



Rapid Ecological Assessment for the Sheboygan River Area of Concern (Sheboygan County)

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



Wisconsin's Natural Heritage Inventory Program
Bureau of Endangered Resources
Department of Natural Resources
P.O. Box 7921, Madison, WI 53707

March 2012

PUBL ER-838 2012

Acknowledgments

We extend our appreciation to Vic Pappas, WDNR Basin Supervisor - Sheboygan Team Leader; Debbie Beyer, UW-Extension Natural Resources Educator; Jon Gumtow, Sheboygan River Basin Partnership; Laurel Last, WDNR Water Resources Management Specialist; Betsy Galbraith, US Fish & Wildlife Service NRDA Coordinator; Dr. Gary Casper, Principal Biologist and Owner - Great Lakes Ecological Services; Tom Sear, Senior Project Engineer – Short Elliot Hendrickson, Inc; Donalea Dinsmore, WDNR Great Lakes Program Coordinator; Sean Strom, WDNR Wildlife Biologist for their support and assistance. Funding for this project was provided by a grant from the Great Lakes Restoration Initiative.

Primary Authors: Stacy Hron, Dale Katsma, John Masterson, Travis Motl, Rich Staffen, Matthew Steiger

Contributors:

- Jeff Baughman – birds
- Julie Bleser – data management
- Owen Boyle – bats, community ecology
- Cedarburg Science – invasive species surveys and mapping
- Jason Dare – herptiles, mussels
- Gary Casper -- herpetology
- Andy Clark – botany, community ecology
- Drew Feldkirchner – report contributions
- Steve Galarneau - mussels
- Kim Grveles – migratory birds
- Stacy Hron – invasives
- Terrell Hyde- zoology data processing
- Christina Isenring – community ecology, data processing, inventory coordination
- Ed Johnson - mussels
- Dale Katsma – wintering birds, kingfisher nest surveys, small mammals and mink surveys
- Lisie Kitchel – mussels
- Cynthia Malone – report editing
- John Masterson – fishes, aquatic macroinvertebrates and plants
- Dustin Miller – wintering birds, kingfisher nest surveys, small mammals and mink surveys
- Travis Motl – fishes
- Dave Redell – bats
- William A. Smith – zoology
- Elizabeth Slivinski – maps
- Rich Staffen – inventory coordination, zoology data processing
- Stantec Consulting Services, Inc. – landowner contact, GIS services, habitat restoration / water quality improvement inventory and report
- Matthew Steiger – invasives
- Roland Wang – report contributions
- Paul White – bats

Cover Photo: Canoeists on the Sheboygan River in fall. Photo by: Debbie Beyer - UWEX

Table of Contents

Introduction	6
Purpose and Objectives	6
Overview of Methods	6
Background on Past Efforts	10
Special Management Designations	11
Regional Ecological Context	12
Central Lake Michigan Coastal Ecological Landscape	12
Regional Biodiversity Needs and Opportunities	13
Rare Species of the Central Lake Michigan Coastal Ecological Landscape	14
Description of the Study Area	15
Location and Size	15
Ecoregion	16
Physical Environment	17
Vegetation	19
Rare Species and High Quality Natural Communities of Sheboygan and Sheboygan Falls Townships	27
Management Considerations and Opportunities for Biodiversity Conservation... ..	30
Migratory Birds	30
Breeding Birds	32
Lake Michigan Near Shore Mid-Winter Birds	34
Bat Conservation	36
Small Mammals and Mink Study	37
Aquatic Resources	38
Ecological Priorities for SGCN	41
Natural Community Management Opportunities	41
Invasive Plants	41
Conservation Sites: Site-specific Opportunities for Biodiversity Conservation	43
Future Needs	44
Glossary	45
Species List	47
Reference List	49
Additional Resources	53

List of Figures

Figure 1. Location of the Sheboygan River Area of Concern.....	9
Figure 2. Ecological Landscapes of Wisconsin and the Study Area.....	12
Figure 3. Survey Parcels of Interest in the Sheboygan River Area of Concern.....	15
Figure 4. Landtype Associations of the Study Area.....	16
Figure 5. Vegetation for the study area prior to Euro-American settlement.....	20
Figure 6. Landcover for the SRAOC from the Wisconsin DNR Wiscland GIS coverage (WDNR 1993).....	23
Figure 7. Priority Stopover Habitat for Landbirds within the SRAOC.....	31
Figure 8. Priority Stopover Habitat for Shorebirds within the SRAOC.....	32
Figure 9. Priority Stopover Habitat for Waterfowl within the SRAOC.....	36
Figure 10. Location of Conservation Sites identified within the SRAOC.....	43

List of Tables

Table 1. Major Natural Communities Management Opportunities in the Central Lake Michigan Coastal Ecological Landscape.....	13
Table 2. Listing Status for Rare Species in the Central Lake Michigan Coastal Ecological Landscape as of November 2011.....	14
Table 3. Summary of aquatic plant survey data for site SR 02 on the Sheboygan River.....	26
Table 4. Documented Rare Species and High-quality Natural Communities for the Sheboygan River Area of Concern.....	27
Table 5. Area of Importance - Area of Importance reflects the relative importance of Wisconsin to a species and its conservation, based on the abundance of the species in the state relative to other areas.....	30
Table 6. Most Commonly Encountered Birds during Winter Surveys of the SRAOC.....	34
Table 7. Comparison of Small Mammals Captured in 1993 and 2011-12.....	38
Table 8. Fish Community and Benthic Macroinvertebrate Index of Biotic Integrity and Stream Habitat Ratings for the Sheboygan River Area of Concern	40
Table 9. Populations of Targeted Invasive Species Identified and Mapped in SRAOC with their Abundance in the Project Area.....	42

Appendices

- A. Natural Heritage Inventory Methods Overview and Working List Explanation
- B. Map of Conservation Opportunity Areas for the Central Lake Michigan Coastal Ecological
Landscape
- C. Descriptions for Rare Species and High Quality Natural Communities
- D. Central Lake Michigan Coastal Ecological Landscape Species of Greatest Conservation Need
- E. Conservation Sites within the Sheboygan River Area of Concern

The Sheboygan River Area of Concern At a Glance

Exceptional Characteristics of the Study Area

- **Rare Animals and Plants.** The diverse habitats of the Sheboygan River Area of Concern (SRAOC) support numerous rare species. Thirty-four rare animal species are known from the SRAOC, including four State Threatened, and 30 Special Concern species. Ten rare plant species are known from the SRAOC, including two State Endangered, two State Threatened, and six Special Concern species.
- **Migratory Bird Stopover Habitat.** The location of the SRAOC makes this an important property for migratory birds. Continuing encroachment of urban development in the area and diminished quality of forests and wetlands because of invasive species threatens viability of this migratory bird stopover site. Restoration of the natural habitats remaining could greatly enhance this area for landbirds, shorebirds, and waterfowl.
- **Surrogate Grasslands.** The open landscape, away from the Sheboygan River, includes fallow fields, hayfields, lightly grazed pastures or old fields, cultivated fields, and golf courses. Several grassland bird Species of Greatest Conservation Need (SGCN), priority grassland species with declining populations, and species important because of the role WI plays in conserving these bird populations utilize these habitats, presenting an opportunity for management.
- **River Corridors.** Unique aquatic resources are present in the SRAOC and include seeps, Ephemeral Ponds, Floodplain Forest, and Warmwater River systems. Rare fish, bats, aquatic invertebrates, birds, and plants are known to utilize these habitats in some manner within the SRAOC.

Site Specific Opportunities for Biodiversity Conservation

Two ecologically important sites were identified on the SRAOC. These Conservation Sites were delineated because they generally encompass the best examples of 1) rare and representative natural communities, 2) documented occurrences of rare species and SGCN, and/or 3) opportunities for ecological restoration or connections. These sites warrant high restoration consideration during the development of the Fish and Wildlife Habitat Management and Restoration Plan.

