Continuum

Presettlement data describes the uplands of the FRHE as having natural community patterns running the entire vegetation spectrum from dry forest to open prairie. Many of these natural systems have been converted to farming or conifer plantations within the FRHE, significantly impacting numerous species. Most of the communities along this natural continuum are fire-dependent, and fire will likely be a necessary management tool for restoring or maintaining them. Additional information is needed to further our understanding of the current quality and extent of existing remnants, highlighting the need for additional inventory work in the future. Sites that provide opportunities to restore the entire Dry Forest-Oak Savanna-Dry Prairie Continuum to the FRHE should be a priority. Potential restoration sites for the dry forest-oak savanna-dry prairie continuum include:

- Oxford Woods and Savanna
- Head of Green Lake (nearby uplands)
- Page Creek Oak Barrens
- Lawrence Creek
- Limekiln Bluff
- Greenwood Wildlife Area
- Jackson Kettle Complex

### Wetlands

Wetlands in the FRHE are highly variable and include communities with more northerly affinities, such as Northern Sedge Meadows, as well as those associated with southern Wisconsin like Calcareous Fens, Tamarack (rich) Swamps, Southern Sedge Meadows, and Wet and Wet-mesic Prairies. The FRHE also contains communities that are more widespread across the state such as Alder Thickets and Emergent and Submergent Aquatic communities. Drainage for agriculture and development, grazing, and the spread of

invasives such as reed canary grass have altered many, if not most, of the wetlands within the FRHE. Sites with potential for wetland restoration include:

- Page Creek (Also a TNC restoration priority)
- Grand River Wildlife Area
- Puchyan Prairie<sup>10</sup>
- White River Marsh
- Comstock Bog - Meadow<sup>11</sup>
- Summerton Bog North / South

### Lakes

The FRHE has an excellent diversity of lake types including both deep and shallow, clear, hardwater, sandy bottomed lakes, fluctuating shoreline lakes, bog lakes, spring ponds, oxbow lakes, and flowages. At least one lake (Stueck's Pond) has unique properties and supports the only known intact population of the State Threatened dragonfly spatterdock darner (*Aeshna mutata*). The deep, clear, hardwater lakes are the most developed, but some good intact examples remain. Sites with potential for lake restoration include:

- Bass Lake
- Jackson Kettle Complex

### Rivers & Streams

The FRHE has a significant number of intact cold hard headwater streams, many of which are included in State Fishery Areas. Much less common are the larger warmwater streams. The Fox River itself supports aquatic life, but is probably too degraded to support several species which are found in the lower White River. The segment of the White River from the dam in Neshkoro to the Fox River is probably the best warmwater stream in the FRHE. However, the dam at Neshkoro is a possible source of concern for the integrity of the White River system because the river may be subject to extreme fluctuations in flow. The Mecan River is renowned for its water quality and contains a rich invertebrate fauna. Sites with potential for river and stream restoration include:

- Lawrence Creek
- Lunch Creek
- French Creek
- Silver Creek
- White River – West Branch
- Montello River (floodplain forest)

### Invasive Species Management

Invasive species, whether native or exotic, are an increasing threat to natural habitats within many parts of the FRHE. Invasive species, such as purple loosestrife, garlic mustard, exotic honeysuckles, and rusty crayfish can become established in natural communities and displace desirable native species, thereby degrading the habitat that other species depend upon. Land managers and concerned private landowners in the FRHE should be aware of the threats that invasive species pose. A key to challenging the spread of invasive species is first to identify populations and then work to reduce or eliminate those occurrences.

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<sup>10</sup> This site is part of the larger White River Marsh site and is one of the largest wet grasslands in the state (R. Hoffman, personal communication). A portion of this wetland is currently a State Natural Area.

<sup>11</sup> This site is part of the larger Germania Wildlife Area site.

FRHE planners and conservation organizations could help prevent or control invasive species outbreaks by establishing "buffer areas" around high quality sites to minimize the effects of surrounding disturbances that often lead to invasions. Also, management needed to help maintain a site should be timed and impacts that spread invasives avoided in order to minimize the possibility of introducing invasives to ecologically important sites.

## **Issues Affecting the FRHE**

For all of its important ecological resources in the study area, the FRHE has been, and continues to be, impacted by many of the same environmental issues that affect other parts of the state. Many of these issues are related to incompatible land uses. The Bureau of Endangered resources has not conducted a thorough examination of all of the environmental issues affecting the FRHE. However, there are several key items affecting natural habitats within the FRHE, based on information provided by the workshop contributors and current BER knowledge of the area; these are listed below. Most of these issues have been covered in detail in other reports and publications<sup>12</sup>. See Appendix E for site-specific threats as submitted by Workshop contributors.

### **1. Impacts to Water resources**

- Dams
- Altered hydrological regimes (e.g., ditching)
- Nonpoint source pollution (e.g., eutrophication, sedimentation)
- Shoreline development

### **2. Invasive species (aquatic and terrestrial plants and animals)**

### **3. Fire suppression**

### **4. Recreational impacts**

### **5. Ecosystem Simplification** (e.g., pine plantation or crop monocultures replacing native communities)

### **6. Ecosystem Fragmentation** (e.g., such as caused by development, increase in multiple ownerships within a given area, residential and commercial development, and agriculture)

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<sup>12</sup> see "Additional Resources" section

# Future Information Needs

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A comprehensive evaluation of the broad biodiversity and endangered species concerns within the FRHE study area is currently limited by a lack of knowledge and information regarding many of the Sites. Additional inventory on specific Sites and status surveys for individual species and natural community types is critical to broaden our understanding of the ecological significance of the study area.

The Sites listed in this section are priorities for future biotic inventory efforts within the FRHE study area based on information submitted for the workshop, current NHI data, and subsequent interpretation. These inventory priorities represent gaps in our current level of information in the following categories:

## Need for Boundary Revisions

The boundaries of most Sites were compiled by aggregating all the workshop sites that overlapped or were within close proximity in a particular area. The expertise and accuracy applied to boundary delineation was different for each contributor. Sites were not subsequently reviewed in detail sufficient to delineate an appropriate boundary that reflects the resources of significance. Thus, boundaries may expand or decrease depending upon further analysis. This work should be completed prior to any site protection.

## Significant Ecological Sites

Many of the Significant Ecological Sites lack adequate information regarding their value for biodiversity and endangered resources. Inventory at the following Sites may significantly change each Site's prioritization and improve our understanding of the Site's potential to harbor rare plants, animals, or natural communities.

**Table 4. Priority Sites for Future Inventory**

<b>Site Name</b>	<b>Ecological Significance Category</b>
Mud Lake	High
Silver and Mud Lakes	High
Corning - Weeting Lakes	Medium-High
Fluctuating Shoreline Lakes	Medium-High
Klawitter Creek Fen	Medium-High
Montello River	Medium-High
Sugar Island Wetlands	Medium-High
Summerton Bog North/South	Medium-High
Bass Lake	Medium-High
Page Creek	Medium-High
Adams Cty. Waterfowl PA	Medium
Bog Relics	Medium
East Jordan Woods	Medium
Grotzke Rd. Area	Medium
Harris Marsh	Medium
Head of Green Lake	Medium
Jackson Kettle Complex	Medium

<b>Site Name</b>	<b>Ecological Significance Category</b>
Lewiston Flatwoods	Medium
Lime Kiln Bluff	Medium
Lower Silver Creek	Medium
Lucerne Lake	Medium
Meilke Lake	Medium
Moon-Echo Lakes Area	Medium
New Haven Woods	Medium
Oxford Woods and Savanna	Medium
Packwaukee Hdwd. Swamp	Medium
Rock Hill Outcrops	Medium
Soules Creek Area	Medium
Sucker Creek	Medium
Swan Lake Wildlife Area	Medium
Thompson Lakes Area	Medium
White River - West Branch	Medium
Koro Bog	Low
Little Green Lake Mesic Forest	Low

### **Status Survey Needs for Species and Natural Communities**

A better knowledge of the distribution and abundance of certain plant and animal species and natural communities within the FRHE would add to our understanding of the area's significance. Status surveys within the FRHE for the following communities and species are recommended (this list is not exhaustive):

#### **Birds**

forest raptors  
grassland birds  
migratory shorebirds

#### **Fish**

pugnose shiner

#### **Insects**

aquatic invertebrates  
grassland invertebrates  
wetland lepidoptera

#### **Mammals**

Small mammals

#### **Natural Communities**

Coastal Plain Marsh  
Northern Sedge Meadow  
Pine Barrens  
Oak Barrens

#### **Plants**

squarestem spikerush  
brook grass

#### **Reptiles**

Blandings turtle  
massasauga rattlesnake  
slender glass lizard

## Rare Species Occurrences Not Included Within Significant Ecological Sites

Some areas within the FRHE contain documented occurrences of rare species that are not captured within one of the Significant Ecological Site boundaries. Many of these records are outdated or the areas lack adequate inventory. Further evaluation is necessary to better understand their significance, particularly at the following locations:

- Dakota Swale: Bushy aster (*Aster dumosus* var *strictior*) was recorded here
- Portage Marsh: Historic site for the Massasauga rattlesnake (*Sistrurus catenatus catenatus*)
- Crooked Lake: historic site for squarestem spike rush (*Eleocharis quadrangulata*) and 3 natural communities
- Fairburn Wet Prairie: Wet-mesic Prairie immediately northeast of the White River Marsh Wildlife Area
- Armchair Lake: one of few northern sedge meadows in this area and part of the study area with little detailed information but several natural communities

# Additional Resources

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The general ecological issues that affect the FRHE are addressed in several publications and other materials available from the WDNR and other organizations. In addition, background information on species, natural communities and restoration strategies are available to assist with conservation planning and management planning. These resources are listed below. The BER web site (<http://www.dnr.state.wi.us/org/land/er/>) will soon contain updated lists of these and other resources, as well as other website links where available.

## Ecological Issues and Conservation Planning within the FRHE

- Wisconsin's Biodiversity as a Management Issue Report, Wisconsin Department of Natural Resources, May 1995, [http://www.dnr.state.wi.us/org/es/science/pubs/tr/biodiversity\\_manage\\_book.htm](http://www.dnr.state.wi.us/org/es/science/pubs/tr/biodiversity_manage_book.htm)
- Wisconsin Manual for Control of Invasive Exotic Plant Species, 1997, <http://www.dnr.state.wi.us/org/land/er/invasive/>
- America's Least Wanted: Alien Species Invasions of U.S. Ecosystems (Stein and Flack 1996), The Nature Conservancy and NatureServe, <http://www.natureserve.org/publications/leastwanted/index.htm>
- The Prairie-Forest Border Ecoregion: A Conservation Plan (TNC 2001), The Nature Conservancy
- Managing Habitat for Grassland Birds: A Guide for Wisconsin (Sample and Mossman 1997)
- Wisconsin's Forestry Best Management Practices Monitoring, 1995-97, Div. of Forestry
- A Regional Natural Areas and Critical Species Habitat and Protection Management Plan for Southeastern Wisconsin, No. 42, 1997
- Wisconsin DNR Biodiversity Report, 1995

## Endangered Resources within the FRHE

Resources available from BER by calling (608) 266-7012 or emailing [ber@dnr.state.wi.us](mailto:ber@dnr.state.wi.us)

- List of Wisconsin's Endangered and Threatened Species (also available through the BER Web site)
- Natural Heritage Inventory Natural Communities—2001 version (also available through the BER Web site)
- Standard references for taxonomic groups and communities
- Summary of SNA information and sources
- Wisconsin Butterflies Checklist
- List of Barrens and Dry Prairie Associated Moths
- Dragonflies of Wisconsin Checklist
- List of other BER publications and other materials available – including those listed below
- The Endangered and Threatened Invertebrates of Wisconsin, 1999, PUB-ER-085-99
- The Endangered and Threatened Vertebrates of Wisconsin, 1997, PUB-ER-091
- Guide to Wisconsin's Endangered and Threatened Plants, 1993, PUB-ER-067
- Threatened and Endangered Species in the Forests of Wisconsin: A Guide to Assist with Forestry Activities, 2000
- Database of Rare Plant Species by Habitat Type
- Bald Eagles in Wisconsin: A Management Guide for Landowners, 1997
- Peregrine Falcons: A Native Returns to Wisconsin Activity Guide

- Wisconsin's Endangered Flora
- Wisconsin Wolf Management Plan, 1999
- Amphibians of Wisconsin, 2001
- Snakes of Wisconsin, 2000

The materials below are technical bulletins available from the Bureau of Integrated Science Services Research Center or the Division of Forestry:

- Plant Species Composition of Wisconsin Prairies, Tech. Bull. No.188, 1995
- Atlas of the Wisconsin Prairie and Savanna Flora, Tech. Bull. No.191, 2000
- Checklist of the Vascular Plants of Wisconsin, Tech. Bull. No.192, 2001

## Web Sites Links with Additional Information

- List of internet links from ER Website, <http://www.dnr.state.wi.us/org/land/er/links.htm>
- NatureServe Website, <http://www.natureserve.org/>
- NHI Online Database, [http://www.dnr.state.wi.us/org/land/er/nhi/NHI\\_ims/onlinedb.htm](http://www.dnr.state.wi.us/org/land/er/nhi/NHI_ims/onlinedb.htm)
- Breeding Bird Atlas Maps for Listed Species, <http://www.uwgb.edu/birds/wbba/>
- Wisconsin Herpetological Atlas website, <http://www.mpm.edu/collect/vertzo/herp/atlas/atlas.html>
- The Wisconsin Vascular Plant Web Page, Wisconsin State Herbarium, UW-Madison, <http://www.botany.wisc.edu/wisflora/>
- USGS Northern Prairie Wildlife Research Center Web Site: [www.npwrc.usgs.gov](http://www.npwrc.usgs.gov)
- Online version: *Wetland Plants and Plant Communities of Minnesota and Wisconsin*, by Steve Eggers and Donald Reed: [www.npwrc.usgs.gov/resource/1998/mnplant/mnplant.htm](http://www.npwrc.usgs.gov/resource/1998/mnplant/mnplant.htm)
- Karner blue butterfly information: [www.dnr.state.wi.us/org/land/er/publications/karner/karner.htm](http://www.dnr.state.wi.us/org/land/er/publications/karner/karner.htm)
- Fish and Wildlife Service information on federal species: <http://midwest.fws.gov/endangered/saving/outreach.html>
- Michigan Natural Features Inventory Abstracts: <http://www.msue.msu.edu/mnfi/abstracts.htm>
- Missouri Natural History Division Abstracts: <http://www.conservation.state.mo.us/nathis/endangered/bmp.htm>
- Field Guides Online, <http://www.enature.com/>
- USDA Natural Resources Conservation Service Plants Database, <http://plants.usda.gov/>
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## **Additional Background Information on the Fox River Headwaters Ecosystem**

*Excerpted from a Report Prepared by Clark Forestry, Inc.*

### **Introduction**

Much of the information compiled by staff at Clark Forestry, Inc. for this project was incorporated into the Ecological Overview in the main body of this document. This appendix contains some additional background information on ecological characteristic of the FRHE area that may be of use to some readers.

### **Geology**

The furthest advance of the Wisconsin Glaciation forms the western boundary of the FRHE. This terminal moraine, which is also part of the northeastern boundary of Wisconsin's driftless area, was formed by the recession of the Green Bay Lobe between 15,000 and 11,000 years ago. As the glacier melted and receded northeast towards present Green Bay, it discharged outwash and left ground moraines. Large blocks of ice left buried in the till of the terminal moraine melted, forming kettle lakes (Martin, 1916).