- **Kohler Property.** This Conservation Site protects the largest block of remaining Northern Mesic Forest along the lower Sheboygan River. The presence of Ephemeral Ponds (found nowhere else in the SRAOC) and seepage areas within these forests adds to the biodiversity and significance of these stands. These forests support several rare species and Surrogate Grasslands at the site provide habitat for good numbers of grassland bird species of conservation concern. The site also includes a stretch of the river where intolerant fish were found along with rare mussels. Management activities at the site should focus on removal of invasive species found throughout the mesic forests.
- **Schuchardt Property.** This Conservation Site represents one of the only undeveloped tracts of any size within the SRAOC and protects moderate-quality wetland communities not found at any other location in the project area. These wetland communities, Emergent Marsh and Southern Sedge Meadow, are important natural community opportunities within the Central Lake Michigan Coastal Ecological Landscape (WDNR 2006b). The site has good restoration potential as migratory bird stopover habitat due to the existing emergent marsh / open water wetland and crop field. Willow Creek runs through the site and is the only coldwater tributary to the Sheboygan River within SRAOC project area. Controlling invasive species within the wetlands and on the forested slopes and restoring agricultural fields to wetlands and grassland habitat at the site are priorities.

Introduction

Purpose and Objectives

This report is intended to be used as a source of information for developing the Fish and Wildlife Habitat Management and Restoration Plan for the Sheboygan River Area of Concern (SRAOC; Figure 1). The regional ecological context for the SRAOC is also provided to assist in developing this plan. Properties included in this assessment from the SRAOC are public lands owned by:

- City of Sheboygan Falls
- Village of Kohler
- University of Wisconsin – Sheboygan
- Sheboygan County
- City of Sheboygan
- Redevelopment Authority

Private lands assessed within the SRAOC include:

- Kohler Property
- Schuchardt Property

The primary objectives of this project were to collect biological inventory information relevant to the development of a Fish and Wildlife Habitat Management and Restoration Plan for the SRAOC and to analyze, synthesize, and interpret this information for use by the Technical Advisory Committee (TAC) to identify potential restoration areas within the SRAOC. This effort focused on assessing areas of documented or potential habitat for rare species or species of conservation concern and identifying natural community management opportunities.

Survey efforts for the SRAOC were limited to a “rapid ecological assessment” for 1) identifying and evaluating ecologically important areas, 2) documenting rare species occurrences, and 3) documenting occurrences of high quality natural communities. There will undoubtedly, be gaps in our knowledge of the biota of this property, especially for certain taxa groups identified as representing either opportunities or needs for future work.

Overview of Methods

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

Natural Heritage programs track certain *elements* of biological diversity: rare plants, rare animals, high-quality examples of natural communities, and other selected natural features. The NHI Working List contains the elements tracked in Wisconsin; they include endangered, threatened, and special concern plants and animals, as well as the natural community types recognized by NHI. The NHI Working List is periodically updated to reflect new information about the rarity and distribution of the state’s plants, animals, and natural communities. The most recent Working List is available from the Wisconsin DNR Web site (*Wisconsin Natural Heritage Working List*).

The Wisconsin NHI program uses standard methods for biotic inventory and supporting property planning documents (Appendix A). Existing NHI data and other relevant background information is collected serving as the starting point for conducting a biotic inventory to support master planning. Prior to this project, data for the SRAOC were limited to:

- 1) Statewide Natural Area Inventory, a county-by-county effort conducted by WDNR's Bureaus of Research and Endangered Resources between 1969 and 1984 focusing on natural communities but included some surveys for rare plants and animals.
- 2) Research projects and WDNR reports aimed at inventory, identification, and bio-monitoring of vertebrate animals for their susceptibility to PCB contamination.
- 3) Additional taxa-specific surveys, water quality assessments, and sediment investigation research.

The most recent taxa-specific field surveys for the study area were conducted during 2011. Survey locations were identified using recent aerial photos, USGS 7.5' topographic maps, various Geographic Information System (GIS) sources, information from past survey efforts, discussions with project coordinators, and the expertise of several biologists familiar with the properties or with similar habitats in the region. Based on the location and ecological setting of the SRAOC, key inventory considerations included the identification of remaining high-quality forested areas, functioning wetlands, Surrogate Grasslands, migrant and wintering birds, representative fauna associated with Sheboygan River, and species determined to be good indicators of the health of the formerly contaminated river system. Both public and private lands, where access was granted, were surveyed.

Survey methodology varied for these surveys and was limited in extent. Rare plant and high-quality natural community surveys performed by NHI staff utilizing meandering surveys, aimed at documenting high-quality examples of natural communities while documenting all common, representative, and rare plants located. Additional plant and natural community surveys were contracted to consulting firms and focused on mapping natural communities at the Schuchardt Property, identifying restoration sites on public property, and identifying and mapping the extent of invasive species populations within the SRAOC.

Breeding bird surveys utilized the point count method to inventory all species heard or seen during the month of June while they are most vocal and considered resident breeders at a site. Belted kingfisher (*Cyrele alcyon*) nests were monitored using a video camera probe to check nests for eggs and visited bi-weekly until the nest was determined to have successfully fledged young or failed. Burrows were monitored for clutch size, hatching success, fledging success and for deformities in chicks. Wintering bird surveys expanded upon methods used for the Mid-Winter Waterfowl Surveys and performed every January in cooperation with the U.S. Fish & Wildlife Service Division of Migratory Bird Management. The methods for the surveys in the SRAOC included non-waterfowl and non-open water sites (when open water is not available) and occurred bi-weekly throughout the winter season.

Acoustical bat surveys were performed during the summer resident period and noted species richness and abundance for the project area. Small mammal surveys focused on re-sampling areas of the SRAOC previously surveyed in 1993, when all samples collected had detectable levels of PCB congeners.

Aquatic invertebrates and fish surveys of the SRAOC and tributaries within its project boundaries were completed to establish a baseline for community and habitat characteristics in these waters. Surveys included fish and benthic macroinvertebrate communities and stream habitat. Fish community surveys were executed following WDNR Fisheries Management electrofishing and netting survey protocols. Data

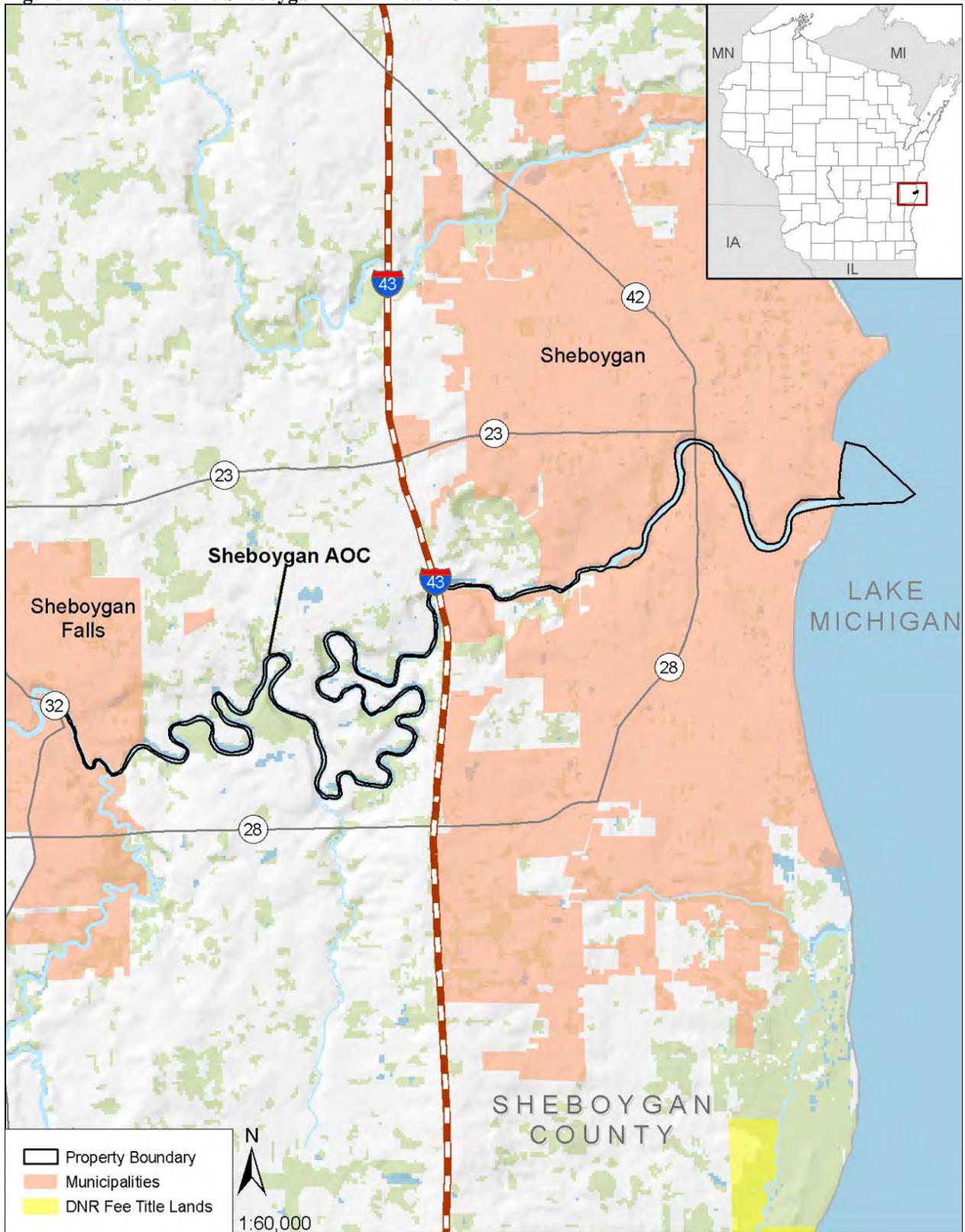
derived from these surveys provide valuable information on the physical, chemical, and biological condition of the streams.

Herptile surveys were focused in small part on inventory of the SRAOC for target rare reptiles and amphibians, but largely focused on assessing the existing habitat at several properties for the potential to support common or rare herptiles.

More detailed methodology of all of these projects is available in the Quality Assurance Project Plan prepared for the U.S. Environmental Protection Agency (Last 2011). The collective results from all of these surveys were used, along with other information, to identify ecologically important areas (Conservation Sites) within the SRAOC and inform the Fish and Wildlife Habitat Management and Restoration Plan.

Scientific names for all species mentioned in the text are included in a list on page 47.

Figure 1: Location of the Sheboygan River Area of Concern



Background on Past Efforts

Various research and planning efforts have taken place previously within the SRAOC. The following are examples of such projects and the significant findings that were identified.

The **Water Resources of the Sheboygan River Basin** (WDNR 2001a) a supplement to the **State of the Sheboygan River Basin Report** (WDNR 2001b) intended to provide a mechanism for identifying natural resource needs, priorities and recommendations for the Sheboygan River Basin. The reports highlighted the strategic priorities of the WDNR, their partners and the public for the conservation and management of important natural resources in the Sheboygan River basin for the next several years. The supplement **Water Resources of the Sheboygan River Basin** provided detailed water quality data to support the summary information and recommendations in the **State of the Sheboygan River Basin Report**.

A research paper on **High Residues in Birds from the Sheboygan River, Wisconsin** (Heinz et al. 1984) measured organochlorine residues in the carcasses and organs of four species of birds collected along the Sheboygan River downstream from Sheboygan Falls during a four-year period from 1976-1980. The analysis of specimens of four species of birds sampled contained PCB residues considered harmful to some species tested in a laboratory. The authors found high PCB levels in wildlife samples along the Sheboygan River and recommended future monitoring of these residues.

A **Bird, Mammal, and Herptile Survey and Report** (Hetzl 1995) was undertaken within the SRAOC in response to the PCB contamination of the lower Sheboygan River. The report serves as a baseline inventory of birds, mammals, and herptiles of the SRAOC and gives some information on the abundance and status of these species and the presumed breeding status of birds as noted. Bird surveys were done throughout the year to note wintering, migrant, and breeding birds. Bio-monitoring of herptiles was done to track bio-accumulation of riverine contaminants. Mark and recapture studies of turtles was done to provide information on density of these species.

A student internship report, **Small Mammal Populations along PCB Contaminated Sections of the Sheboygan River, Wisconsin** (Seeley 1993), was a bio-monitoring project developed to study the effects of PCB contamination on riparian wildlife. As part of the project, small mammals along polluted and non-polluted sections of the Sheboygan River were live trapped to determine species occurrence and abundance along with PCB contamination. Polluted sections within the SRAOC included shoreline areas near Kohler, WI. Information on PCB levels in terrestrial mammals were used to help clarify the effects of PCB's in the food chain and as part of the bio-monitoring project for cleanup efforts on the river.

The Breeding Bird Community of the Pigeon River Floodplain, Sheboygan County, Wisconsin (Hubert 1988) is a thesis studying breeding bird communities of two Sheboygan County river floodplains, along the Pigeon River and Sheboygan River. The two floodplain areas are in close proximity but have different land uses. The Pigeon River floodplain, just north of the city of Sheboygan, was used historically for agricultural purposes and is currently relatively undisturbed. In contrast, the Sheboygan River floodplain is highly developed, occurring through the center of the city of Sheboygan and includes the lower reaches of the SRAOC. Results indicated the Pigeon River floodplain (76 species) had a much higher diversity of bird species than the Sheboygan River (36 species), and similarly, the Pigeon River showed much higher indices for bird species richness than the Sheboygan River.

The **Sheboygan River Food Chain and Sediment Contaminant Assessment** (Burzynski 2000) tried to establish baseline contaminant concentrations associated with sediments, water column, and the biota within the SRAOC, to identify potential bioaccumulation factors. Each of the biotic components was carefully chosen to reflect food chain links to the contaminants available from the sediments and water column.

The **Land Legacy Report** (WDNR 2006a) was designed to identify Wisconsin's most important conservation and recreation needs for the next 50 years. The report identifies lands (Onion River Grasslands and Kohler – Andrae Dunes) and waters (Sheboygan County Trout Streams) nearby the SRAOC as important for grassland restoration and agricultural protection along with significant river marsh, pine and hardwood forests, an active and stabilized sand dune system, and significant recreational opportunities associated with trout streams.

The **Wisconsin Coastal Wetlands Assessment Report** (Epstein et. al 2002) assessed existing coastal wetland data to determine ecologically significant coastal wetland sites within the Lake Michigan and Lake Superior basins. The goals were to identify inventory gaps for guiding future inventory and planning efforts by the Bureau of Endangered Resources and others. The SRAOC fell within the Southern Lake Michigan Coastal Zone, but no primary sites were chosen from within the SRAOC. Kohler – Andrae State Park, approximately four miles south of the SRAOC, is the closest Primary Site chosen and protects the largest dune complex on Wisconsin's western shore of Lake Michigan providing habitat for many highly specialized plants and rare animals.

Special Management Designations

The lower Sheboygan River and Harbor were designated a **Great Lakes Area of Concern** (AOC) in 1987 by the International Joint Commission (IJC). This AOC encompasses the lower 14-mile section of river downstream from the Sheboygan Falls Dam including the entire harbor and near-shore area of Lake Michigan. In the Sheboygan River, high levels of nutrients, solids, and toxic chemicals along with land use changes are suspected to have contributed to the degradation of animal and plant populations and the reduction in fish and wildlife habitat and populations. Of the 14 possible impaired uses in the AOC, nine Beneficial Use Impairments (BUIs) have been identified for the Sheboygan River and Harbor AOC.