Ninety-percent of the FRHE lies over sandstone bedrock; the balance is underlain by carbonates and volcanic rock. Across 80% of the study area the bedrock is buried under at least 50 feet of glacial drift, and it's deeper than 100 feet on nearly half of the area. Outcrops are rare: one finds bedrock within five feet of the surface on less than one-percent of the landscape. Surficial deposits are largely sand and gravel on the terminal moraine, and a mixture of outwash and wind-blown sand and lacustrine clays to the east. The FRHE is generally low and flat. Greater than 90% of the area lies below 1000 feet above sea level, and slopes greater than three percent occur on only seven percent of the landscape.

### **Hydrology**

The study area drains into the Fox River via a number of sub-basins including the Mekan, White, Montello, and Grand Rivers; Neenah Creek; and Green, Buffalo, and Puckaway Lakes. The approximately 218 lakes within the FRHE represent about 2% of the state's total in terms of total area and number. Considering that the study area occupies just slightly more than 2% of the state's total acreage, these numbers are average. Green Lake (7,346 acres) is the largest lake in the area, and at 236 feet is the deepest natural lake in the state. The FRHE has 16 lakes listed as rare natural communities by the NHI, including excellent examples of both deep and shallow hard water lakes.

Extensive wetlands occupy the FRHE's abundant, poorly-drained glacial depressions. Out of Wisconsin's 72 counties, Marquette and Green Lake, which make up the heart of the study area, rank 11th and 4th respectively in terms of percentage of county area classified as wetland (WDNR, 2002). Wetlands occupy about one-fifth of the total acreage of the FRHE. A few of the largest, including the White River, Germania, and Grand River Marshes, are partially protected by State Wildlife Areas. About 34,000 acres, representing 17% of the total wetland area in the FRHE, is currently under state ownership.

Numerous coldwater streams, including the White and Mekan Rivers, and Wedde, Chaffee, Tagatz and Caves Creeks originate from springs along the terminal moraine in the northwest portion of the study

area. Most headwaters areas are protected by one of five State Fishery Areas that occupy some 20,000 acres.

## **Soils**

The FRHE lies within Aldo Leopold's so-called "sand counties," which are named for the sand-dominated glacial drift that blankets the region. While the soils of central Wisconsin have been called the "Golden Sands" for their ability to produce high crop yields when irrigated (Hole, 1976), they have relatively low moisture-holding capacity and are susceptible to drought. Because water moves so easily in and out of these coarse-textured soils, associated vegetation reacts quickly to seasonal changes in moisture and temperature. If vegetation is removed, bare soil is especially susceptible to wind erosion (Hole, 1976).

## **Presettlement Vegetation**

During the mid-1800s the U.S. Government Land Office (GLO) performed the surveys that established today's township-range-section system of property description. As surveyors moved across the landscape, they recorded the species and diameters of "witness trees" at each section and quarter-section corner. In addition, they made general observations about topography, hydrology, soils, timber, and mineral resources. Although surveyors varied significantly in their botanical knowledge, vocabulary, and enthusiasm for note-taking, their field notes represent an important snapshot of the state during the early days of European settlement.

In 1976, R.W. Finley used the GLO records to produce a 1:500,000 scale map entitled "Original Vegetation Cover of Wisconsin." This map has since been digitized and is available for analysis as a GIS coverage. Table A.1 summarizes the extent of the major presettlement vegetation types in the FRHE, and Figure A.1 shows their spatial arrangement. Oak species occurring in communities somewhere along a forest-opening-barrens continuum covered nearly three-quarters of the entire FRHE, and nearly all of the uplands. Less fire-tolerant species persisted only where topography or hydrologic features provided firebreaks. In lowland areas, open wetlands covered over seven times the area of forested wetlands.

## **Current Land Use / Land Cover**

The Wisconsin Initiative for Statewide Cooperation on Landscape Analysis and Data (WISCLAND) collected land cover data for the entire state using Landsat Thematic Mapper (TM) satellite imagery between 1991 and 1993. Landsat imagery is composed of pixels, each one representing a 30 by 30 meter square on the ground. Each pixel is assigned a value based on its spectral reflectance, and each value is associated with a different land cover type based on the known "spectral signature" of that type. By lumping or splitting associated cover types, we can use WISCLAND to map land cover at different scales and resolutions. The final WISCLAND dataset (which uses a three-level hierarchical classification scheme) is distributed as an ARC/INFO grid file that can be quantitatively analyzed using ArcView's Spatial Analyst extension.

Table A.2 summarizes the land cover of the FRHE at all three levels of the hierarchy, and Figure A.2 shows general land cover at level one. Conversion of pre-settlement oak forests and openings to agriculture caused forest cover to decrease from nearly three-quarters before settlement to less than one-quarter today. Percentage of wetland has remained relatively constant at about 20%.

**Table A.1. Presettlement Vegetation Cover of the FRHE**

<b>Vegetation Type</b>	<b>Acres</b>	<b>% of Total</b>
<b>Xeric Deciduous Forest</b> white oak, black oak, bur oak	431,593	52.4%
<b>Open Wetland</b> marsh and sedge meadow, wet prairie, lowland shrubs	156,857	19.0%
<b>Oak Openings</b> bur oak, white oak, black oak	148,277	18.0%
<b>Open Water</b>	24,587	3.0%
<b>Prairie</b>	20,030	2.4%
<b>Lowland Coniferous Forest</b> white cedar, black spruce, tamarack, hemlock	19,733	2.4%
<b>Brush</b>	7,199	0.9%
<b>Mesic Deciduous Forest</b> sugar maple, basswood, red oak, white oak, black oak	5,528	0.7%
<b>Mixed Deciduous/Coniferous Forest</b> aspen, white birch, pine	4,501	0.5%
<b>Coniferous Forest</b> white pine, red pine	3,005	0.4%
<b>Barrens</b> jack pine, scrub (hill's) oak	2,208	0.3%
<b>Lowland Broadleaved Forest</b> willow, soft maple, box elder, ash, elm, cottonwood, river birch	40	0.0%
<b>TOTAL:</b>	<b>823,558</b>	<b>100.0%</b>

**Table A.2. Current Land Cover of the FRHE**

WISCLAND LEVEL ONE	Acres	% of Total	Level Two	Acres	% of Lev. 1	Level Three	Acres	% of Lev. 2
1. URBAN/ DEVELOPED	7,423	1%	1.1 High Intensity	3,111	42%			
			1.2 Low Intensity	3,708	50%			
			1.3 Golf Course	604	8%			
2. AGRICULTURE	267,249	32%	(Undifferentiated)	8,655	3%			
			2.1 Herbaceous/ Field Crops	258,585	97%	2.1.2 Corn	106,866	41%
						2.1.7 Other Row Crops	74,892	29%
						2.1.8 Forage Crops	76,827	30%
			2.3 Cranberry Bog	9	0%			
3. GRASSLAND	146,590	18%						
4. FOREST	207,317	25%	4.1 Coniferous	25,028	12%	4.1.1 Jack Pine	1,794	7%
						4.1.2 Red Pine	20,602	82%
						4.1.11 Mixed/Other	2,633	11%
			4.2 Broad-leaved Deciduous	145,019	70%	4.2.2 Oak	109,676	76%
						4.2.8 Maple	62	0%
						4.2.12 Other	35,282	24%
			4.3 Deciduous/Conifer	37,270	18%			
5. OPEN WATER	30,212	4%						
6. WETLAND	161,252	20%	6.1 Emergent/Meadow	74,102	46%			
			6.2 Lowland Shrub	38,265	24%	6.2.1 Broad-leaved Deciduous	37,185	97%
						6.2.2 Broad-leaved Evergreen	883	2%
						6.2.3 Needle-leaved	197	1%
			6.3 Forested	48,885	30%	6.3.1 Broad-leaved Deciduous	35,689	73%
						6.3.6 Coniferous	12,446	25%
						6.3.10 Mixed Decid./Conif.	750	2%
7. BARREN	2,374	0%						
8. SHRUBLAND	1,061	0%						

TOTAL: 823,478 100%

## Ecoregions

An ecoregion is a geographic area that has a relatively consistent pattern of topography, geology, soils, vegetation, natural processes, and climate. The most widely-used ecoregion classification scheme is the U.S. Forest Services "National Hierarchical Framework of Ecological Units" (NHFEU) (Bailey, 1995 and Keys, 1995). This system divides North America into four "ecosystem domains"; each domain is further divided into "divisions," "provinces," "sections," "subsections," and "landtype associations."

### DNR Ecological Landscapes

In order to provide Wisconsin resource managers with a simple ecoregion classification customized for their state, the DNR grouped NHFEU subsections to form 17 distinct "ecological landscapes" (ELs). Ninety-three percent of the FRHE lies within the Central Sand Hills EL; the Southeast Glacial Plains EL (about 50,000 acres in eastern portion) and the Central Sand Plains EL (less than 1000 acres along the terminal moraine) occupy the balance. The Central Sand Hills EL is composed of two NHFEU subsections: a broad kettle moraine in the west (subsection 222Kb) and a relatively flat area of pitted outwash in the east (subsection 222Kd). Landtype associations (LTAs) are the finest level of the ecoregion hierarchy, but since there is currently very little published information at the LTA level, the descriptions that follow are written at the subsection level.

### NHFEU Subsections

Wisconsin is divided nearly in half along the tension zone by two ecosystem divisions: the Warm Continental (210) in the north and the Hot Continental (220) in the south. The FRHE lies just south of that boundary, entirely within the Hot Continental Division, the Eastern Broadleaf Forest province (222), and the Southwestern Great Lakes Morainal section (222K) (Keys, 1995). Five distinct subsections occur within the FRHE (see Figure A.3):

#### **222Kb: Central Wisconsin Moraines and Outwash** (512,192 acres, 62% of FRHE)

Sandy pitted outwash, steep terminal moraine, and rolling ground moraine topography characterize this subsection. Northern pin oak forest, bur oak openings, and big bluestem-Indiangrass prairie dominated this area in presettlement times and represent the best opportunities for restoration. Kettle lakes, ponds, and wetlands are abundant because of the frequent glacial depressions.

Soils are sands and loamy sands on the outwash, and loamy sands to sandy loams on the moraines. Center pivot irrigation has allowed for cultivation of most of the level sand plains, while oak forests dominate areas that are poorly suited to agriculture. Rare natural communities include oak barrens, wet mesic prairies, calcareous fens, and coastal plain marshes (Albert, 1995). Nearly 34,000 acres representing 7% of the subsection is under state ownership.

*LTAs: 222Kb01: Arnott-Almond Moraine Complex, 222Kb03: Wild Rose-Wautoma Moraine Complex, 222Kb04: Coloma Plain, 222Kb05: Buffalo Lake Outwash Channels, 222Kb06: Lewiston Basin, 222Kb07: Portage Floodplain*

#### **222Kd: South Central Wisconsin Prairie and Savanna** (257,352 acres, 31%)

This subsection is primarily rolling to hilly ground and end moraine topography made up of sandy outwash, loamy till, and clayey lake deposits. Prior to settlement bur oak openings dominated in areas without significant firebreaks, while white oak-red oak forests occupied sites protected by streams or wetlands.

Today nearly all of the level ground in this subsection is cultivated. Forests persist almost exclusively in areas where excessive slope or poor drainage makes agriculture impractical. Oak openings (savannas), wet mesic prairies, wet prairies, and calcareous fens are the most significant rare natural communities (Albert, 1995). The state owns just over 2% of this subsection.

*LTAs: 222Kd01: Rio Moraines, 222Kd02: Green Lake Moraines, 222 Kd04: Pardeeville Plains  
222Kd07: Princeton Drumlins, 222Kd08: French Creek Moraines*

**222Kc: Lake Winnebago Clay Plain** (49,276 acres, 6%)

Flat lake plains and ground moraines reworked by glacial lakes characterize this subsection, which extends into the northeastern part of the FRHE. Red clay soils dominate, and are high in carbonates because of the dolomitic rock that underlies the area. Sugar-maple basswood forests dominated this subsection prior to settlement, but oak openings and forests were common on the portion within the FRHE because of high fire frequency (Albert, 1995). Extensive wetlands and agriculture dominate the area today. Nearly all of the 17,000-acre White River Marsh Wildlife Area lies within this subsection, which is 31% state-owned within the FRHE.

*LTA: 222Kc07: Redgranite Lake Plain*

**222Ke: Southern Green Bay Lobe** (3,784 acres, < 1%) **and**

**222Ra: Central Wisconsin Sand Plain** (954 acres, < 1%)

These subsections occupy very small areas at the margin of the study area. The Central Wisconsin Sand Plain is set apart by its largely unglaciated, nearly level topography. The Southern Green Bay Lobe occupies a large glaciated area of southeastern Wisconsin extending from the lower Fox Valley to west of Madison. A complex of ground moraines, terminal moraines, and lake plains of sand and silt loam characterize the area.

*LTAs: 222Ke12: Beaver Dam Drumlins, 222Ra08: Plover-Hancock Outwash Plain*

## **References**

See Appendix B for a full reference list from the Clark Forestry Report.

# Coarse Filter Analysis for the Fox River Headwaters Ecosystem

*Excerpted from a Report Prepared by Clark Forestry, Inc.*

## Introduction

Clark Forestry, Inc. used a coarse filter screening approach to assess the ecological resources of the FRHE to support landscape-level resource management planning. With that long-term goal in mind, the following report and accompanying Geographic Information System (GIS)-based maps were prepared to achieve the following short-term objectives:

- To gather information on the ecologically important resources of the study area.
- To identify critical habitat.
- To recognize potential restoration and protection opportunities.
- To provide a summary of the above information to participants in the March 2002 Workshop (See Appendix D).

The approach was modeled after the one used to perform a similar assessment of the Wolf River Basin in 1999 (Epstein et al. 2002). The objective was to identify sites with high potential for occurrences of threatened, endangered, and special concern species or natural communities, or sites of otherwise high conservation value. The primary emphasis was identification of potential high-quality natural communities. A related goal of the project was to continue to develop a cost effective, easily replicated process to identify sites using GIS and aerial photography. In order to maintain the efficiency of the coarse filter approach, this analysis was not supported by extensive ground-truthing or field work. We assumed that the methods used in this process would result in missing some small (less than 40 acre) areas and areas whose attributes could not be captured using available data layers.

## Information Sources

GIS Data Layers Distributed by WDNR Geographic Services Section (WDNR/GEO):

- County Boundaries, Roads, Highways, Municipalities
- WISCLAND Land Cover Classification
- 75-meter Digital Elevation Model
- Digital Orthophotography
- 1:100K and 1:24K Hydrology
- Original Vegetation Cover
- State Lands
- Surficial Deposits
- Bedrock Type
- Bedrock Depth
- Sections, Subsections, Landtype Associations (from LTA Disk 2.1)
- Ecological Landscapes
- 1:24K USGS DRGs

Data Provided by NHI:

- Element Occurrences (point and polygon themes)

- Element Occurrence descriptions

#### Non-Digital Sources:

- 1:15,840 black and white infrared aerial photography
- USGS 1:100,000 topographic maps
- State Natural Area Descriptions
- NHI 2001 Field Inventory Report

### **Site Types**

Finding natural communities - which often occur in very small (< 10 acre) patches on the landscape - can be difficult or impossible using coarse-grained, statewide GIS data layers. Our solution to this problem was to group natural communities into more general "site types" that could be identified on aerial photos based on their gross morphology, and wouldn't fall through a coarse-grained GIS filter. By assessing the list of natural community element occurrences for the study area, looking at existing state natural areas, and consulting those personally familiar with the FRHE, we developed a set of 10 site types that each capture one or more of the natural communities represented in the study area.

### **Query Design**

GIS queries were designed to identify areas of high likelihood for each site type. The query results provided a manageable area to search more closely with aerial photography and ground truthing.

For each site type we developed search criteria by identifying those attributes that made up a type's "signature," and collecting GIS coverages that contained those attributes. As a starting point for setting the search parameters, we used existing natural community element occurrences, State Natural Areas, and the 2001 NHI Field Inventory report to identify at least one known, representative site for each of the site types. The first query for each type was designed simply to capture the known site. This query, of course, also captured an area outside the known site; we then refined the search parameters based on whether this area was too limiting or too inclusive. Our goal was to capture a manageable area that contained both known and unknown sites. Table B.1 shows a summary of site types, representative communities for each type, search criteria and parameters.