They include:

- restrictions on fish and wildlife consumption
- eutropication or undesirable algae
- fish tumors or other deformities
- bird or animal deformities or reproduction problems
- degradation of benthos
- degradation of phytoplankton and zooplankton populations
- restrictions on dredging activities
- degradation of fish and wildlife populations
- loss of fish and wildlife habitat

The SRAOC is considered one of the 43 most contaminated areas in the Great Lakes drainage basin. The worst areas of contamination in the Sheboygan River are designated as Superfund sites. There are two Superfund sites located within the river channel in the AOC. The Superfund Program is administered by US Environmental Protection Agency (EPA) and was established to address abandoned hazardous waste sites with the intent to protect human and environmental health. The first site is the Sheboygan River & Harbor site, which also encompasses the lower 14 miles of the river. The primary pollutants of concern for this site are PCBs. The second Superfund site is the former Camp Marina Manufactured Gas Plant, which is located in the lower portion of the river in the City of Sheboygan near Boat Island. The primary pollutants of concern for this site are polycyclic aromatic hydrocarbons (PAHs). The end goal is for all of the Great Lakes Areas of Concern to be restored and protected so that they can be “delisted,” or removed from the list of 43 Areas of Concern within the Great Lakes.

Regional Ecological Context

Central Lake Michigan Coastal Ecological Landscape

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

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

The SRAOC properties are located in the Central Lake Michigan Coastal Ecological Landscape (Figure 2; WDNR In Prep.). The Central Lake Michigan Coastal Ecological Landscape stretches from southern Door County west across Green Bay to the Wolf River drainage, then southward in a narrowing strip along the Lake Michigan shore to central Milwaukee County. Owing to the influence of Lake Michigan in the eastern part of this landscape, summers are cooler, winters are warmer, and precipitation levels are greater than at locations farther inland. Dolomites and shales underlie the glacial deposits that blanket virtually all of the Central Lake Michigan Coastal Ecological Landscape. The dolomite Niagara Escarpment is the major bedrock feature, running across the entire landscape from northeast to southwest. Series of dolomite cliffs provide critical habitat for rare terrestrial snails, bats, and specialized plants. The primary glacial landforms are ground moraine, outwash, and lakeplain. The topography is generally rolling where the surface is underlain by ground moraine, variable over areas of outwash, and nearly level where lacustrine deposits are present. Important soils include clays, loams, sands, and gravels.

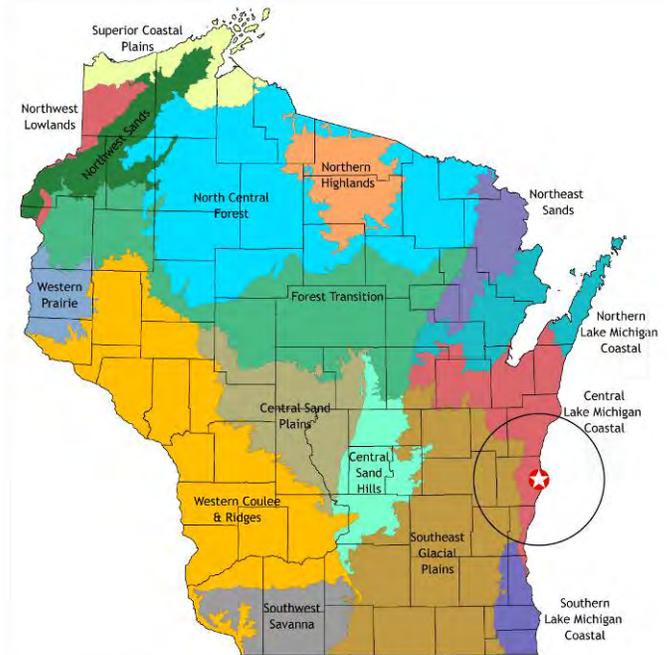


Figure 2: Ecological Landscapes of Wisconsin with the Study Area encircled.

Historically, most of this landscape was vegetated with mesic hardwood forest composed primarily of sugar maple (*Acer saccharum*), basswood (*Tilia americana*), and American beech (*Fagus grandifolia*). Eastern hemlock (*Tsuga canadensis*) and eastern white pine (*Pinus strobus*) were locally important, but hemlock was generally restricted to cool moist sites near Lake Michigan. Areas of poorly drained glacial lakeplain supported wet forests of tamarack (*Larix laricina*), northern white-cedar (*Thuja occidentalis*), black ash (*Fraxinus nigra*), red maple (*Acer rubrum*), and elm (*Ulmus* spp.), while the Wolf and Embarrass Rivers flowed through extensive floodplain forests of silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), and swamp white oak (*Quercus bicolor*). Emergent marshes and wet

meadows were common in and adjacent to lower Green Bay, while Lake Michigan shoreline areas featured beaches, dunes, interdunal wetlands, marshes, and highly diverse ridge and swale vegetation. Small patches of prairie and oak savanna were present in the southwestern portion of this landscape.

The biota is especially noteworthy for the rare regional endemic plants and animals associated with Lake Michigan shoreline habitats, and the highly specialized animals inhabiting the Niagara Escarpment. The coastal areas annually host significant concentrations of migratory birds, especially during the spring migration period. The waters of Lake Michigan and Green Bay, and the Wolf-Embarrass River corridors, provide seasonally critical habitat for numerous animals. Lakes are uncommon and most of them have been at least partially developed. Fragmentation of upland habitats is severe throughout this landscape. Most of the upland forest has been removed over the past 150 years as the land was converted to agricultural, residential, and industrial uses. Today, approximately 84% of this Ecological Landscape is non-forested. The remaining forest consists mainly of mesic maple-basswood or maple-beech types or lowland hardwoods composed of soft maples, ashes (*Fraxinus* spp.), and elms. Invasive species have become a major concern in both terrestrial and aquatic habitats. Reed canary grass (*Phalaris arundinacea*), common reed grass (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*), garlic mustard (*Alliaria petiolata*), Eurasian buckthorns (*Rhamnus* spp.) and honeysuckles (*Lonicera* spp.), and common carp (*Cyprinus carpio*) are especially troublesome. Significant wetlands are still present, but most have been affected to some degree by hydrologic disruption, pollution, sedimentation, and the encroachment of invasive species. Large acreages of marsh in Lower Green Bay have been filled to accommodate urban development.

Regional Biodiversity Needs and Opportunities

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

There are management opportunities for 35 natural communities in the Central Lake Michigan Coastal Ecological Landscape. Of these, seven are considered “major” opportunities (Table 1). A “major” opportunity indicates that the natural communities can be sustained in the Ecological Landscape, either because many significant occurrences of the natural community have been recorded in the landscape or major restoration activities are likely to be successful in maintaining the community’s composition, structure, and ecological function over a longer period of time. An additional 13 natural communities are considered “important” in this landscape. An “important” opportunity indicates that although the natural community does not occur extensively or commonly in the Ecological Landscape, one to several occurrences do occur and are important in sustaining the community in the state. In some cases, important opportunities exist because the natural community may be restricted to just one or a few Ecological Landscapes within the state and there may be a lack of opportunities elsewhere.

Table 1. Major Natural Communities Management Opportunities in the Central Lake Michigan Coastal Ecological Landscape (EMPT 2007 and WDNR 2006b)

Dry Cliff	Great Lakes Dune	Lake Michigan*	Warmwater Streams*
-----------	------------------	----------------	--------------------

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

Rare Species of the Central Lake Michigan Coastal Ecological Landscape

Numerous rare species are known from the Central Lake Michigan Coastal Ecological Landscape. “Rare” species include all of those species that appear on the WDNR’s NHI Working List (*Wisconsin Natural Heritage Working List*) classified as “Endangered,” “Threatened,” or “Special Concern.” Table 2 lists the number of species known to occur in the Central Lake Michigan Coastal Ecological Landscape based on information stored in the NHI database as of November 2011 (WDNR In Prep).

Table 2. Listing Status for rare species in the Central Lake Michigan Coastal Ecological Landscape as of November 2011 (WDNR In Prep.)

Listing Status	Mammals	Birds	Herptiles	Fishes	Invertebrates	Total Fauna	Total Flora	Total Rare
Federally Endangered	0	0	0	0	2	2	0	2
Federally Threatened	0	0	0	0	0	0	2	2
Federal Candidate	0	0	0	0	1	1	0	1
State Endangered	0	6	2	1	3	12	5	17
State Threatened	1	6	2	4	7	20	12	32
State Special Concern	0	13	1	6	50	70	19	89

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

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

There are 32 vertebrate SGCN significantly associated with the Central Lake Michigan Coastal Ecological Landscape (See Appendix D). This means that the species is (and/or historically was) significantly associated with the Ecological Landscape, and restoration of natural communities this species is associated with in the Ecological Landscape would significantly improve conditions for the species.

Description of the Study Area

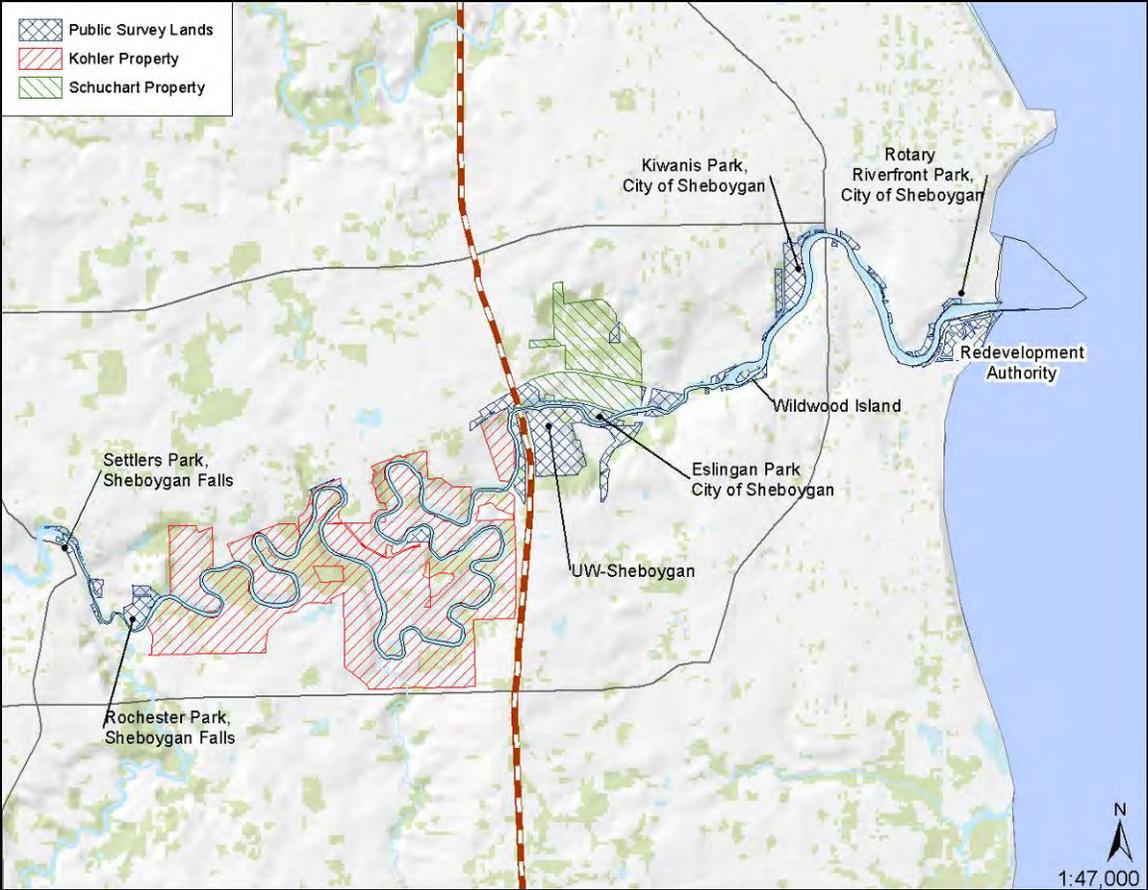
Location and Size

The SRAOC is a cluster of private and public parcels comprising approximately 1,670 acres and located along the Sheboygan River in Sheboygan County (Figure 3). The project area begins at the city of Sheboygan Falls and follows the Sheboygan River to the mouth at Lake Michigan within the city of Sheboygan. The area is highly urbanized, as the city of Sheboygan is both the county seat and largest city in Sheboygan County with Sheboygan metro area supporting a total population of 115,507 (US Census 2010). Interstate 43 runs approximately through the middle of the SRAOC and connects the area to Milwaukee about 50 miles to the south and Green Bay approximately 64 miles to the north.

Survey parcels of interest in the SRAOC included:

- **Kohler Property** (1,200 acres) is located on both sides of the Sheboygan River spanning much of the AOC from the city of Sheboygan Falls to the Interstate 43 Bridge.
- **Schuchardt Property** (178 acres) is located just north of the Sheboygan River, between Interstate 43 and Taylor Drive about 0.5 miles south of STH 23 in the city of Sheboygan.
- **Public Lands** (292 acres) to include the Sheboygan River, Wildwood Island, Kiwanis Park, Esslingen Park, along with UW-Sheboygan, Sheboygan County, Village of Kohler, and City of Sheboygan lands. These parcels are scattered throughout the AOC from the city of Sheboygan Falls to the mouth of the Sheboygan River in the city of Sheboygan.

Figure 3: Survey Parcels of Interest in the SRAOC

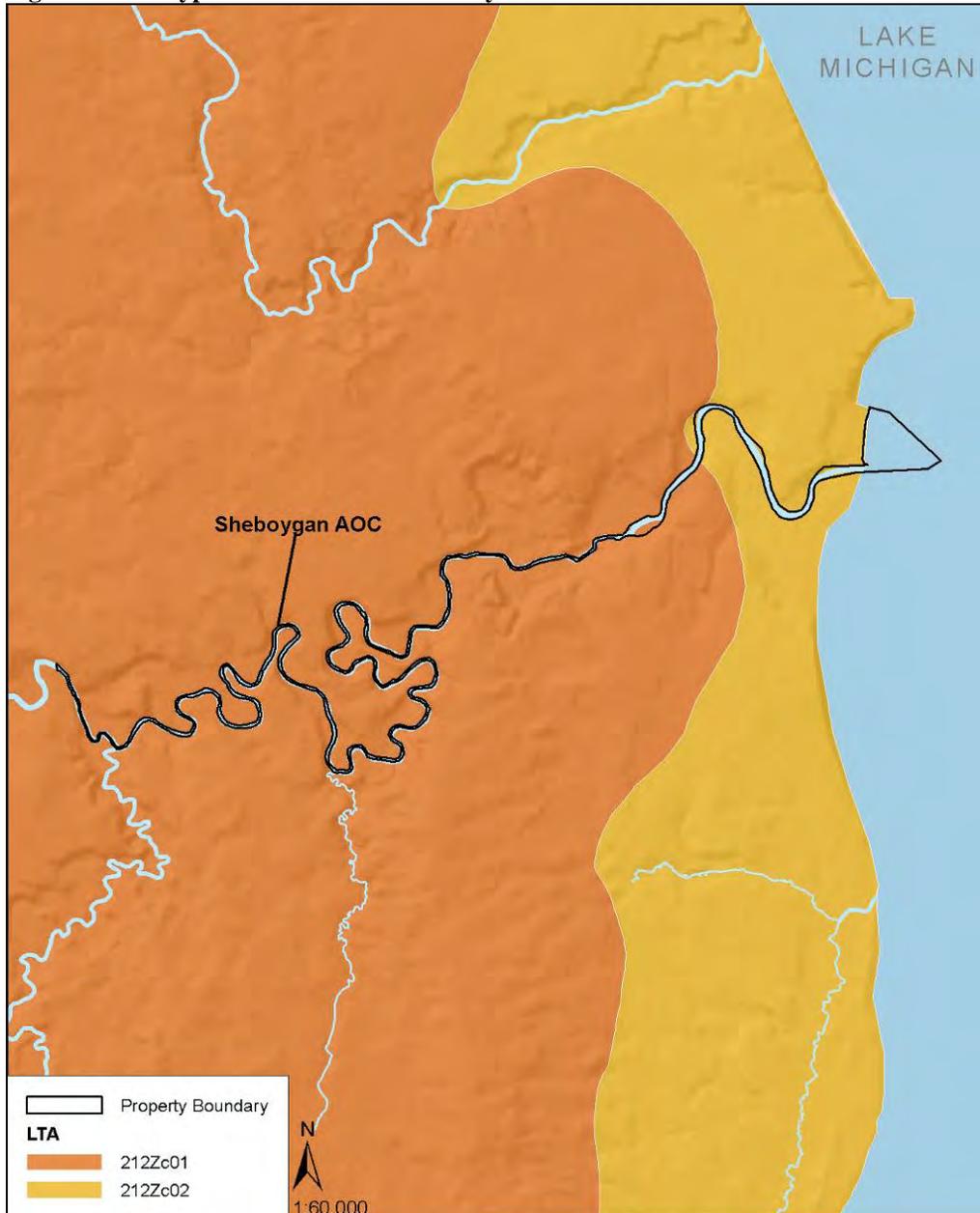


Ecoregion

From the National Hierarchical Framework of Ecological Units (NHFEU), the unit relevant to this study is the Manitowoc Till Plain Subsection and two Landtype Associations (LTA; Figure 4). Landtype Associations represent an area of 10,000 – 300,000 acres and contain similarities of landform, soil, and vegetation. The following Landtype Associations are within the study area:

- Sheboygan Moraines LTA (212Zc01). The characteristic landform pattern is undulating moraine with deep valleys and escarpments. Soils are predominantly well-drained silty clay loam over calcareous clay till.
- Manitowoc Plains LTA (212Zc02). The characteristic landform pattern is nearly level lake plain with dunes and old beaches common. Soils are predominantly well-drained loam over calcareous clayey, silty, and sandy lacustrine.

Figure 4: Landtype Associations of the Study Area



Physical Environment

Geology and Geography

The Central Lake Michigan Coastal Ecological Landscape is underlain by a variety of sedimentary and igneous rocks of Devonian, Silurian, Ordovician, Cambrian, and Proterozoic origin (WDNR In Prep.). Bedrock beneath most of the Ecological Landscape, and the entire Sheboygan River AOC, is Silurian dolomite of the Niagara Escarpment. It underlies all the counties along Lake Michigan, extending as far west as Lake Winnebago. It is the most resistant of the Paleozoic rocks in Wisconsin and often appears as ridges or cliffs where surrounding bedrock has been eroded (Schultz 2004). The depth to bedrock is between 50-100 feet below the surface.

Soils

(From the Ecological Landscapes of Wisconsin Handbook [WDNR In Prep.]

Most upland soils in the Central Lake Michigan Coastal Ecological Landscape were formed in reddish-brown calcareous loamy till or lacustrine deposits on moraines, till plains, and lake plains. The dominant soil is moderately well drained and loamy or clayey with a silt loam surface. Drainage classes range from well drained to somewhat poorly drained. Soils generally have moderate to very slow permeability, and moderate to very high available water capacity. Soils that are shallow to limestone or dolomite bedrock occur here. A few areas have soils formed in acid wind-blown sand, or outwash sand. Soils along the Lake Michigan shoreline are formed in calcareous clayey, silty, and sandy lacustrine deposits, acid to calcareous wave-deposited beach sand, and wind-blown sediments. Most lowland soils are very poorly drained non-acid muck, while some are in poorly drained outwash, till, and lacustrine materials. The major river valleys have soils formed in sandy, loamy, or silty alluvium; some areas are subject to periodic flooding.

Soils in the **Manitowoc Till Plain (Subsection 212Zc)** within the SRAOC have undulating moraines with deep valleys and escarpments upstream from the city of Sheboygan with somewhat poorly drained clayey soils with a silty clay loam surface over calcareous clay till. The nearly level lake plain area of the SRAOC near Lake Michigan has well drained loam soils over calcareous clayey, silty, and sandy lacustrine.

Hydrology

The Sheboygan River and its tributary network form the major drainage system in Sheboygan County (Weber et. al 1968). The Sheboygan River originates in east-central Fond Du Lac County and flows eastward into Sheboygan County, ultimately entering Lake Michigan in the city of Sheboygan. Three named tributaries of the Sheboygan River within the SRAOC are the Onion River, Weedens Creek, and Willow Creek, and there are two unnamed tributaries within the project area. There are no named lakes within the SRAOC and only two small unnamed lakes, both located on the Kohler Property. There are six dams on the Sheboygan River within Sheboygan County: Sheboygan Marsh Dam, Franklin Dam, Johnsonville Dam, Sheboygan Falls Dam, Waelderhaus Dam, and Kohler Dam. The Sheboygan Falls Dam is the starting point for the SRAOC, the lower Kohler and Waelderhaus Dams occur within the SRAOC.

The watershed of the lower Sheboygan River is a mixture of urban and rural land use. Many different pollution sources impair the Sheboygan River's biological and water quality integrity throughout the entire stretch of river. Cropland erosion, construction site runoff, in-place pollutants, and nonpoint source runoff limit water quality. The limiting factors for this reach are toxic contamination from

polychlorinated biphenyls (PCBs), heavy metals, PAHs, excessive sedimentation, bacterial pollutants, urban storm water runoff, hydrologic modification (impoundments and tributary stream channelization), stream bank erosion, stream bank pasturing, cropland erosion and construction site erosion (WDNR 2001). This causes high stream turbidities, sedimentation, flow fluctuations, nutrient enrichment, dissolved oxygen fluctuations, loss of habitat, toxicity, PCB bioaccumulation (fish advisories in downstream sections) and fish migration interference (WDNR 2001). High concentrations of PAHs were discovered in the sediment near an old coal gasification site upstream of Camp Marina in the city of Sheboygan (WDNR 2001).

The lower stretch of the Sheboygan River downstream of the Sheboygan Falls Dam extending to the mouth of the Sheboygan River, makes up the AOC project boundary. The lower river and harbor are subject to standing wave effects from Lake Michigan. Within this stretch of the river there are markedly different sections of stream habitat. In general, the downstream sections are wider and slow-flowing with soft substrate consisting of smaller material, such as silt, sand, and gravel. In upstream areas, the river narrows, becomes shallow and relatively fast-flowing with substrate consisting more of coarse material, such as larger gravel, cobble, and boulders. This is typical of most streams and larger rivers. This stream reach is classified as a warmwater sport fish community. The fishery consists of smallmouth bass, largemouth bass, walleye, channel catfish, and assorted panfish. Smallmouth bass dominate the sport fishery in this segment. Tolerant forage species include black bullhead, blacknose dace, common carp, central mudminnow, green sunfish, and white sucker. This segment also exhibits seasonal runs of salmon and trout. In response to concerns about PCB contamination of the fish, annual consumption advisories exist for this segment of river. The U.S. Army Corps of Engineers ceased its previously routine dredging of the Sheboygan River channel in 1973 and of the harbor mouth in 1991 to avoid disturbing and spreading contaminated sediment. The restrictions on dredging have resulted in limitations on use of these waters by private marinas and recreational boaters as well as commercial shipping.

The Onion River is the largest of the three tributaries surveyed within the SRAOC flowing north before emptying into the Sheboygan River at Sheboygan Falls. The Onion River is a warmwater stream with portions upriver fed by spring waters leading to a segment being classified as trout water supporting a healthy, naturally reproducing brown trout community. The downstream portion of the river runs through large acreages of farmland, where heavy pasturing is contributing to erosion of the stream banks and increased siltation of the stream (Weber et. al 1968). Water clarity is typically turbid during the growing season, because of runoff from farm fields and bioturbation from carp feeding on the stream bottom. The lower Onion River supports a mainly tolerant warmwater fishery with common carp, black bullhead, blacknose dace, creek chub, white sucker, and green sunfish present. Gamefish include northern pike and smallmouth bass. Overall the Onion River's water quality is fair to poor in the lower reach below Waldo Dam and good to excellent in the river's upstream reaches (above Waldo).