For the mesic forest type, we found that we could not formulate an effective GIS query. We did, however, locate three potential quality mesic forest sites during our aerial photography interpretation phase. For two of the types - open uplands and lakes - we determined that locating potential sites with a reasonable degree of certainty was beyond the scope of this overview. Prairie remnants are impossible to locate using WISCLAND (our finest resolution data layer), and very difficult to identify on black and white infrared aerial photographs because they lack a unique textural or tonal signature. Identifying potential high-quality lakes was also a problem because of the lack of relevant GIS coverages. We believe that input provided by local land managers at the Experts Workshop will fill these gaps effectively.

**Table B.1. Coarse Filter Site Types**

Site Type	Key Natural Communities	Criteria	Parameters
Kettle Complexes	oak barrens northern dry forest southern dry forest sand barren oak woodland	Wiscland Level 2 Area Surf. Deposits Open Water	175, 190 (deciduous and mixed conifer/deciduous) greater than 100 acres "sand and gravel" Intersect at least one lake smaller than 5 acres
Upland Oak Openings	oak woodland southern dry forest mesic prairie dry prairie	Wiscland Level 3 Area Preset. Veg Surf. Deposits	177 (oak), 179 (northern pin oak), 180 (red oak) greater than 40 acres "oak opening" "clay" and "sand"
Bedrock Controlled Features	bedrock glade dry prairie cedar glade southern dry forest moist cliff	Bedrock Depth Aspect Slope	code 570 (70% of area 5 feet or less to bedrock) southwest (135 to 315 degrees) greater than 5%
Open Uplands	mesic prairie dry prairie	* See Note	
Flatwoods	northern wet forest northern dry mesic forest southern mesic forest floodplain forest	Wiscland Level 2 Area SLOPE	175, 190 (deciduous and mixed conifer/deciduous) greater than 160 acres entire area has slope less than 1%
Mesic Forests	southern mesic forest southern dry-mesic forest northern dry-mesic forest northern wet forest	Non GIS-Based Search	
Open Wetlands	open bog southern sedge meadow shrub carr alder thicket calcareous fen coastal plain marsh emergent aquatic	Wiscland Level 2 Area	211 (emergent/wet meadow), 217 (lowland shrub) greater than 640 acres
		Or Wiscland Level 2 Area Subsection	211 (emergent/wet meadow), 217 (lowland shrub) greater then 20 acres 222Kd or 222Ke (eastern part of basin)
		Or Wiscland Level 2 Area Soil	211 (emergent/wet meadow), 217 (lowland shrub) greater then 40 acres "We" or "Wm" (Willette Muck)
		Or Dnr Wetland Class. Area	"shrub/scrub", "emergent/wet meadow" greater than 320 acres
Forested Wetlands	tamarack (rich) swamp floodplain forest northern wet forest	Wiscland Level 2 Area	222 (forested wetland) greater than 100 acres
Streams	stream--cold, hard, fast	Gradient Water Source	greater than 0.3 % groundwater dominated
Lakes		* See Note	

\* CFI was unable to formulate effective queries for these site types using available data layers.

## Results

After executing GIS queries, evaluating aerial photography, and conducting windshield surveys, CFI identified 48 potential high-quality sites covering almost 92,000 acres within the study area (see Table B.2). The three lowland site types - open wetlands, forested wetlands, and stream corridors - were the most common, and made up 80% of the total acreage. Kettle complexes were the most frequent type on upland sites. Figure B.1 shows their spatial arrangement and Table B.3 provides a complete listing of individual sites and acreages.

**Table B.2. Coarse Filter Results by Site Type**

Site Type	Number of Sites	Acreage	% of Total Acreage
Open Wetland	17	44,955	48.9%
Forested Wetland	8	6,498	7.1%
Stream	6	22,007	23.9%
Bedrock Controlled Feature	5	1,687	1.8%
Kettle Complex	5	11,335	12.3%
Flat Woods	3	4,400	4.8%
Mesic Forest	3	336	0.4%
Upland Oak Openings	1	729	0.8%
Totals:	48	91,947	100.0%

**Table B.3. List of Coarse Filter Sites**

Site ID	County	Site Name	Site Type	Acreage
CFI-01	MAR	Limekiln Bluff	Upland oak opening	729
CFI-02	MAR	Oxford Oak Barrens	Kettle complex	4,604
CFI-03	GRE	Puckaway Lake Flatwoods	Flat woods	2,605
CFI-04	ADA	Upper Lawrence Creek	Kettle complex	2,402
CFI-05	WAU	Upper Mecan River	Stream	4,585
CFI-06	MAR	Montello River Floodplain Forest	Forested wetland	1,128
CFI-07	GRE	White River Marsh	Open wetland	23,152
CFI-08	WAU	Chaffee Creek	Stream	4,117
CFI-09	WAU	Wedde Creek	Stream	3,839
CFI-10	MAR	Upper Caves Creek	Stream	3,415
CFI-11	COL	Swan Lake Wetland	Open wetland	2,816
CFI-12	ADA	Upper Neenah Creek	Stream	2,402
CFI-13	WAU	Upper White River	Stream	3,648
CFI-14	COL	French Creek Wetland	Open wetland	2,916
CFI-15	GRE	Grand River Wetland	Open wetland	6,337
CFI-16	MAR	Comstock Bog - Meadow	Open wetland	609
CFI-17	GRE	Berlin Fen And Sedge Meadow	Open wetland	596
CFI-18	MAR	Observatory Hill	Bedrock controlled feature	202
CFI-19	ADA	Jackson Kettle Complex	Kettle complex	780
CFI-20	COL	Weeting Lake Wetland	Forested wetland	1,408
CFI-21	ADA	Adams County National Waterfowl Production Area	Kettle complex	1,324
CFI-22	MAR	Briggsville Conifer Swamp	Forested wetland	226
CFI-23	COL	Red Pine Rock Woods	Bedrock controlled feature	659
CFI-24	MAR	Page Creek Marsh	Open wetland	981
CFI-25	MAR	Little Observatory Hill	Bedrock controlled feature	239
CFI-26	MAR	Stone Hill Swamp	Forested wetland	728
CFI-27	MAR	Tuttle Lake Woods	Flat woods	1,165
CFI-28	GRE	19th Road Marsh	Forested wetland	458
CFI-29	MAR	Mud Lake	Forested wetland	472
CFI-30	GRE	Little Green Lake Mesic Forest	Mesic forest	76
CFI-31	COL	Fox Headwaters Meadow	Open wetland	204
CFI-32	GRE	Grand Lake Wetland	Open wetland	317

Site ID	County	Site Name	Site Type	Acreage
CFI-33	GRE	Manchester Woods	Mesic forest	132
CFI-34	GRE	Marquette Marsh	Open wetland	206
CFI-35	GRE	Roy Creek Forest	Mesic forest	127
CFI-36	GRE	Puchyan River/Snake Creek Bottom	Open wetland	2,193
CFI-37	GRE	Green Lake Station Sedge Meadow	Open wetland	29
CFI-38	ADA	New Haven Woods	Kettle complex	2,225
CFI-39	WIN	Koro Bog	Open wetland	220
CFI-40	GRE	Puchyan Marsh	Open wetland	882
CFI-41	GRE	Mitchells Glen	Bedrock controlled feature	197
CFI-42	GRE	Rock Hill Outcrops	Bedrock controlled feature	390
CFI-43	COL	Lewiston Flatwoods	Flat woods	630
CFI-44	WAU	Jordan's Lake Wetland	Forested wetland	668
CFI-45	MAR	Harris Marsh	Open wetland	1,295
CFI-46	WAU	Upper Mecan River Wetland	Open wetland	1,094
CFI-47	WAU	Upper White River Wetland	Open wetland	1,110
CFI-48	WAU	Wautoma Swamp	Forested wetland	1,410

### ***Assessment of Coarse Filter Analysis***

Using GIS and remote sensing data to locate sites of potentially high ecological significance across a landscape is a quickly developing science. Each attempt yields new information about the pitfalls and rewards conducting such an analysis. Early indications show a good correlation between the coarse filter sites and the sites provided by local experts. Though the coarse filter approach was complex, it has advantages when compared to a full-scale inventory of an area. The coarse filter takes a "third party" perspective that results in an objective look at the entire study area. Because it uses a bird's eye view, the analysis allows a quick and cost-effective assessment of the broader landscape context of each site.

However, limitations exist with sites that occur in small patches on the landscape or don't have relatively simple signatures. By definition, GIS queries don't allow one to locate a site smaller than the minimum mapping unit of the input data layers. In this case the finest-grained layer was the WISCLAND land cover grid, with a resolution of 30 meters (about 0.25 acres). The statewide digital elevation model (DEM) is also relatively fine-grained, with a resolution of 75 meters (about 1.5 acres). Most other potentially useful data layers, however, were digitized from statewide maps and are much coarser. For example, the average mapping unit size for the original vegetation coverage is about 2,700 acres, while the surficial deposits average is over 11,000 acres, and the bedrock type average is 21,000 acres. Locating discrete sites that don't have a signature based on the WISCLAND land cover classification, - such as prairies, fens, mature forests, or lakes - requires more reliance on aerial photography, local knowledge, and other more traditional information sources.

In the end we were able to conduct a systematic, primarily GIS-based search of the study area for all but three (open uplands, lakes, and mesic forests) of our original site types. A brief description of how we searched for each type follows.

- **Kettle Complexes:** The attributes that make up this type's signature (large forested blocks containing small lakes along the terminal moraine) were relatively easy to capture by searching for the intersections of forests, small lakes, and gravel deposits.
- **Upland Oak Openings:** Because these communities were historically an important component of this landscape, we created a site type that searched for them outside of kettle complexes. As expected, there was a significant amount of overlap between the two types. Though it was impossible to positively identify oak "openings" (because WISCLAND does not provide forest

density information), we were confident that the combination of the kettle complex and oak opening queries identify the best oak savanna and/or oak barrens restoration opportunities.

- **Bedrock Controlled Features:** By focusing on southwest facing, steep slopes with bedrock near the surface, we formulated a query that proved very effective after conducting aerial photo analysis and ground truthing.
- **Open Uplands:** This site type was intended to include existing prairie remnants and potential prairie restoration sites. Because LANDSAT imagery doesn't differentiate between old fields or pasture (which represent a significant acreage in the FRHE) and prairies, WISCLAND is of relatively little use. Prairie remnants also often occur in very small patches on the landscape. Color infrared aerial photographs would have been helpful, but the extensive ground-truthing required to effectively locate small prairie remnants would have been beyond the scope of this overview.
- **Flat Woods:** Because it depended on our two highest resolution layers (WISCLAND and the DEM), it was simple to design a query that identified possible sites.
- **Mesic Forests:** Without a layer that provides forest density or age class information, it is difficult to identify high-quality forests using GIS. We did, however, use GIS to identify the general regions most likely to support mesic forests. The most useful information source in this case was aerial photographs, because mature, intact hardwood forests have a unique, easily recognizable signature.
- **Open Wetlands:** Both WISCLAND and the Wisconsin Wetland Inventory provide good information about open wetlands, however provide little information on community quality. A search based on a minimum acreage captures only the large, usually well-documented complexes. In order to capture the smaller wetlands in the eastern part of the project area, we lowered the minimum size to 20 acres and relied more heavily on aerial photo analysis.
- **Forested Wetlands:** Because WISCLAND has a unique category for this type, and potential high-quality sites were likely to occur as large, contiguous tracks, this query was simple and effective.
- **Streams:** Queries for this site type relied on The Nature Conservancy's "Aquatic Classification of Wisconsin's Streams and Rivers Using Physical Characteristics to Predict Biologic Potential" GIS dataset. A simple search of streams with relatively high gradients and groundwater sources effectively captured the higher-quality streams in the area.
- **Lakes:** To date, there is no GIS data layer that provides enough information about Wisconsin's lakes to conduct an assessment of quality. Though the tabular data from the "Surface Water Resources" handbooks for each county have been condensed into a digital database, it is not practical to analyze on a landscape level without spatial attribute information. Lakes are a very important part of the FRHE, but to assess them with any confidence (even at the coarse-filter level) would require resources and expertise that are beyond the scope of this study.

## Recommendations for Future Coarse Filter Analyses

GIS-based coarse filter analysis is, and will continue to be, a valuable tool for ecosystem inventory projects. It will become more useful as GIS technology develops and more, higher-resolution layers are made available. Using current statewide layers, GIS queries will capture mostly large, already well-

documented sites. As the study size decreases, so does the effectiveness of GIS for locating individual sites. It is important that the scale of the data match the scale of the study area.

At this point, aerial photographs, 1:24,000 topographic maps, interviews with local experts, and ground-truthing are still the best methods for individual site location and characterization. The best use of GIS is to provide a landscape-level overview of a study area, and to quickly determine the ecological context of individual sites.

Future projects will allow us to continue to develop a more systematic method for identifying coarse filter targets. In the next study, it might be more effective to divide the process into two distinct phases, one that focuses on reconnaissance and asks the question "What kinds of unique and/or sensitive ecosystems occur on this landscape?" and a second that asks "Where do these ecosystems occur?"

In the end, there is no substitute for the knowledge held by those who have lived and worked within a study area. But GIS offers the opportunity to efficiently assess the ecological attributes of a large landscape, locate areas where high-quality ecosystems are most likely to occur, and analyze the ecological context that individual sites falls within. The most efficient coarse filter analysis will be the one that incorporates the right balance of local knowledge, published information, and GIS analysis.

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# State Natural Areas within the Fox River Headwaters Ecosystem

*Excerpted from longer descriptions prepared by State Natural Areas staff*

**Bass Lake Fen:** Features a 20-acre fen located on the undeveloped shore of Bass Lake. The fen is exceptionally diverse with many small springs, openings, and ponds providing a calcium-rich habitat that supports 126 species of plants. Of note is the state-threatened false asphodel (*Tofieldia glutinosa*), and two special concern species. To the east, the fen grades into sedge meadow and the two communities are bordered on the north by tamarack swamp and on the south by shrub carr. The five-acre Bass Lake is a clear fertile lake, some 27 feet deep, with a sandy marl bottom. The lake has a good warm water fishery and is an important waterfowl area. Sandhill cranes, which nest nearby, use the area extensively. Bass Lake is owned by the DNR and was designated a State Natural Area in 1983.

**Berlin Fen:** Berlin Fen contains two mound fens, the smaller on the south side near the abandoned railroad trail and the larger covering nearly the entire northern portion of the site. The mounds are dome-shaped piles of wet calcareous peat and have unique combinations of plants. The larger mound is dominated by shrubby cinquefoil and chairmaker's rush while the smaller mound is dominated by prairie grasses. Throughout the main mounds are areas of marl rivulets and pools, which harbor a very unusual flora including special concern species. Preliminary studies suggest that sedge wren, common yellowthroat, and savanna and clay-colored sparrows breed here. Berlin Fen is owned by the DNR and was designated a State Natural Area in 1986.

**Caves Creek (within Upper Fox Headwaters SNA):** Caves Creek contains the headwaters of Caves Creek with spring seeps and runs, a 2-acre spring pond, sedge meadow and tamarack swamp, and oak barrens. The spring seeps are floristically rich and are surrounded by a diversity of wetlands. The barrens lies on a south-facing slope and contains a good diversity of prairie species including little blue-stem, June grass, flowering spurge, and bird's-foot violet. A state endangered species, western slender glass lizard (*Ophisaurus attenuatus*), has been found at the site.

**Chaffee Creek (within Upper Fox Headwaters SNA):** Upper Chaffee Creek Meadow contains a wetland complex of fen, wet-mesic and wet prairie with over 100 native plant species present. Running through the site is Chaffee Creek. The creek valley varies between very wet sedge meadow through fen-like areas along the gentle north slope of the creek and grading to wet-mesic prairie. Grasses include big and little blue-stem, blue-joint grass, and slender wheat grass. Featured forbs are marsh pea, Michigan lily, western sunflower, pale-spike lobelia, Kalm's lobelia, grass-of-parnassus, marsh fern, and swamp lousewort.

**Comstock Bog-Meadow:** Lying within a 1000-acre natural basin in the glaciated Central Plain, Comstock Bog-Meadow features a large, quaking sedge meadow marsh with a high diversity of unusual plants. The undisturbed marsh is permanently wet and relatively free of water fluctuations. The south end lies on a drainage divide and is dominated by narrow leaved sedges with many acid bog plants occurring on the quaking, rhizomatous mat. Of particular interest is the unique assemblage of plants with many characteristic calcareous wetland species growing in association with bog species. Northward and westward the species composition changes to more closely resemble a sedge meadow. The marsh is used by a variety of rare breeding bird species, small mammals, muskrat, mink, reptiles and amphibians.

Sandhill cranes nest in the marsh and use the area as a fall staging site. In 1851, the original land surveyors described the area as a wet, quaking marsh, “over which we crossed with not a little danger to our lives.” Comstock Bog-Meadow is owned by the DNR and was designated a State Natural Area in 1975.

**Fountain Creek Wet Prairie:** Fountain Creek Wet Prairie is a large wet prairie, a very rare community in Wisconsin. The site features a high quality low prairie, which tapers to a nearly pure stand of prairie cordgrass. Because the area is located within the Grand River Marsh Wildlife Area, it is used by a large number of geese, sandhill cranes, great blue herons, and two species of concern: the northern harrier and bobolink. The wet prairie soils are easily compacted and vegetation fragile – please walk softly. Fountain Creek Wet Prairie is owned by the DNR and was designated a State Natural Area in 1972.

**Germania Wet Prairie (within Germania Marsh Wildlife Area):** Situated on the terraces above the Mecan River is Germania Wet Prairie, a diverse wet to wet-mesic prairie with a showy flora and some sedge meadow and fen affinities. The natural area has had little to no previous disturbance such as grazing, which is a common occurrence in the surrounding area. Grasses include prairie cord grass, blue-joint grass, and slender wheat grass. Herbaceous plants include wild bergamot, prairie blazing-star, mountain mint, swamp thistle, Michigan lily, marsh bellflower, downy phlox, boneset, tall meadow-rue, pale-spike lobelia, and royal fern.

**Koro Prairie:** Koro Prairie features a stretch of high-quality mesic prairie with many species of native prairie plants. Dominated by big bluestem, this site contains other common mesic prairie species. This remnant is especially noteworthy because of its location at the northeastern edge of the prairie-oak savanna region in Wisconsin. The site runs along an abandoned railroad right-of-way and frequent fires sparked by the trains helped maintain the fire-adapted prairie vegetation. Koro Prairie is owned by Winnebago County and was designated a State Natural Area in 1990.

**Lawrence Creek:** Lawrence Creek is a cold, hard water trout stream with an excellent stream flora and fauna and the designated portion constitutes the main spawning area for a large reproducing population of brook trout. Originating in ground moraine about one and a half miles upstream, the creek is internationally famous for research on brook trout ecology, life history, and management. Rare plant species include the state-endangered brook grass (*Catabrosa aquatica*), and three special concern species. Lawrence Creek is owned by the DNR and was designated a State Natural Area in 1968.

**Lunch Creek Wetlands:** Lunch Creek Wetlands features one of the most diverse and species rich sedge meadows in Wisconsin situated within a mainly undisturbed watershed, an uncommon occurrence in Wisconsin. This large wetland complex is free of exotic species and dominated by fen and sedge meadow communities containing a total of 115 plant species. Wetland air photos show patterning—a rare phenomenon seen only at two other natural areas in Wisconsin—Cedarburg Bog and Bogus Swamp. The patterning is evident on the ground where high and low areas often show dramatic differences in plant species presence with wire grass sedges found in lower “impoundment” areas and a forb dominated sedge meadow directly adjacent to it. A fen-like meadow emanates from the uplands and upland islands surrounding the lower areas. The area provides ideal habitat for grassland and wetland birds. Over 5,000 sandhill cranes roost here in October and early November. Lunch Creek Wetlands is owned by the DNR and was designated a State Natural Area in 2000.

**Muir Park:** Ennis Lake is a 30-acre kettle lake occupying a marshy pocket in ground moraine. The seepage lake is spring fed with a marl bottom and a maximum depth of 30 feet. The surrounding vegetation is diverse and includes a rich calcareous fen that lies along an outlet stream, sedge meadow, and open bog, northern wet forest dominated by tamarack, southern dry forest, oak opening, and wet-

mesic prairie. The area was settled in 1849 by the Ennis and Muir families and was the boyhood home of John Muir, founder of the Sierra Club, who admired the natural beauty of the area. Muir Park is owned by Marquette County and was designated a State Natural Area in 1972.

**Observatory Hill:** The highest point in Marquette County is Observatory Hill, an isolated outcropping of porphyritic rhyolite, an igneous rock embedded with feldspar crystals. The hill, rising 300 feet above the surrounding landscape, has long been known by naturalists and was a favorite childhood haunt of John Muir who lived nearby. Recently, scientists have discovered the existence of petroglyphs on the hill's rock outcroppings, which may be part of a larger prehistoric petroform found in Marquette County. The slopes are covered with a southern dry forest community dominated by red and white oak, basswood and shagbark hickory and much of the area is now being restored to oak savanna – an imperiled vegetation community in Wisconsin. Near the top of the hill, bedrock is exposed or close to the surface creating acidic conditions where a specialized glade community has developed. Red cedar dominates the glade and the thin soils support a sparse ground cover of mosses, ferns, and lichens. Two state-threatened species, are also found on the site. Observatory Hill is owned by the DNR and was designated a State Natural Area in 1989.

**Page Creek Marsh:** Located in the central sands of Wisconsin, Page Creek Marsh is a large wetland preserve that supports a rich diversity of plants, rare meadow birds, and waterfowl. Dominant plant communities are northern and southern sedge meadow, and sandy oak savanna. Also present are fens, wet-mesic prairie, bog, and seepage lakes. Page Creek winds northwest near the west edge of the marsh through gently rolling farmland enhanced by remnants of native prairie and savanna. Page Creek Marsh is of particular value as a staging area for sandhill cranes during their fall migration. Luxuriant with emergent aquatic plants, the secure, deep-water habitat of the marsh provides cover for large numbers of birds every season. Numerous rare plants and animals are found here. Page Creek Marsh is owned by the DNR and was designated a State Natural Area in 1996.

**Princeton Prairie:** Located in an extensive basin where the meandering White and Puchyan Rivers empty into the Fox River, Princeton Prairie features a high quality wetland complex with numerous rare plants and animals. The site contains a diversity of wetland communities with southern sedge meadow, wet-mesic prairie, and open marsh. A low wet-prairie-marsh-sedge meadow complex can be found at the edge of the Puchyan River wetlands and contains a rich diversity of species. The area is also important waterfowl breeding habitat. Princeton Prairie is owned by the DNR and was designated a State Natural Area in 2002.

**Puchyan Prairie:** Puchyan Prairie features a large wet-mesic prairie, marsh, and sedge meadow complex at the edge of extensive wetlands bordering the Puchyan River. The prairie is particularly diverse and includes a large population of prairie parsley, a state-threatened plant. Toward the Puchyan River the vegetation grades into an extensive mosaic of undisturbed shallow marsh of cattail-bulrush, sedge meadow dominated by tussock sedge and bluejoint grass, and a wooded island dominated by large black and bur oaks with hazelnut and Pennsylvania sedge. Numerous rare animals are found here. Puchyan Prairie is owned by the DNR and was designated a State Natural Area in 1981.

**Silver Lake:** Silver Lake is an approved SNA project area with no land acquisition to date. When lands are purchased from a willing seller, it will be added to the official list of SNAs. The project area contains a shallow 52-acre lake with widely fluctuating water levels that provides one of the finest areas for Atlantic coastal plain disjuncts. These coastal plain disjuncts are plant species more commonly found along the Atlantic coast and are thus considered “disjunct” or separated from their home range. Located within the sandy soils of the terminal moraine, the 10-foot deep seepage lake contains other rare plants including Robbins' spike-rush and the only known Wisconsin population of the state-endangered dwarf umbrella-sedge. Surrounding the lake is a 40-foot high sandy ridge extending west into the lake. This

area harbors a high quality oak savanna dominated by black oak with some red, white, and bur oak. The site contains an unusually good native prairie and savanna flora with over 80 species.

**Snake Creek Fen:** Features a high-quality calcareous fen and associated springs located within a large wetland complex in the Snake Creek corridor. The prairie fen is characterized by saturated soil and is dominated by prairie grasses and forbs along with several indicator fen species. Included within the natural area is a wet prairie, southern sedge meadow, and two depressions dominated by sedges and rare plants. Springs emanating from the depressions bring cold, alkaline water to the surface where calcium and magnesium precipitates to form small marl flats. Numerous rare plants are found here including three state-threatened species and four special concern species. Rare birds include yellow rail and Le Conte's sparrow. Snake Creek Fen is owned by the DNR and was designated a State Natural Area in 1998.

**Summerton Bog:** Summerton Bog is a highly diverse complex of low meadow, bog, fen, tamarack, and shrub communities. Located in the southeastern corner is a five-acre glacial till island wooded with red and white oaks. On the western flank of the island is a calcareous fen. Its calcium-rich waters have allowed an unusual assemblage of plants to thrive including typical fen species. Forested communities are mostly dominated by tamarack with a few black spruce. Nesting birds include sandhill crane, bobolink, sedge wren, Nashville warbler, and veery. Of note is the presence of nine species of orchid and the pickerel frog, a species of special concern in Wisconsin. Prescribed burns and brushing are conducted to maintain sedge meadow and fen community vigor. Summerton Bog is owned by the Nature Conservancy and was designated a State Natural Area in 1966.

**White River Prairie/Tamaracks (within White River Wildlife Area):** White River Prairie/Tamaracks contains one of the largest tamarack bogs and one of the largest and least disturbed wet prairie remaining in Wisconsin. The tamarack bog contains a dense canopy of tamarack with an understory dominated by sphagnum moss with a sparse willow and dogwood component. Ground cover consists of many northern plant species such as yellow bluebead lily and three-leaved gold-thread. The low, wet prairie contains an excellent flora with some fen aspects and is dominated by a great diversity of native species, none of which occupy more than 10% of any area. Some plants more typical of fens include sweet grass, shrubby cinquefoil, and boneset. Grasses present are big blue-stem, blue-joint grass, and prairie cord grass. Showy forbs include prairie blazing-star, Michigan lily, narrow-leaved loosestrife, wild bergamot, swamp milkweed, swamp saxifrage, spiderwort, culver's-root, golden alexanders, northern bedstraw, and hoary vervain. Scattered around are small upland black oak "islands" and small ponds, which add diversity to the site. The prairie harbors a substantial population of the state-threatened Henslow's sparrow (*Ammodramus henslowii*).

**White River Sedge Meadow (within White River Marsh Wildlife Area):** White River Sedge Meadow features the largest southern sedge meadow in Wisconsin, and contains a full variety of environmental gradients. The wetland complex contains a deep marsh with cat-tails and tussock sedge and contains a diversity of emergent aquatic species to the south. Because of its size, White River Sedge Meadow has been identified as the best opportunity within Wisconsin to manage wet meadow birds, including least bittern (*Ixobrychus exilis*), American bittern (*Botaurus lentiginosus*), sedge wren (*Cistothorus platensis*), grasshopper sparrow (*Ammodramus savannarum*), and Henslow's sparrow (*Ammodramus henslowii*). Thousands of sandhill cranes stage here every fall before their migration south. Scattered along the White River are patches of floodplain forest, which harbor rare birds including red-shouldered hawk (*Buteo lineatus*), cerulean warbler (*Dendroica cerulea*), and Acadian flycatcher (*Empidonax virescens*). Black terns have previously nested here. Other breeding birds include yellow-billed cuckoo (*Coccyzus americanus*), red-headed woodpecker (*Melanerpes erythrocephalus*), veery, prothonotary warbler, American redstart, and northern oriole.

**Zinke Lake (within Upper Fox Headwaters SNA):** a small hard water spring lake with a tamarack-dominated shore. The water is deep, clear, and cold with limited aquatic vegetation that includes common horsetail, common pondweed, chara, and water milfoil. The spring outlet has a soft sandy bottom and contains white water crowfoot. Other plants include marsh-marigold, lousewort, cow parsnip, ironweed, bulbet water-hemlock, showy goldenrod, and Missouri goldenrod. The lake's outlet stream is also used by brook trout for spawning.



# The Fox River Headwaters Ecosystem Workshop

*Submitted by Anne Forbes, Andy Galvin, and Drew Feldkirchner*

The Bureau of Endangered Resources (BER) is charged with the inventory and analysis of biotic and ecological resources across Wisconsin. However, given the size of the state, the ecological complexity of the landscape, and the resources needed to compile meaningful inventory results and keep them current, it is a task that depends on information gathered from a variety of sources. In order to create new approaches to comprehensive inventory, BER partnered with the Wolf River Basin Geographic Management Unit (GMU) to identify the most significant ecological resources in the Basin by involving as many individuals with first-hand knowledge of those resources as possible in a pilot workshop in 1999 (Epstein et al. 2002). Following the success of that effort, BER partnered with the Upper Fox GMU to apply a similar approach to identify the significant ecological resources of the Fox River Headwaters Ecosystem (FRHE) located in the western portion of the GMU. As with the Wolf Basin, the project's purposes were to increase the common understanding of the significant ecological resources of the area among all participants, as well as to work in teams to recommend significant sites for ongoing conservation planning.

## Approach and Methods

At the FRHE workshop, people with local knowledge of the area's resources worked together to score the ecological significance of 83 proposed Sites, using the following set of seven ecological attributes.

The Site:

1. . . is unfragmented and functionally intact.
2. . . includes locally critical habitat for common plants or animals.
3. . . includes uncommon or rare natural communities.
4. . . includes uncommon or rare plants, animals, or other features.
5. . . has actual connectivity with other important sites.
6. . . has potential connectivity with other important sites.
7. . . has potential for natural community restoration.

Working with a trained facilitator, teams of 10-12 participants reached agreement on a score for each attribute for each Site, based on its own merit, applying marks of H (high), M (medium), L (low), or U (unknown). Each team worked around a table-sized working map showing the locations of all Sites and Individual Records, and each participant received a booklet of spreadsheets with the detailed records for each Site (Appendix E). The map and spreadsheets were constructed using two different, complimentary methodologies. One method, the Coarse Filter screening approach, used GIS analysis followed by analysis of aerial and satellite images for a "birds-eye" assessment of the entire Fox River Headwaters Ecosystem (FRHE) landscape. The other method was based entirely on Contributor Records, or observations documented by individuals who have observed the area at an on-the-ground level.

## Records from Coarse Filter Analysis

The Coarse Filter screening approach was modeled after a similar assessment used for the Wolf River Basin in 1999 and is described in detail in Appendix B. The objective was to identify sites with potential for high quality natural communities; species that are threatened, endangered, or of special concern; or

other factors reflecting high conservation value. The primary emphasis was identification of potential high-quality natural communities. A related goal of the project was to continue to develop a cost effective, easily replicated process to identify sites using GIS and aerial photography.

The Coarse Filter process involved a GIS analysis and follow-up analysis using aerial photography (see Appendix B). In order to maintain the cost efficiency of the Coarse Filter approach, this analysis was not supported by extensive ground-surveys or field work, only limited “windshield surveys.” While these methods would provide an important landscape scale analysis of the area, we knew that the methods might miss many small (< 40 acre) areas and areas whose attributes might not be represented by the data and criteria used (e.g., delineating different types of wetlands).