Weedens Creek is a small intermittent stream flowing north into the Sheboygan River approximately one mile downstream from the Kohler Dam. Its official classification is that of cool-warm transition headwater. The stream bed is characterized by gravel and rubble, and steep banks prevail along the northern portion (Weber et. al 1968). The watershed is mostly rural land use with small amounts of commercial and industrial areas. Downstream sections of Weedens Creek flow through Kohler properties including the Blackwolf Run golf course, River Wildlife and Kohler Stables. Through these properties, significant portions of the stream remains naturalized. Upstream sections of the stream flow through agricultural land use where stream channelization is more common, which can impact stream habitat and the biological integrity. Considerable pasturing in the watershed is causing erosion of banks, increased water fertility, and siltation (Weber et. al 1968). The stream had a reputation for a spring northern pike spawning run in the past (Weber et. al 1968). The fish community of Weedens Creek is generally characterized by tolerant warmwater species.

Willow Creek is the only coldwater tributary to the Sheboygan River within SRAOC project boundaries. Willow Creek is located within the boundaries of the City and Township of Sheboygan, Village of Kohler and headwater areas within the Township of Sheboygan Falls. The stream is approximately 5.12 miles in length with a drainage basin of 4.22 square miles. Soil types in the watershed are glacial in origin and primarily consist of clays and hydric soils. Land use in the watershed is approximately 41% agricultural, 17% transportation, 16% open space, 15% residential, and 11% industrial/commercial. Urbanization increases in the lower portion of the watershed. Portions of the headwaters of Willow Creek have been impacted by past development. This includes filling of wetlands, straightening of the stream channel for flood control, storm sewer discharges, thermal impacts, nutrient and sediment loading from nonpoint source runoff, and diversion of groundwater discharge to the stream.

Poor water quality and excess stream flows are factors that can influence the type of fish community found in a stream. In this basin, past land use practices have degraded the water quality and biological integrity of Willow Creek. Future development in the watershed may further impact the stream. However, sufficient evidence based on monitoring shows sections of Willow Creek meet the criteria for classification as a Class II trout stream (Masterson 2006 and 2008). Therefore, the lower 1.6 miles of Willow Creek and its tributaries were reclassified as a Class II trout stream in 2008 to protect the biological integrity of this unique stream. This section of the stream includes the areas immediately downstream of Interstate 43 to the confluence with the Sheboygan River.

Vegetation

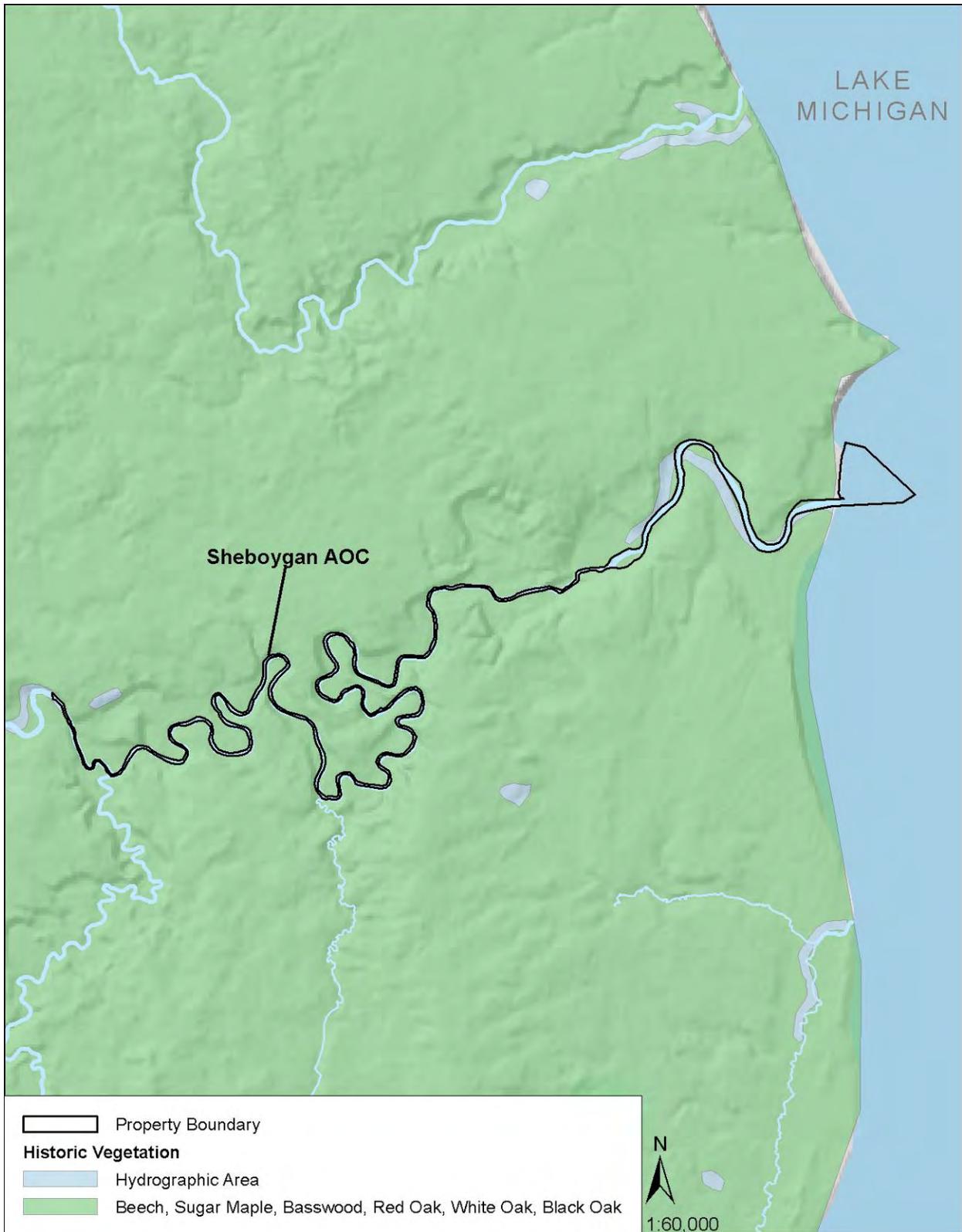
Historic Vegetation

Data from Wisconsin's original Public Land Surveys are often used to infer vegetation cover types prior to Euro-American Settlement. Public Land Surveys for the SRAOC were completed between 1832 and 1835. Finley's (1976) Pre-settlement Vegetation map (Figure 5) identifies the study areas as being dominated by mesic forests of American beech, sugar maple, basswood, northern red oak (*Quercus rubra*), white oak (*Quercus alba*), and black oak (*Quercus velutina*). Land conversion, hydrological changes, invasive species, and forest fragmentation have all had dramatic effects on the plant communities and wildlife throughout the study area. Little forested acreage remains, with the formerly vast mesic forests in this Ecological Landscape now uncommon. Despite the lack of public land in this Ecological Landscape, there are potentially many suitable locations to emphasize reforestation through private lands management programs (WDNR In Prep.).

The Forest Landscape Ecology Lab at the University of Wisconsin-Madison recently compiled spatial data on Wisconsin's Land Cover in the mid-1800's using information from the original Public Land Survey to reconstruct pre-settlement Wisconsin vegetation (Schulte and Mladenhoff 2001). They have identified tree species composition based upon witness tree data used by the early surveyors and pre-settlement tree density estimates. Schulte and Mladenhoff's data show that the SRAOC was composed largely of American beech, elm, basswood, and sugar maple, but with some areas of eastern white pine present near Sheboygan Falls, corresponding well with what is currently the Kohler Property. Tree density estimates identify the SRAOC as almost entirely forested prior to European settlement with a small area of savanna structure along what is today the I-43 corridor.

Wisconsin's Historic Aerial Image Finder from the State Cartographer's Office enables viewing of black and white aerial photos from between 1937 – 1941. These historic aerial photos show the SRAOC as an open landscape with scattered patches of trees or forest along the Sheboygan River similar to current conditions. The surrounding landscape of the SRAOC was at this time, less developed with more land in agricultural production.

Figure 5: Vegetation for the study area prior to Euro-American settlement. Data are from Finley (1976).