Using various GIS data layers, the staff at Clark Forestry, Inc. consolidated natural communities into general "site types" that could be identified on aerial photos based on their gross morphology, and wouldn't fall through a coarse-grained GIS filter. By assessing the list of NHI element occurrences for the study area (threatened, endangered, and special concern species or natural communities in the NHI database), looking at existing state natural areas, and consulting those personally familiar with the FRHE, CFI developed a set of 10 site types that capture all of the natural communities represented in the study area.

After executing GIS queries, evaluating aerial photography, and conducting windshield surveys, CFI identified 48 potential high-quality areas covering almost 92,000 acres within the study area. The three lowland types - open wetlands, forested wetlands, and stream corridors - were the most common and made up 80% of the total acreage. Kettle complexes were the most frequent type on upland sites. (see Appendix B for details).

## **Records from Individual Contributors**

The first step in gathering site information was to identify individuals who might have specialized knowledge of natural communities, critical habitats, populations of rare plants and animals, and other unique features in the FRHE area. The intent was to reach out to potential experts from all walks of life including scientists, resource managers, conservation enthusiasts, amateur naturalists, anglers, and bird-watchers. From an initial list of 157 individuals contacted by letter or phone, 30 responded with interest in participating and providing information, and they also suggested other potential contributors. Each contributor was asked to complete a Site Information Form (Appendix E) and identify a rough site boundary on a map of the area provided. The end result was that 37 individuals provided 192 Contributor Records.

## **Delineating Sites and Teams for the Workshop**

The 48 Coarse Filter Records and 192 Contributor records were combined into 83 Sites based on their ecological characteristics and proximity to each other. Each site may encompass more than one contributor or coarse filter record. A large working map and site information tables (Appendix E) were created for use at the workshop. The working maps show generalized “boundaries” for each Site and the locations of the individual Coarse Filter or Contributor records within them.

For the purposes of the workshop, the 83 Sites were apportioned among 5 teams in order to assign each team a reasonable number of Sites to score during the workshop. Although the general ecological characteristics and proximity played a role, these divisions were somewhat arbitrary. Each team was simply named for a color to easily cue workshop participants to locate their assignments on the working maps and in the spreadsheets. The distribution of Sites and the number of records are provided in Table D.1.

**Table D.1. Workshop Sites.**

Team	# of Sites	# of Coarse Filter Records	# of Contributor Records
Green Team	15	8	58
Blue Team	16	14	40
Purple Team	14	10	43
Red Team	19	8	30
Yellow Team	19	8	21

### Workshop Site Results

All sites scored at the workshop are listed below (Table D.2) in decreasing order, according to their average scores for ecological significance. Those with the highest scores are listed first and where scores are tied, the sites are listed in alphabetical order.

The Workshop results, and subsequent analysis, are presented in more detail in the *Identification of Significant Ecological Sites* chapter, and their significance for conservation planning is discussed in the chapter *Opportunities for Conservation Design*.

**Table D.2. Workshop Sites.**

Site	Team	Average Score
Caves / Tagatz Fisheries	Purple	3.00
Germania Wildlife Area	Blue	3.00
Grand River Wildlife Area	Blue	3.00
Neenah Creek Valley	Red	3.00
Norwegian Bay Wetlands	Yellow	3.00
Oxbo Wetlands	Blue	3.00
Puckaway Flatwoods	Blue	3.00
Puckaway Lake	Blue	3.00
Rock Hill Outcrops	Blue	3.00
White River Marsh Area	Blue	3.00
FRNW Refuge / Packwaukee	Red	2.86
Mecan River Fisheries Area	Green	2.86
Mecan Springs	Green	2.86
Mitchell's Glen	Yellow	2.86
Soules Creek Area	Green	2.86
Sugar Island Wetlands	Yellow	2.86
White River Fisheries	Green	2.86

<b>Site</b>	<b>Team</b>	<b>Average Score</b>
Head of Green Lake	Yellow	2.83
Lucerne Lake	Blue	2.83
Sucker Creek	Blue	2.83
White River - West Branch	Green	2.83
Meilke Lake	Green	2.75
Roy Creek Forest	Yellow	2.75
Stone Hill Swamp	Green	2.75
Buffalo Lake Area	Red	2.71
French Creek Wetland	Red	2.71
Lower Silver Creek	Yellow	2.60
Berlin Fen & Sedge Meadow	Blue	2.57
Corning - Weeting Lakes	Red	2.57
Lawrence Creek	Purple	2.57
Lower White River	Green	2.57
Fluctuating Shoreline Lakes	Purple	2.50
Oxford Correctional Area	Purple	2.50
Bass Lake	Green	2.43
Becker Waterfowl PA	Yellow	2.43
Bennett Oak Savannah	Yellow	2.43
Grotzke Rd. Area	Red	2.43
Jordan's Lake Wetland	Blue	2.43
Lake Maria	Yellow	2.43
Utley	Yellow	2.43
Greenwood Wildlife Area	Green	2.29
Lunch Creek	Green	2.29
Mt. Morris Cemetary	Green	2.29
Oxford Woods and Savanna	Purple	2.29
Princeton Sturgeon Site	Blue	2.29
Summerton Bog N/S	Red	2.29
Thompson Lake	Yellow	2.29
Marquette Marsh	Blue	2.20
Wood Lake	Green	2.20
Upper Neenah Creek	Purple	2.17
Bog Relics - Swamp Lake	Purple	2.14
Adams Cty. Nat. Waterfowl PA	Purple	2.00

Site	Team	Average Score
Bog Relics-Harris Pond	Purple	2.00
Briggsville Conifer Swamp	Red	2.00
Dreheim / Berndt Restoration	Yellow	2.00
Jordan Lake Area	Red	2.00
Koro Bog	Blue	2.00
Lime Kiln Bluff	Purple	2.00
Little Green Lake Mesic Forest	Yellow	2.00
Manchester Woods	Yellow	2.00
New Haven Woods	Red	2.00
Packwaukee Hdwd. Swamp	Red	2.00
Klawitter Creek Fen	Purple	1.86
Montello River	Purple	1.86
Grand Lake Wetland	Yellow	1.83
Jackson Kettle Complex	Purple	1.75
Kolka Property	Green	1.71
Swan Lake WA	Red	1.71
Hwy 82 Grasslands	Red	1.60
McCourtney (Oak Savanna Remnant)	Purple	1.57
SR 73 Degraded Wetland	Yellow	1.57
Grn Lk Station Sedge Meadow	Blue	1.50
Beechnut Road Barrens	Green	1.43
Green Lake Center	Yellow	1.43
Cuff Lake	Yellow	1.40
Freedom Grasslands	Red	1.40
Blue Lake Marsh	Red	1.33
Byers Wetland	Red	1.29
Mitchell Grassland	Red	1.29
Patrick Lake	Purple	1.29
Soo Line Prairie Remnant	Red	1.29
Bannerman Trail	Blue	1.14
Fox River Headwaters	Yellow	1.00
Lewiston Flatwoods	Red	U



## Fox River Headwaters Workshop Materials

This appendix contains materials provided to participants at the Fox River Headwaters Ecosystem Workshop held March 8, 2002:

- ❖ Workshop agenda
- ❖ Workshop attendees list
- ❖ brief methodology for site identification and reporting
- ❖ sample scoring form
- ❖ records contributed by Workshop participants, sorted by team (records submitted following the workshop are provided at the end of the appendix)

**Fox River Headwaters Ecosystem  
Significant Ecological Areas Workshop  
March 8, 2002**

**Workshop Purposes**

- Increase our common understanding of the ecological features of the Fox River Headwaters Ecosystem.
- Work in teams to assess the significance of sites, based on a set of ecological attributes.
- Understand how the workshop results will be reported and used.

**Workshop Agenda**

10:00 a.m.	<b>Welcome and Agenda Review</b>
	Overview <ul style="list-style-type: none"> <li>a. Ecology of the Fox River Headwaters Ecosystem (FRHE)</li> <li>b. Methods: Coarse Filter Inventory, Contributed Information, and Mapping</li> </ul>
10:30	Instructions for Teams
10:45	<b>Team Session #1</b> Introduce team members. Become familiar with the maps and spreadsheets. Examine the distribution of sites throughout the FRHE.
11:15	Whole Group. Brief reporting and instructions for Session #2.
11:30	Team Session #2 Using the maps and spreadsheets and following your facilitator's instructions, assess the ecological significance of the Sites assigned to your team.
12:15 p.m.	<b>Lunch Break</b>
12:45	<b>Team Session #2, continued</b> Recorders: turn in a copy of your team's worksheet for computer entry
1:45	<b>"Open House"</b> Select one other team station to visit (facilitators remain) and work with the facilitator to offer feedback on their work.
2:15	Whole Group. Review the day's product, a map of recommended high priority sites in the FRHE, showing the combined results of all teams.

2:45 | Next Steps and Evaluation

3:00 | **Adjourn**

# Workshop Guidelines

## Guidelines for Team Work

- ▶ Note the range of expertise among the members of your group and make space for each member to participate.
  - Who are contributors of sites and site information?
  - Who has on-the-ground knowledge of the area?
  - Who can support the process by asking good questions, integrating information, and summarizing ideas?
- ▶ Help support the facilitators and recorders.
- ▶ Help keep us on topic and on time – use the *woodpile*.

## Guidelines for Today's Outcomes

- ▶ The teams are asked to assess the current ecological significance of the sites, each on their own merit, using the ecological attributes provided.
- ▶ Today's process is as important as the product. That is, the communication among participants and the increased common knowledge of the ecology of the FRHE area is an important and intended outcome.
- ▶ We need to stay focused on today's task. Other aspects of the analysis will take place after the workshop and during WDNR Feasibility Analysis.
- ▶ Issues to be addressed later include site size and boundaries; ecological significance of sites on statewide and national levels; and the sensitivity of sites to surrounding land use and other potential threats to ecological integrity.

## Fox River Headwaters Ecosystem Workshop

# Workshop Attendees

\* Indicate Contributors that provided site information

### Blue Group

Pat Arndt\*, Berlin School Forest/Educator-Berlin  
Richard Bautz\*, DNR- Integrated Science Services  
Dr. William Brooks, Ripon College  
Daryl Christensen\*, Private Individual  
Bettie Harriman\*, Wisconsin Society for Ornithology  
Linda Hyatt, DNR- Upper Fox Water Team Leader  
Mike Penning, DNR- Facilities & Lands  
Jerry Reetz\*, DNR- Wildlife Management  
William Smith\*, DNR- Endangered Resources  
Walter Walker, Private Individual

### Green Group

David Algrem, DNR- Law Enforcement  
Nancy Cervantes\*, DNR- Wildlife Management  
Andy Clark, DNR- Endangered Resources  
Elward Engle\*, DNR (retired)  
Mike Engel\*, U S Fish & Wildlife Service  
Eric Epstein\*, DNR- Endangered Resources  
Barry Gilbeck\*, DNR- Customer Assistance & External Relations  
Rod Glaman, DNR- Forestry  
Darcy Kind\*, DNR- Endangered Resources  
Scott Provost\*, DNR- Fisheries Management & Habitat Protection  
Curt Wilson, DNR- Northeast Regional Land & Forestry Leader

### Yellow Group

Randall Berndt\*, Private Individual  
Jim Congdon, DNR- Rock River Basin Water Leader  
Tom Eddy\*, Private Individual/Educator-Green Lake  
Jim Kronschnabel\*, DNR (retired)  
Betty Les, DNR- Endangered Resources  
Mark Martin\*, DNR- Endangered Resources  
Tom Nigus\*, DNR- Upper Fox Land & Forestry Team Leader  
Steve Prissel, Natural Resource Conservation Service, USDA  
Ted Pyrek, DNR- Lower Wisconsin Land & Forestry Team Leader  
Shelly Schaetz, DNR- Integrated Science Services  
Jed Ungrodt\*, Clark Forestry, Inc.

### Purple Group

Susan Borkin, Milwaukee Public Museum  
Kim Grveles\*, Adams County Land Conservation Department

David Hamel\*, Private Individual  
Shelly Hamel\*, Private Individual  
Rebecca Isenring, DNR- Central Wisconsin Land & Forestry Team Leader  
Ruth Johnson, DNR- Fisheries Management & Habitat Protection  
Steve Lenz\*, U S Fish & Wildlife Service  
Gretchen Miller, Twin Lakes Conservancy, Inc.  
Don O'Keene\*, Twin Lakes Conservancy, Inc.  
Jim Tomasko\*, DNR- Facilities & Lands  
Nicole Van Helden\*, The Nature Conservancy, Inc.

## **Red Group**

Christi Buffington, URS Corporation  
Tim Ehlinger\*, University of Wisconsin-Milwaukee  
Carrie Fhyte\*, Adams County Land Conservation Department  
Randy Hoffman\*, DNR- Endangered Resources  
Neil Johnson, Buffalo Lake District  
Pat Kaiser, DNR- Wildlife Management  
Frank Kirschling, DNR- Forestry  
Diane Kitchen\*, U S Fish & Wildlife Service  
James Motycha\*, Buffalo Lake District  
Dave Paynter\*, DNR- Fisheries Management & Habitat Protection  
Dennis Schroeder, Buffalo Lake District

## **Workshop Organization**

### **Workshop Facilitation/Organization**

Anne Forbes, Partners in Place  
Andy Galvin, DNR- Endangered Resources  
Drew Feldkirchner, DNR- Endangered Resources  
Fred Clark\*, Clark Forestry, Inc.

### **Team Facilitators**

Kate Barrett- Purple Group, DNR- Watershed Management  
Ellen Barth- Red Group, DNR- Upper Fox River Basin Land & Forestry Leader  
Jill Mrotek- Green Group, DNR- Facilities & Lands  
Rebecca Power- Yellow Group, UW-Extension/ Fox-Wolf Basin Educator  
Rob McLennan- Blue Group, DNR- Upper Fox River Basin Water Leader

### **Note Takers**

Craig Anderson, DNR- Endangered Resources  
Greg Moeller, DNR- Upper Fox River Basin  
Carl Mesman, DNR- Law Enforcement  
Janel Pike, DNR- Watershed Management

## Fox River Headwaters Ecosystem Workshop

# Methods for Site Identification and Reporting

The Sites and Contributor Records presented in the spreadsheets that follow, and on the working maps prepared for the workshop, represent the results of two different, complimentary methodologies for identifying ecologically significant sites. One method, the Coarse Filter screening approach, uses GIS analysis followed by analysis of aerial and satellite images for a “birds-eye” assessment of the entire Fox River Headwaters Ecosystem (FRHE) landscape. The other method is based entirely on observations made by individual contributors who know local sites at an on-the-ground level.

The individual records for the Coarse Filter sites, are represented on the spreadsheets by the prefix CFI (for Clark Forestry, Inc.) and shaded with a light gray screen. The records from individual contributors are represented by a prefix based on the initials of the contributors name and are not shaded.

All records, from the Coarse Filter analysis and Individual Contributors, were combined into Sites based on their ecological characteristics. The working maps show “boundaries” for each Site and the records within it. This resulted in a total of 83 Sites that contain all 192 individual Contributor records and 48 Coarse Filter records.

## Records from Coarse Filter Analysis

The Coarse Filter screening approach was modeled after a similar assessment used for the Wolf River Basin in 1999. The objective was to identify sites with high potential for occurrences of threatened, endangered, and special concern species or natural communities, or sites of otherwise high conservation value. The primary emphasis was identification of potential high-quality natural communities. A related goal of the project was to continue to develop a cost effective, easily replicated process to identify sites using GIS and aerial photography.

The Coarse Filter process involved a GIS analysis and follow-up analysis using aerial photography. In order to maintain the cost efficiency of the Coarse Filter approach, this analysis was not supported by extensive ground-surveys or field work, only limited “windshield surveys.” While these methods would provide an important landscape scale analysis of the area, we knew that the methods might miss many small (< 40 acre) areas and areas whose attributes might not be represented by the data and criteria used.

Using various GIS data layers, the staff at Clark Forestry, Inc. consolidated natural communities into general "site types" that could be identified on aerial photos based on their gross morphology, and wouldn't fall through a coarse-grained GIS filter. By assessing the list of NHI element occurrences for the study area (threatened, endangered, and special concern species or natural communities in the NHI database), looking at existing state natural areas, and consulting those personally familiar with the FRHE, CFI developed a set of 10 site types that capture all of the natural communities represented in the study area.

After executing GIS queries, evaluating aerial photography, and conducting windshield surveys, CFI identified **48 potential high-quality sites** covering almost 92,000 acres within the study area. The three lowland site types - open wetlands, forested wetlands, and stream corridors - were the most common and made up 80% of the total acreage. Kettle complexes were the most frequent type on upland sites.

## Records from Individual Contributors

The first step in gathering site information was to identify individuals who might have specialized knowledge of the FRHE study area. The workshop design team developed a list of known individuals and sent a letter to each to ascertain their interest and see if they knew of others that should be contacted. Of the total 157 individuals that were contacted, 30 expressed interest in participating and providing information. A Site Information Form and map of the study area were subsequently sent to these folks, requesting that they identify a site boundary and provide information on the ecological characteristics of that site. The result was that 37 individuals (including additional DNR staff that provided information at a later time) provided 192 Contributor Records throughout the study area. These are presented in the spreadsheets and maps as described above.

## The Teams for the Workshop

For the purposes of the workshop, the FRHE was divided into 5 teams based on general ecological characteristics of the Sites. These divisions were somewhat arbitrary, as indicated by the fact that the teams are named by color. The distribution of Sites and records by team is as follows:

<i>Team</i>	<i># of Sites</i>	<i># of Coarse Filter Records</i>	<i># of Contributor Records</i>
Green Team	15	8	58
Blue Team	16	14	40
Purple Team	14	10	43
Red Team	19	8	30
Yellow Team	19	8	21

**Notice:** Completion of this form is voluntary. Data collected will be used to support the Fox River Headwaters Ecosystem study. Personal information (your name) collected on this form is solely intended for use to contact you if DNR staff require additional information.

**Site ID #**     
Note: One form per site

**Site Name**

Your Name

**Site Information**

**Describe the Site:**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Significant Feature(s)** (check all that apply):

Natural Community(ies): \_\_\_\_\_

Plant(s): \_\_\_\_\_

Animal(s): \_\_\_\_\_

Geologic Feature(s): \_\_\_\_\_

Other: \_\_\_\_\_

**Describe possible threats or future changes:**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Describe the Surrounding Land Use:**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Site is Surrounded By:**

more than 75% agricultural or developed land

50-75% agricultural or developed land

less than 50% agricultural or developed land

**Ownership:**  Public  Private  
 Public/Private

**Proximity to Public Land:**

site is more than one mile from State ownership

site is within one mile of State ownership

site adjoins or is partly in State ownership

**Estimated Size (acres):** \_\_\_\_\_

**Estimated Accuracy of Site Boundary:**

¼ mile  1 mile  5 miles

**Information Format**

**Information on this site is recorded as:**

Maps  Database or Spreadsheet

Field Notes  Journal/Article

Other \_\_\_\_\_

**Will You Attend the Workshop on March 8, 2002?**

Yes  No

Please review the instructions on the back regarding how to fill out the Site Form. An example is also provided for your use. An electronic version of this form is available upon request. If you have any questions, please call Tom Nigus at 920-787-4686 ext. 3009.

**Please return Site Forms & map by November 26**

Additional information and comments about this site can be added to the back of the form.

# Site Form Instructions

Below are descriptions of each of the items on the Site Form. Please fill out the Site Forms as best you can – one form per site. We suggest that you focus on describing the site(s) that you have located on the enclosed map, the significant features of each, and the type of information you have. Please be as complete as you can.

**Site ID#:** Create this ID using your first, middle and last name initials and a site # in numerical order starting with 01 (i.e. Fred Joe Smith would put FJS-01, FJS-02, FJS-03, etc.).

Please be sure the site ID# is also on the map.

**Site Name:** Provide a name that will distinguish it from all other sites. Base the name on location first and the site's features second (i.e. Bear Creek Pines, Thornton Heron Rookery).

**Your Name:** Your name.

## Site Information

**Describe the Site:** Describe the site by natural features such as habitat, primary vegetation, wildlife features, lakes, streams and rivers, topography, etc.

**Significant Features:** What are the significant ecological resources at the site? Check all that apply and provide specific names of communities or species if you can.

**Threats and Changes:** Are you aware of any potential or planned changes at or near the site that may threaten its ecology (i.e. impending development, proposed projects, change in land use, etc.)?

**Surrounding Land Use:** Is the site surrounded by forests, farms, developed areas, or wetlands, etc.?

**Site Surrounded By:** What percentage of the site, especially the highest quality portion of the site, is surrounded by a natural, native or undisturbed landscape?

**Ownership:** Is the site publicly or privately owned, or both?

**Proximity to Public Land:** What is the proximity to publicly owned land (estimate distance in miles)?

**Estimated Size:** Estimate size of site in acres.

**Estimated Accuracy:** What is your level of confidence in the boundaries of the site that you drew on the map? Do you estimate that they are accurate within a ¼ mile, a 1 mile, or a 5 mile radius of the site?

## Information Format

**Information Format:** What kind of records do you have to document the information on this site? Check as many as apply.

Please note the information you provide will become public information. Provide a level of detail that you are comfortable with. If you are interested in providing data to the Natural Heritage Inventory database, DNR Natural Heritage Inventory staff will work with you to more precisely define your information.

If you have any questions on how to fill out the Site Form or to identify sites on the map, please call Tom Nigus at 920-787-4686, ext. 3009 for assistance.

Mail Site Form and map to Tom Nigus:

**Wisconsin Department of Natural Resources; 427 E. Tower Drive, Suite 100; Wautoma, WI 54982**

**Additional Comments about the Site:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# Fox River Headwaters Ecosystem - Scoring the Sites

# Sample Form

Attribute	Site 1	Site 2	Site 3																
Site is unfragmented and functionally intact																			
Site includes locally critical habitat for common plants or animals																			
Site includes uncommon or rare natural communities																			
Site includes uncommon or rare plants, animals, other features																			
Site has actual connectivity with other important sites																			
Site has potential connectivity with other important sites																			
Site has potential for natural community restoration																			

Rank the attributes for each Site on its own merits: H = high; M = medium; L = low; U = unknown

**Appendix F.**

**List of Significant Ecological Sites and Element Occurrences**

The following is a list of element occurrence records documented within the NHI database for each of the Significant Ecological Sites. The list was compiled on September 18, 2002. Some species and natural communities are particularly vulnerable to collection or disturbance. Thus, the occurrences of the species below were deleted from the sites where they occur.

**Animals**

- Calephelis mutica* (Swamp Metalmark)
- Chlidonias niger* (Black Tern)
- Oarisma powesheik* (Poweshiek Skipperling)
- Sistrurus catenatus* (Eastern Massasauga Rattlesnake)
- Sterna caspia* (Caspian Tern)
- Sterna forsteri* (Forster's Tern)
- Tyto alba* (Barn Owl)

**Plants**

- Cypripedium candidum* (Small White Lady's-slipper)
- Cypripedium parviflorum* (Small Yellow Lady's-slipper)
- Cypripedium reginae* (Showy Lady's-slipper)

**Other**

- Migratory Bird Concentration Site

SCIENTIFIC NAME (COMMON NAME)	STATE STATUS	FEDERAL STATUS	DATE
<b>Adams County National Waterfowl Protection Area</b>			
PLANTS			
SCLERIA TRIGLOMERATA (WHIP NUTRUSH)	SC		1941
COMMUNITIES			
LAKE--SHALLOW, SOFT, SEEPAGE	NA		1979
NORTHERN SEDGE MEADOW	NA		1979
<b>Bass Lake</b>			
ANIMALS			
CATINELLA EXILE (PLEISTOCENE CATINELLA)	SC/N		1997
EMYDOIDEA BLANDINGII (BLANDING'S TURTLE)	THR		2001
GRAMMIA PHYLLIRA (PHYLLIRA TIGER MOTH)	SC/N		1999
LYCAEIDES MELISSA SAMUELIS (KARNER BLUE BUTTERFLY)	SC/FL	LE	1991
MEROPLEON AMBIFUSCUM (NEWMAN'S BROCADE)	SC/N		1998
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		1977
STROBILOPS AFFINIS (EIGHTFOLD PINECONE)	SC/N		1997
VERTIGO ELATIOR (TAPERED VERTIGO)	SC/N		1997
VERTIGO MORSEI (SIX-WHORL VERTIGO)	SC/N		1997
PLANTS			
ASTER DUMOSUS VAR STRICTIOR (BUSHY ASTER)	SC		1963
DESCHAMPSIA CESPITOSA (TUFTED HAIRGRASS)	SC		1940
ELEOCHARIS COMPRESSA (FLAT-STEMMED SPIKE-RUSH)	SC		1995
ELEOCHARIS OLIVACEA (CAPITATE SPIKERUSH)	SC		1963
EQUISETUM VARIEGATUM (VARIEGATED HORSETAIL)	SC		2000
POLYGALA CRUCIATA (CROSSLEAF MILKWORT)	SC		1969
TOFIELDIA GLUTINOSA (STICKY FALSE-ASPHODEL)	THR		1979
TRIGLOCHIN PALUSTRIS (SLENDER BOG ARROW-GRASS)	SC		2000

SCIENTIFIC NAME (COMMON NAME)	STATE STATUS	FEDERAL STATUS	DATE
UTRICULARIA PURPUREA (PURPLE BLADDERWORT)	SC		1975
<b>COMMUNITIES</b>			
CALCAREOUS FEN	NA		2000
EMERGENT AQUATIC	NA		1979
FLOODPLAIN FOREST	NA		1983
LAKE--DEEP, HARD, SEEPAGE	NA		1983
SHRUB-CARR	NA		1983
SOUTHERN DRY FOREST	NA		1983
SOUTHERN SEDGE MEADOW	NA		1983
<b>Becker Waterfowl Protection Area</b>			
<b>ANIMALS</b>			
EMYDOIDEA BLANDINGII (BLANDING'S TURTLE)	THR		1979
NOTROPIS TEXANUS (WEED SHINER)	SC/N		1925
<b>Beechnut Road Barrens</b>			
<b>PLANTS</b>			
MALAXIS BRACHYPODA (WHITE ADDER'S-MOUTH)	SC		1918
<b>Berlin Fen &amp; Sedge Meadow</b>			
<b>ANIMALS</b>			
AECHMOPHORUS OCCIDENTALIS (WESTERN GREBE)	SC/M		1990
GALLINULA CHLOROPUS (COMMON MOORHEN)	SC/M		1990
IXOBRYCHUS EXILIS (LEAST BITTERN)	SC/M		1990
<b>PLANTS</b>			
GENTIANOPSIS PROCERA (LESSER FRINGED GENTIAN)	SC		1986
MUHLENBERGIA RICHARDSONIS (SOFT-LEAF MUHLY)	END		1989
SCLERIA VERTICILLATA (LOW NUTRUSH)	SC		1989
TOFIELDIA GLUTINOSA (STICKY FALSE-ASPHODEL)	THR		1986
TRIGLOCHIN MARITIMA (COMMON BOG ARROW-GRASS)	SC		1986
TRIGLOCHIN PALUSTRIS (SLENDER BOG ARROW-GRASS)	SC		1986
<b>COMMUNITIES</b>			
CALCAREOUS FEN	NA		1984
SOUTHERN SEDGE MEADOW	NA		1984
WET-MESIC PRAIRIE	NA		1978
<b>Bohn and Crooked Lakes</b>			
<b>PLANTS</b>			
CAREX SYCHNOCEPHALA (MANY-HEADED SEDGE)	SC		1977
STROPHOSTYLES LEIOSPERMA (SMALL-FLOWERED WOOLLY BEAN)	SC		1957
<b>COMMUNITIES</b>			
LAKE--DEEP, HARD, SEEPAGE	NA		1980
<b>Buffalo Lake Area</b>			
<b>ANIMALS</b>			
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		1980
OPHISAURUS ATTENUATUS (WESTERN SLENDER GLASS LIZARD)	END		1990
<b>PLANTS</b>			
EPILOBIUM STRICTUM (DOWNY WILLOW-HERB)	SC		1992
UTRICULARIA GEMINISCAPA (HIDDEN-FRUITED BLADDERWORT)	SC		1962
<b>COMMUNITIES</b>			
LAKE--DEEP, HARD, DRAINAGE	NA		1977
SOUTHERN SEDGE MEADOW	NA		1977
WET-MESIC PRAIRIE	NA		1977
<b>Caves / Tagatz Fisheries</b>			
<b>ANIMALS</b>			

SCIENTIFIC NAME (COMMON NAME)	STATE STATUS	FEDERAL STATUS	DATE
AESHNA MUTATA (SPATTERDOCK DARNER)	THR		1989
CHLOSZYNE GORGONE (GORGONE CHECKER SPOT)	SC/N		1985
EMYDOIDEA BLANDINGII (BLANDING'S TURTLE)	THR		2001
LESTES EURINUS (AMBER-WINGED SPREADWING)	SC/N		1989
LYCAEIDES MELISSA SAMUELIS (KARNER BLUE BUTTERFLY)	SC/FL	LE	2001
LYCAENA EPIXANTHE (BOG COPPER)	SC/N		2001
<b>PLANTS</b>			
ASCLEPIAS LANUGINOSA (WOOLY MILKWEED)	THR		1999
ASCLEPIAS OVALIFOLIA (DWARF MILKWEED)	THR		2001
POLYTAENIA NUTTALLII (PRAIRIE PARSLEY)	THR		1942
TALINUM RUGOSPERMUM (PRAIRIE FAME-FLOWER)	SC		2001
<b>COMMUNITIES</b>			
ALDER THICKET	NA		1978
CALCAREOUS FEN	NA		1978
SHRUB-CARR	NA		1978
SOUTHERN DRY-MESIC FOREST	NA		1978
SPRINGS AND SPRING RUNS, HARD	NA		1978
STREAM--FAST, HARD, COLD	NA		1978
<b>Corning - Weeting Lakes</b>			
<b>ANIMALS</b>			
BUTEO LINEATUS (RED-SHOULDERED HAWK)	THR		1983
QUADRULA METANEVRA (MONKEYFACE)	THR		UNK
THAMNOPHIS SAURITUS (NORTHERN RIBBON SNAKE)	END		1929
<b>COMMUNITIES</b>			
ALDER THICKET	NA		1979
NORTHERN WET FOREST	NA		1979
SHRUB-CARR	NA		1979
SOUTHERN SEDGE MEADOW	NA		1979
<b>Fluctuating Shoreline Lakes</b>			
<b>PLANTS</b>			
ELEOCHARIS ENGELMANNII (ENGELMANN SPIKE-RUSH)	SC		2001
PSILOCARYA SCIRPOIDES (LONG-BEAKED BALDRUSH)	THR		1988
<b>French Creek Wetland</b>			
<b>ANIMALS</b>			
NOTROPIS TEXANUS (WEED SHINER)	SC/N		1925
VIREO BELLII (BELL'S VIREO)	THR		1985
<b>PLANTS</b>			
OROBANCHE UNIFLORA (ONE-FLOWERED BROOMRAPE)	SC		1890
<b>COMMUNITIES</b>			
CALCAREOUS FEN	NA		1988
NORTHERN WET FOREST	NA		1977
SHRUB-CARR	NA		1977
SOUTHERN SEDGE MEADOW	NA		1984
<b>Fox River National Wildlife Refuge / Packwaukee</b>			
<b>ANIMALS</b>			
ACRIS CREPITANS BLANCHARDI (BLANCHARD'S CRICKET FROG)	END		1988
ETHEOSTOMA MICROPERCA (LEAST DARTER)	SC/N		1925
FUNDULUS DIAPHANUS (BANDED KILLIFISH)	SC/N		1929
OPHISAURUS ATTENUATUS (WESTERN SLENDER GLASS LIZARD)	END		1988
<b>PLANTS</b>			
GENTIANOPSIS PROCERA (LESSER FRINGED GENTIAN)	SC		1987

SCIENTIFIC NAME (COMMON NAME)	STATE STATUS	FEDERAL STATUS	DATE
OROBANCHE UNIFLORA (ONE-FLOWERED BROOMRAPE)	SC		1890
SCLERIA VERTICILLATA (LOW NUTRUSH)	SC		1974
TOFIELDIA GLUTINOSA (STICKY FALSE-ASPHODEL)	THR		1969
<b>COMMUNITIES</b>			
CALCAREOUS FEN	NA		1987
LAKE--DEEP, HARD, DRAINAGE	NA		1976
NORTHERN WET FOREST	NA		1985
SOUTHERN DRY-MESIC FOREST	NA		1985
SOUTHERN SEDGE MEADOW	NA		1987
WET-MESIC PRAIRIE	NA		1976
<b>Germania Wildlife Area</b>			
<b>ANIMALS</b>			
BUTEO LINEATUS (RED-SHOULDERED HAWK)	THR		1978
CICINDELA PATRUELA HUBERI (A TIGER BEETLE)	SC/N		1999
HEMILEUCA MAIA (BUCK MOTH)			1997
LYCAEIDES MELISSA SAMUELIS (KARNER BLUE BUTTERFLY)	SC/FL	LE	1995
MEROPLEON AMBIFUSCUM (NEWMAN'S BROCADE)	SC/N		1998
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		1977
POANES MASSASOIT (MULBERRY WING)	SC/N		1999
<b>PLANTS</b>			
JUNCUS MARGINATUS (GRASSLEAF RUSH)	SC		1958
POLYGALA CRUCIATA (CROSSLEAF MILKWORT)	SC		1990
RHEXIA VIRGINICA (VIRGINIA MEADOW-BEAUTY)	SC		1995
<b>COMMUNITIES</b>			
NORTHERN DRY-MESIC FOREST	NA		1978
NORTHERN SEDGE MEADOW	NA		1984
NORTHERN WET FOREST	NA		1976
SOUTHERN SEDGE MEADOW	NA		2001
SOUTHERN TAMARACK SWAMP (RICH)	NA		1984
<b>Germania Wildlife Area</b>			
<b>ANIMALS</b>			
HEMILEUCA MAIA (BUCK MOTH)			1997
MEROPLEON AMBIFUSCUM (NEWMAN'S BROCADE)	SC/N		1998
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		1977
POANES MASSASOIT (MULBERRY WING)	SC/N		1999
<b>PLANTS</b>			
POLYGALA CRUCIATA (CROSSLEAF MILKWORT)	SC		1990
<b>COMMUNITIES</b>			
NORTHERN DRY-MESIC FOREST	NA		1978
NORTHERN WET FOREST	NA		1976
SOUTHERN SEDGE MEADOW	NA		2001
<b>Grand River Wildlife Area</b>			
<b>ANIMALS</b>			
EMYDOIDEA BLANDINGII (BLANDING'S TURTLE)	THR		1981
ERIMYZON SUCETTA (LAKE CHUBSUCKER)	SC/N		1991
ETHEOSTOMA MICROPERCA (LEAST DARTER)	SC/N		1925
NOTROPIS TEXANUS (WEED SHINER)	SC/N		1925
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		1988
OPHISAURUS ATTENUATUS (WESTERN SLENDER GLASS LIZARD)	END		1979
PANDION HALIAETUS (OSPREY)	THR		1981
VIREO BELLII (BELL'S VIREO)	THR		1982

SCIENTIFIC NAME (COMMON NAME)	STATE STATUS	FEDERAL STATUS	DATE
<b>COMMUNITIES</b>			
CALCAREOUS FEN	NA		1978
EMERGENT AQUATIC	NA		1978
SOUTHERN DRY FOREST	NA		1968
SOUTHERN SEDGE MEADOW	NA		1978
WET PRAIRIE	NA		1986
WET-MESIC PRAIRIE	NA		1978
<b>Green Lake Center</b>			
ANIMALS			
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		UNK
<b>Greenwood Wildlife Area</b>			
ANIMALS			
LYCAEIDES MELISSA SAMUELIS (KARNER BLUE BUTTERFLY)	SC/FL	LE	1997
SOREX ARCTICUS (ARCTIC SHREW)	SC/N		1973
TYMPANUCHUS CUPIDO (GREATER PRAIRIE-CHICKEN)	THR		1979
PLANTS			
CALAMAGROSTIS STRICTA (SLIM-STEM SMALL-REEDGRASS)	SC		2001
DESCHAMPSIA CESPITOSA (TUFTED HAIRGRASS)	SC		1978
ELEOCHARIS OLIVACEA (CAPITATE SPIKERUSH)	SC		1962
STROPHOSTYLES LEIOSPERMA (SMALL-FLOWERED WOOLLY BEAN)	SC		1957
COMMUNITIES			
CALCAREOUS FEN	NA		1978
EMERGENT AQUATIC	NA		1978
LAKE--DEEP, HARD, SEEPAGE	NA		1978
SOUTHERN MESIC FOREST	NA		1978
SPRINGS AND SPRING RUNS, HARD	NA		1978
<b>Green Lake Station Sedge Meadow</b>			
ANIMALS			
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		UNK
<b>Grotzke Road Area</b>			
COMMUNITIES			
DRY PRAIRIE	NA		1979
NORTHERN DRY-MESIC FOREST	NA		1979
NORTHERN WET FOREST	NA		1979
OAK BARRENS	NA		1979
SOUTHERN DRY FOREST	NA		1979
SOUTHERN SEDGE MEADOW	NA		1979
<b>Harris Marsh</b>			
COMMUNITIES			
NORTHERN DRY-MESIC FOREST	NA		1979
NORTHERN SEDGE MEADOW	NA		1979
NORTHERN WET FOREST	NA		1979
SHRUB-CARR	NA		1979
SOUTHERN DRY FOREST	NA		1979
<b>Head of the Green Lake</b>			
PLANTS			
EPILOBIUM STRICTUM (DOWNY WILLOW-HERB)	SC		1975
<b>Jordan's Lake Wetland</b>			

SCIENTIFIC NAME (COMMON NAME)	STATE STATUS	FEDERAL STATUS	DATE
<b>COMMUNITIES</b>			
ALDER THICKET	NA		1978
LAKE--SHALLOW, HARD, SEEPAGE	NA		1978
NORTHERN SEDGE MEADOW	NA		1978
NORTHERN WET FOREST	NA		1978
<b>Klawitter Creek Fen</b>			
<b>COMMUNITIES</b>			
CALCAREOUS FEN	NA		1990
<b>Kolka Property</b>			
<b>ANIMALS</b>			
LYCAEIDES MELISSA SAMUELIS (KARNER BLUE BUTTERFLY)	SC/FL	LE	1993
<b>Koro Bog</b>			
<b>ANIMALS</b>			
AECHMOPHORUS OCCIDENTALIS (WESTERN GREBE)	SC/M		1990
GALLINULA CHLOROPUS (COMMON MOORHEN)	SC/M		1990
IXOBRYCHUS EXILIS (LEAST BITTERN)	SC/M		1990
<b>Lake Maria</b>			
<b>ANIMALS</b>			
PODICEPS GRISEGENA (RED-NECKED GREBE)	END		1996
<b>Lawrence Creek</b>			
<b>ANIMALS</b>			
EMYDOIDEA BLANDINGII (BLANDING'S TURTLE)	THR		1980
<b>PLANTS</b>			
CATABROSA AQUATICA (BROOK GRASS)	END		2001
DESCHAMPSIA CESPITOSA (TUFTED HAIRGRASS)	SC		2001
GENTIANOPSIS PROCERA (LESSER FRINGED GENTIAN)	SC		1962
JUNCUS MARGINATUS (GRASSLEAF RUSH)	SC		1929
SCLERIA TRIGLOMERATA (WHIP NUTRUSH)	SC		1941
SCLERIA VERTICILLATA (LOW NUTRUSH)	SC		1962
<b>COMMUNITIES</b>			
ALDER THICKET	NA		1979
CALCAREOUS FEN	NA		1979
EMERGENT AQUATIC	NA		1978
LAKE--SHALLOW, HARD, SEEPAGE	NA		1981
LAKE--SHALLOW, SOFT, SEEPAGE	NA		1979
NORTHERN SEDGE MEADOW	NA		1981
OAK WOODLAND	NA		1999
SHRUB-CARR	NA		1979
SOUTHERN DRY FOREST	NA		1979
SPRINGS AND SPRING RUNS, HARD	NA		1979
STREAM--FAST, HARD, COLD	NA		1984
<b>Lewiston Flatwoods</b>			
<b>COMMUNITIES</b>			
SOUTHERN SEDGE MEADOW	NA		1979
<b>Lime Kiln Bluff</b>			
<b>COMMUNITIES</b>			
DRY PRAIRIE	NA		1995
SOUTHERN DRY FOREST	NA		1978
<b>Lower Silver Creek</b>			
<b>ANIMALS</b>			
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		UNK

SCIENTIFIC NAME (COMMON NAME)	STATE STATUS	FEDERAL STATUS	DATE
<b>Lower White River</b>			
ANIMALS			
ALASMIDONTA MARGINATA (ELKTOE)	SC/H		1997
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		1977
OPHISAURUS ATTENUATUS (WESTERN SLENDER GLASS LIZARD)	END		1922
PLEUROBEMA SINTOXIA (ROUND PIGTOE)	SC/H		1997
PLANTS			
CALYLOPHUS SERRULATUS (YELLOW EVENING PRIMROSE)	SC		1915
DESCHAMPSIA CESPITOSA (TUFTED HAIRGRASS)	SC		1940
<b>Lunch Creek</b>			
ANIMALS			
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		1977
PLANTS			
DESCHAMPSIA CESPITOSA (TUFTED HAIRGRASS)	SC		1940
PLATANThERA FLAVA VAR HERBIOLA (PALE GREEN ORCHID)	THR		2000
<b>Mecan River Fisheries Area</b>			
ANIMALS			
AESHNA TUBERCULIFERA (BLACK-TIPPED DARNER)	SC/N		1986
HYGROTUS SYLVANUS (SYLVAN HYGROTUS DIVING BEETLE)	SC/N		1990
LYCAEIDES MELISSA SAMUELIS (KARNER BLUE BUTTERFLY)	SC/FL	LE	1997
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		1977
SOREX ARCTICUS (ARCTIC SHREW)	SC/N		1973
PLANTS			
CALAMAGROSTIS STRICTA (SLIM-STEM SMALL-REEDGRASS)	SC		2001
CARDAMINE PRATENSIS (CUCKOOFLOWER)	SC		1960
CLEMATIS OCCIDENTALIS (PURPLE CLEMATIS)	SC		1962
DESCHAMPSIA CESPITOSA (TUFTED HAIRGRASS)	SC		2001
COMMUNITIES			
ALDER THICKET	NA		1978
CALCAREOUS FEN	NA		1978
LAKE--DEEP, HARD, SEEPAGE	NA		1978
NORTHERN DRY FOREST	NA		1978
NORTHERN DRY-MESIC FOREST	NA		1978
NORTHERN WET FOREST	NA		1978
SPRING POND	NA		1978
SPRINGS AND SPRING RUNS, HARD	NA		1978
WET PRAIRIE	NA		1978
WET-MESIC PRAIRIE	NA		1978
<b>Mecan Springs</b>			
ANIMALS			
LYCAEIDES MELISSA SAMUELIS (KARNER BLUE BUTTERFLY)	SC/FL	LE	1993
SOREX ARCTICUS (ARCTIC SHREW)	SC/N		1973
TYMPANUCHUS CUPIDO (GREATER PRAIRIE-CHICKEN)	THR		1979
PLANTS			
CALAMAGROSTIS STRICTA (SLIM-STEM SMALL-REEDGRASS)	SC		2001
DESCHAMPSIA CESPITOSA (TUFTED HAIRGRASS)	SC		1978
ELEOCHARIS OLIVACEA (CAPITATE SPIKERUSH)	SC		1962
STROPHOSTYLES LEIOSPERMA (SMALL-FLOWERED WOOLLY BEAN)	SC		1957
COMMUNITIES			
CALCAREOUS FEN	NA		1978

SCIENTIFIC NAME (COMMON NAME)	STATE STATUS	FEDERAL STATUS	DATE
EMERGENT AQUATIC	NA		1978
LAKE--DEEP, HARD, SEEPAGE	NA		1978
SOUTHERN MESIC FOREST	NA		1978
SPRINGS AND SPRING RUNS, HARD	NA		1978
<b>Meilke Lake</b>			
PLANTS			
DESCHAMPSIA CESPITOSA (TUFTED HAIRGRASS)	SC		1940
POLYGALA CRUCIATA (CROSSLEAF MILKWORT)	SC		1969
COMMUNITIES			
CALCAREOUS FEN	NA		1979
EMERGENT AQUATIC	NA		1979
SOUTHERN SEDGE MEADOW	NA		1991
<b>Mitchell's Glen</b>			
ANIMALS			
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		UNK
COMMUNITIES			
MOIST CLIFF	NA		1976
SPRINGS AND SPRING RUNS, HARD	NA		1976
<b>Montello River</b>			
ANIMALS			
NOTROPIS TEXANUS (WEED SHINER)	SC/N		1925
PLANTS			
DIARRHENA OBOVATA (BEAK GRASS)	END		2001
COMMUNITIES			
FLOODPLAIN FOREST	NA		1995
NORTHERN DRY-MESIC FOREST	NA		1979
NORTHERN SEDGE MEADOW	NA		1979
NORTHERN WET FOREST	NA		1979
SHRUB-CARR	NA		1979
SOUTHERN DRY FOREST	NA		1979
<b>Moon Echo Lakes Area</b>			
ANIMALS			
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		1980
COMMUNITIES			
EMERGENT AQUATIC	NA		1977
LAKE--SHALLOW, HARD, SEEPAGE	NA		1977
<b>Mount Morris Cemetery</b>			
ANIMALS			
LYCAEIDES MELISSA SAMUELIS (KARNER BLUE BUTTERFLY)	SC/FL	LE	1993
PLANTS			
MALAXIS BRACHYPODA (WHITE ADDER'S-MOUTH)	SC		1918
COMMUNITIES			
DRY PRAIRIE	NA		1978
<b>Mud Lake</b>			
ANIMALS			
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		1980
PLANTS			
CAREX LIVIDA VAR RADICHAULIS (LIVID SEDGE)	SC		1979
COMMUNITIES			
LAKE--SHALLOW, HARD, DRAINAGE	NA		1979
NORTHERN SEDGE MEADOW	NA		1979
NORTHERN WET FOREST	NA		1979

SCIENTIFIC NAME (COMMON NAME)	STATE STATUS	FEDERAL STATUS	DATE
<b>Neenah Creek Valley</b>			
ANIMALS			
FUNDULUS DIAPHANUS (BANDED KILLIFISH)	SC/N		1925
NOTROPIS TEXANUS (WEED SHINER)	SC/N		1925
QUADRULA METANEVRA (MONKEYFACE)	THR		0
THAMNOPHIS SAURITUS (NORTHERN RIBBON SNAKE)	END		1929
PLANTS			
DESCHAMPSIA CESPITOSA (TUFTED HAIRGRASS)	SC		1934
OROBANCHE UNIFLORA (ONE-FLOWERED BROOMRAPE)	SC		1890
COMMUNITIES			
DRY PRAIRIE	NA		1979
MESIC PRAIRIE	NA		1978
NORTHERN DRY-MESIC FOREST	NA		1979
NORTHERN SEDGE MEADOW	NA		1979
NORTHERN WET FOREST	NA		1979
OAK BARRENS	NA		1979
SOUTHERN DRY FOREST	NA		1979
SOUTHERN SEDGE MEADOW	NA		1979
SPRING POND	NA		1979
SPRINGS AND SPRING RUNS, HARD	NA		1979
WET-MESIC PRAIRIE	NA		1978
<b>Norwegian Bay Wetlands</b>			
ANIMALS			
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		UNK
PLANTS			
TOFIELDIA GLUTINOSA (STICKY FALSE-ASPHODEL)	THR		1938
COMMUNITIES			
SHRUB-CARR	NA		1977
SOUTHERN SEDGE MEADOW	NA		1977
<b>Oxbo Wetlands</b>			
ANIMALS			
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		UNK
<b>Oxford Woods and Savanna</b>			
ANIMALS			
CICINDELA PATRUELA HUBERI (A TIGER BEETLE)	SC/N		1999
ISCHNURA HASTATA (CITRINE FORKTAIL)	SC/N		1989
LANIUS LUDOVICIANUS (LOGGERHEAD SHRIKE)	END		2001
PLANTS			
ELEOCHARIS OLIVACEA (CAPITATE SPIKERUSH)	SC		1962
SCLERIA TRIGLOMERATA (WHIP NUTRUSH)	SC		1941
COMMUNITIES			
EMERGENT AQUATIC	NA		1979
LAKE--SHALLOW, SOFT, SEEPAGE	NA		1979
NORTHERN DRY FOREST	NA		1979
NORTHERN SEDGE MEADOW	NA		1979
OAK WOODLAND	NA		1993
SOUTHERN DRY FOREST	NA		1979
SOUTHERN TAMARACK SWAMP (RICH)	NA		1987
<b>Princeton Sturgeon Site</b>			
ANIMALS			
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		UNK
<b>Puckaway Flatwoods</b>			

SCIENTIFIC NAME (COMMON NAME)	STATE STATUS	FEDERAL STATUS	DATE
<b>ANIMALS</b>			
CICINDELA PATRUELA HUBERI (A TIGER BEETLE)	SC/N		2000
OPHISAURUS ATTENUATUS (WESTERN SLENDER GLASS LIZARD)	END		1978
<b>PLANTS</b>			
RHEXIA VIRGINICA (VIRGINIA MEADOW-BEAUTY)	SC		1932
<b>Puckaway Lake</b>			
<b>ANIMALS</b>			
ERIMYZON SUCETTA (LAKE CHUBSUCKER)	SC/N		1991
<b>Rock Hill Outcrops</b>			
<b>COMMUNITIES</b>			
SOUTHERN DRY FOREST	NA		1975
<b>Silver and Mud Lakes</b>			
<b>ANIMALS</b>			
AESHNA MUTATA (SPATTERDOCK DARNER)	THR		1989
LESTES EURINUS (AMBER-WINGED SPREADWING)	SC/N		1989
LESTES INAEQUALIS (ELEGANT SPREADWING)	SC/N		1989
<b>PLANTS</b>			
ASTER DUMOSUS VAR STRICTIOR (BUSHY ASTER)	SC		1990
ELEOCHARIS ROBBINSII (ROBBINS SPIKERUSH)	SC		1990
FUIRENA PUMILA (DWARF UMBRELLA-SEDGE)	END		1992
PSILOCARYA SCIRPOIDES (LONG-BEAKED BALDRUSH)	THR		1998
RHEXIA VIRGINICA (VIRGINIA MEADOW-BEAUTY)	SC		1978
UTRICULARIA PURPUREA (PURPLE BLADDERWORT)	SC		1993
<b>COMMUNITIES</b>			
COASTAL PLAIN MARSH	NA		1977
EMERGENT AQUATIC	NA		1979
LAKE--SHALLOW, HARD, SEEPAGE	NA		1977
NORTHERN DRY-MESIC FOREST	NA		1978
NORTHERN SEDGE MEADOW	NA		1979
NORTHERN WET FOREST	NA		1979
OAK BARRENS	NA		1988
<b>Soo Line Prairie Remnant</b>			
<b>ANIMALS</b>			
QUADRULA METANEVRA (MONKEYFACE)	THR		UNK
<b>COMMUNITIES</b>			
SOUTHERN SEDGE MEADOW	NA		1979
<b>Soules Creek Area</b>			
<b>ANIMALS</b>			
LYCAEIDES MELISSA SAMUELIS (KARNER BLUE BUTTERFLY)	SC/FL	LE	1991
<b>PLANTS</b>			
MALAXIS BRACHYPODA (WHITE ADDER'S-MOUTH)	SC		1918
<b>Stueck's Pond</b>			
<b>ANIMALS</b>			
AESHNA MUTATA (SPATTERDOCK DARNER)	THR		1989
AESHNA TUBERCULIFERA (BLACK-TIPPED DARNER)	SC/N		1989
CRANGONYX RICHMONDENSIS (A SIDE-SWIMMER)	SC/N		1994
LESTES EURINUS (AMBER-WINGED SPREADWING)	SC/N		1989
LESTES VIGILAX (SWAMP SPREADWING)	SC/N		1989
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		1977
<b>PLANTS</b>			
ELEOCHARIS ROBBINSII (ROBBINS SPIKERUSH)	SC		1990

SCIENTIFIC NAME (COMMON NAME)	STATE STATUS	FEDERAL STATUS	DATE
PSILOCARYA SCIRPOIDES (LONG-BEAKED BALDRUSH)	THR		1998
RHEXIA VIRGINICA (VIRGINIA MEADOW-BEAUTY)	SC		1992
UTRICULARIA GEMINISCAPA (HIDDEN-FRUITED BLADDERWORT)	SC		1969
COMMUNITIES			
COASTAL PLAIN MARSH	NA		1977
NORTHERN WET FOREST	NA		1978
OPEN BOG	NA		1978
<b>Stone Hill Swamp</b>			
ANIMALS			
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		1977
PLANTS			
UTRICULARIA GEMINISCAPA (HIDDEN-FRUITED BLADDERWORT)	SC		1969
COMMUNITIES			
OAK OPENING	NA		1967
<b>Sucker Creek</b>			
PLANTS			
OPHIOGLOSSUM PUSILLUM (ADDER'S-TONGUE)	SC		1956
<b>Sugar Island Wetlands</b>			
ANIMALS			
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		UNK
<b>Summerton Bog North/South</b>			
PLANTS			
CARDAMINE PRATENSIS (CUCKOOFLOWER)	SC		1971
GENTIANOPSIS PROCERA (LESSER FRINGED GENTIAN)	SC		1986
POA PALUDIGENA (BOG BLUEGRASS)	THR		1987
COMMUNITIES			
CALCAREOUS FEN	NA		1988
SOUTHERN DRY FOREST	NA		1976
SOUTHERN SEDGE MEADOW	NA		1986
SOUTHERN TAMARACK SWAMP (RICH)	NA		1986
<b>Swamp Lake</b>			
ANIMALS			
ISCHNURA HASTATA (CITRINE FORKTAIL)	SC/N		1989
LANIUS LUDOVICIANUS (LOGGERHEAD SHRIKE)	END		2001
PLANTS			
ELEOCHARIS OLIVACEA (CAPITATE SPIKERUSH)	SC		1962
SCLERIA TRIGLOMERATA (WHIP NUTRUSH)	SC		1941
COMMUNITIES			
SOUTHERN TAMARACK SWAMP (RICH)	NA		1987
<b>Swan Lake Wildlife Area</b>			
ANIMALS			
AFLEXIA RUBRANURA (RED-TAILED PRAIRIE LEAFHOPPER)	END		1963
FUNDULUS DIAPHANUS (BANDED KILLIFISH)	SC/N		1969
PLANTS			
CALAMAGROSTIS STRICTA (SLIM-STEM SMALL-REEDGRASS)	SC		1927
DROSER A LINEARIS (SLENDERLEAF SUNDEW)	THR		1872
SCLERIA TRIGLOMERATA (WHIP NUTRUSH)	SC		1930
TOFIELDIA GLUTINOSA (STICKY FALSE-ASPHODEL)	THR		1964

SCIENTIFIC NAME (COMMON NAME)	STATE STATUS	FEDERAL STATUS	DATE
<b>Thompson Lakes Area</b>			
ANIMALS			
ACRIS CREPITANS BLANCHARDI (BLANCHARD'S CRICKET FROG)	END		1988
ETHEOSTOMA MICROPERCA (LEAST DARTER)	SC/N		1925
FUNDULUS DIAPHANUS (BANDED KILLIFISH)	SC/N		1929
OPHISAURUS ATTENUATUS (WESTERN SLENDER GLASS LIZARD)	END		1988
PLANTS			
ELEOCHARIS ENGELMANNII (ENGELMANN SPIKE-RUSH)	SC		1929
GENTIANOPSIS PROCERA (LESSER FRINGED GENTIAN)	SC		1987
LESPEDEZA VIRGINICA (SLENDER BUSH-CLOVER)	THR		1955
OPUNTIA FRAGILIS (BRITTLE PRICKLY-PEAR)	THR		1991
OROBANCHE UNIFLORA (ONE-FLOWERED BROOMRAPE)	SC		1890
SCLERIA VERTICILLATA (LOW NUTRUSH)	SC		1974
TOFIELDIA GLUTINOSA (STICKY FALSE-ASPHODEL)	THR		1969
COMMUNITIES			
CALCAREOUS FEN	NA		1987
CEDAR GLADE	NA		1971
EMERGENT AQUATIC	NA		1977
LAKE--DEEP, HARD, DRAINAGE	NA		1976
LAKE--SHALLOW, HARD, DRAINAGE	NA		1977
NORTHERN WET FOREST	NA		1985
SOUTHERN DRY FOREST	NA		1987
SOUTHERN DRY-MESIC FOREST	NA		1985
SOUTHERN SEDGE MEADOW	NA		1987
WET-MESIC PRAIRIE	NA		1976
<b>Upper Neenah Creek</b>			
ANIMALS			
CICINDELA PATRUELA HUBERI (A TIGER BEETLE)	SC/N		1999
NOTROPIS TEXANUS (WEED SHINER)	SC/N		1925
PLANTS			
ELEOCHARIS OLIVACEA (CAPITATE SPIKERUSH)	SC		1962
<b>White River - West Branch</b>			
ANIMALS			
SOREX ARCTICUS (ARCTIC SHREW)	SC/N		1973
PLANTS			
DESCHAMPSIA CESPITOSA (TUFTED HAIRGRASS)	SC		1940
COMMUNITIES			
CALCAREOUS FEN	NA		1979
EMERGENT AQUATIC	NA		1979
SOUTHERN SEDGE MEADOW	NA		1991
<b>White River Fisheries</b>			
ANIMALS			
EMYDOIDEA BLANDINGII (BLANDING'S TURTLE)	THR		1987
OPHISAURUS ATTENUATUS (WESTERN SLENDER GLASS LIZARD)	END		1991
SOREX ARCTICUS (ARCTIC SHREW)	SC/N		1973
PLANTS			
CALYLOPHUS SERRULATUS (YELLOW EVENING PRIMROSE)	SC		1915
DESCHAMPSIA CESPITOSA (TUFTED HAIRGRASS)	SC		1940
MALAXIS BRACHYPODA (WHITE ADDER'S-MOUTH)	SC		1918
POLYGALA CRUCIATA (CROSSLEAF MILKWORT)	SC		1969
TALINUM RUGOSPERMUM (PRAIRIE FAME-FLOWER)	SC		1991
COMMUNITIES			

SCIENTIFIC NAME (COMMON NAME)	STATE STATUS	FEDERAL STATUS	DATE
CALCAREOUS FEN	NA		1979
DRY PRAIRIE	NA		1979
EMERGENT AQUATIC	NA		1979
OAK BARRENS	NA		2000
SOUTHERN SEDGE MEADOW	NA		1991
<b>White River Marsh Area</b>			
ANIMALS			
ACIPENSER FULVESCENS (LAKE STURGEON)	SC/H		1991
AFLEXIA RUBRANURA (RED-TAILED PRAIRIE LEAFHOPPER)	END		1997
ALASMIDONTA MARGINATA (ELKTOE)	SC/H		1997
AMMODRAMUS HENSLOWII (HENSLOW'S SPARROW)	THR		1986
AMMODRAMUS SAVANNARUM (GRASSHOPPER SPARROW)	SC/M		1986
BUTEO LINEATUS (RED-SHOULDERED HAWK)	THR		1983
DENDROICA CERULEA (CERULEAN WARBLER)	THR		1988
EMPIDONAX VIRESCENS (ACADIAN FLYCATCHER)	THR		1988
EMYDOIDEA BLANDINGII (BLANDING'S TURTLE)	THR		2001
ERIMYZON SUCETTA (LAKE CHUBSUCKER)	SC/N		1959
EUPHYES BIMACULA (TWO-SPOTTED SKIPPER)	SC/N		1996
FALCO COLUMBARIUS (MERLIN)	SC/M		1915
LYCAEIDES MELISSA SAMUELIS (KARNER BLUE BUTTERFLY)	SC/FL	LE	1998
MACROCHILO BIVITTATA (AN OWLET MOTH)	SC/N		1996
MEROPLEON AMBIFUSCUM (NEWMAN'S BROCADE)	SC/N		1997
MOXOSTOMA VALENCIENNESI (GREATER REDHORSE)	THR		1988
NYCTICORAX NYCTICORAX (BLACK-CROWNED NIGHT-HERON)	SC/M		1977
OPHISAURUS ATTENUATUS (WESTERN SLENDER GLASS LIZARD)	END		1922
PAPAPEMA BEERIANA (LIATRIS BORER MOTH)	SC/N		1996
PLEUROBEMA SINTOXIA (ROUND PIGTOE)	SC/H		1997
POANES VIATOR (BROAD-WINGED SKIPPER)	SC/N		1997
TRITOGONIA VERRUCOSA (BUCKHORN)	THR		1997
TYMPANUCHUS CUPIDO (GREATER PRAIRIE-CHICKEN)	THR		1981
PLANTS			
ELEOCHARIS ROBBINSII (ROBBINS SPIKERUSH)	SC		1984
OPUNTIA FRAGILIS (BRITTLE PRICKLY-PEAR)	THR		1990
POLYTAENIA NUTTALLII (PRAIRIE PARSLEY)	THR		1986
SCIRPUS CESPITOSUS (TUFTED CLUB-RUSH)	THR		1986
SCLERIA VERTICILLATA (LOW NUTRUSH)	SC		1984
TALINUM RUGOSPERMUM (PRAIRIE FAME-FLOWER)	SC		2001
TOFIELDIA GLUTINOSA (STICKY FALSE-ASPODEL)	THR		1986
TRIGLOCHIN MARITIMA (COMMON BOG ARROW-GRASS)	SC		1960
TRIGLOCHIN PALUSTRIS (SLENDER BOG ARROW-GRASS)	SC		1986
COMMUNITIES			
BEDROCK GLADE	NA		1990
CALCAREOUS FEN	NA		1990
EMERGENT AQUATIC	NA		1981
FLOODPLAIN FOREST	NA		1979
MESIC PRAIRIE	NA		1979
NORTHERN DRY-MESIC FOREST	NA		1979
SHRUB-CARR	NA		1979
SOUTHERN DRY FOREST	NA		1981
SOUTHERN SEDGE MEADOW	NA		1988
SOUTHERN TAMARACK SWAMP (RICH)	NA		1979
WET PRAIRIE	NA		1973
WET-MESIC PRAIRIE	NA		1986