Current Vegetation

The public and private properties of the SRAOC are located immediately within a high density urban area, with the surrounding landscape predominately in agricultural production (Figure 6). Kohler – Andrae State Park is within approximately three miles of the SRAOC and hosts the best example of intact, representative native plant communities remaining in this portion of the county, including examples of those types found at the SRAOC. The natural communities found at Kohler – Andrae State Park are high-quality examples of Northern Dry-mesic Forest, Northern Mesic Forest, Floodplain Forest, Emergent Marsh, Alder Thicket, and the numerous associated rare plant and animal species. These examples could serve as reference areas for vegetation structure and composition for restoration efforts of similar, lower-quality areas found within the SRAOC.

Natural community / rare plant / invasive plant surveys were performed in the SRAOC at select areas within the riparian corridor. The primary purpose of these surveys was to discover rare plant species and identify and document representative natural communities for the SRAOC. Survey locations were chosen to locate characteristic habitats, maximize the chance of discovering any rare species, and inventory suspected high-quality natural communities. Data collected in this fashion will be representative of current plants and natural communities present at the selected sites within the SRAOC. At each site, the surveyor identified and described native natural communities and documented rare and invasive plants found, taking notes on condition and quality of the site, context of the landscape, and size of the habitat patch.

The inventory data collected will allow biologists and planners to understand the distribution of rare and characteristic species within the SRAOC, and provide information for selecting the most appropriate sites for conserving rare habitats and associated taxa. These data will also contribute to the overall knowledge of certain rare species, identify threats to these populations, and provide suggestions for natural community restoration potential.

According to natural community surveys conducted in 2011, the current vegetation of the properties is comprised of wetlands and aquatic communities including Warmwater River, Emergent Marsh, Southern Sedge Meadow, and Ephemeral Pond. Forest types noted are Northern Mesic Forest, Southern Dry Forest, Southern Dry-mesic Forest and Floodplain Forest. Surrogate Grasslands are present in moderate acreages throughout the SRAOC. Each natural community is described below in detail providing information on property, extent, quality, composition, and structure.

Ephemeral Pond

There are several examples of Ephemeral Ponds scattered throughout mesic forests of the SRAOC, adding greatly to the biological diversity of the property. Good examples were found at the **Kohler Property** with high amounts of coarse woody debris present. Other “potential Ephemeral Ponds” were also identified for southeast Wisconsin through GIS analysis as part of the Wisconsin Ephemeral Pond Project (WEPP). No other locations or potential Ephemeral Ponds are currently known outside of the Kohler Property.

Ephemeral Ponds are depressions with impeded drainage, holding water for a period of time following snowmelt and typically drying out by mid-summer. They provide critical habitat for aquatic invertebrates such as fairy shrimp (*Eubranchipus* spp.) and for amphibians such as wood frogs (*Rana sylvatica*) and several species of salamanders. Little vegetation data was collected from within the ponds, but common aquatic plants of these habitats include yellow water crowfoot (*Ranunculus flabellaris*), common mermaid weed (*Proserpinaca palustris*), Canadian blue-joint grass (*Calamagrostis canadensis*), floating manna grass (*Glyceria septentrionalis*), spotted water-hemlock (*Cicuta maculate*), smartweeds (*Polygonum* spp.), orange jewelweed (*Impatiens capensis*), and sedges (*Carex* spp.). Stand data from areas surrounding the ponds should be considered, as closed canopy forests with good amounts of

downed woody debris are important structural components for making these attractive as amphibian breeding and foraging areas.

Threats to Ephemeral Ponds include impacts to hydrology by limiting road, ditch, or dike construction and controlling non-native invasive species like reed canary grass. The timing of management activities around Ephemeral Ponds can be critical. By recognizing Ephemeral Pond communities and their associated species distributions throughout forested areas, proactive steps can be taken in the development of forest management plans that will help amphibians and invertebrates without hindering other management activities.

Emergent Marsh

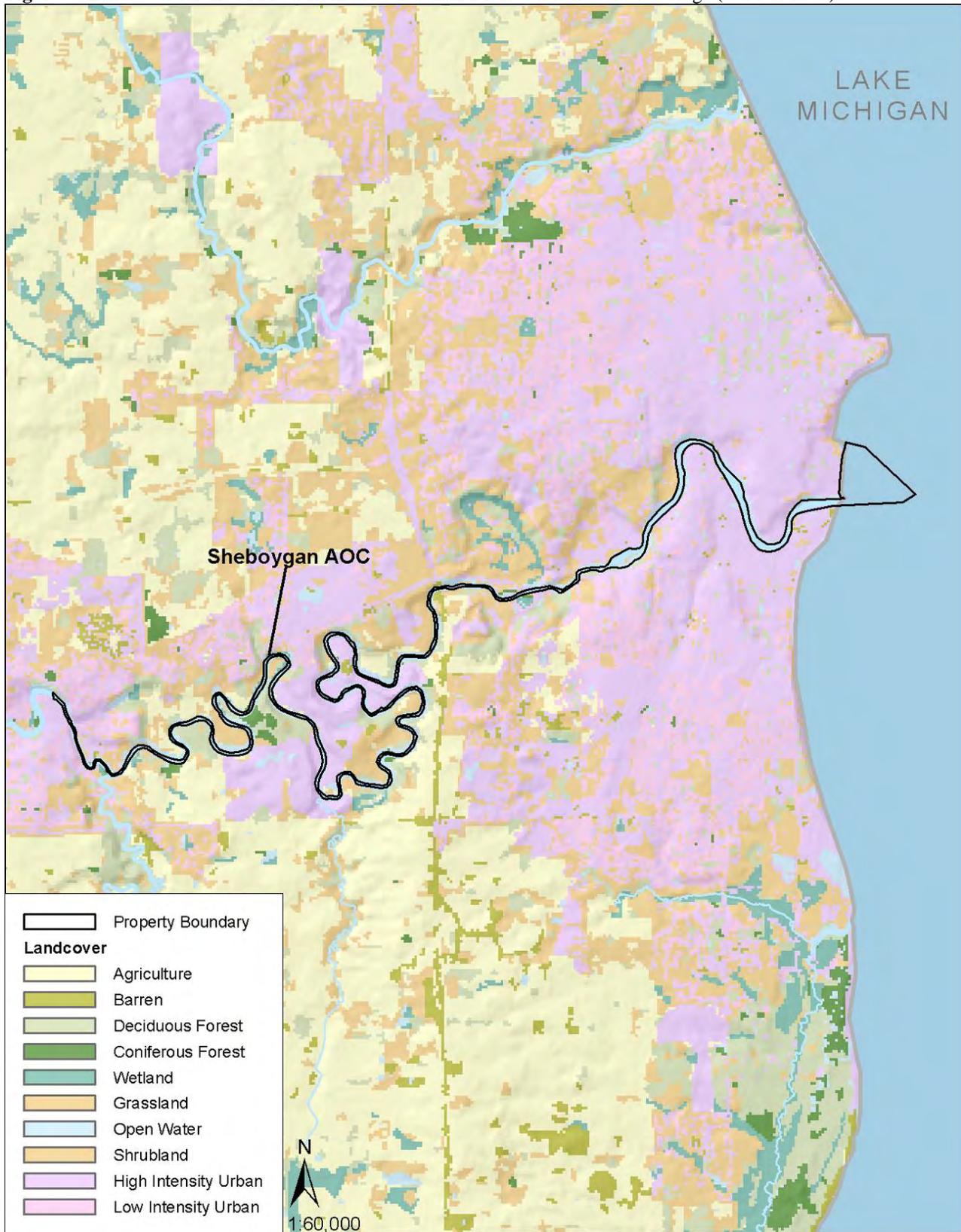
All occurrences of Emergent Marsh, within the SRAOC, were documented within the **Schuchardt Property**. The marsh surrounds a large alfalfa field and is bordered by steep slopes harboring Southern Dry Forest dominated by oak species. The Emergent Marsh is dominated by cat-tails (*Typha* spp.), including narrow-leaved cattail (*Typha angustifolia*), and reed canary grass with scattered willow (*Salix* spp.) and ash species. There is a good deal of open, shallow water areas with some duckweed (*Lemna* sp.), water-plantain (*Alisma* spp.), and water smartweed (*Polygonum amphibium*). Characteristic marsh species present include common duckweed (*Lemna minor*), broad-leaved arrow-head (*Sagittaria latifolia*), common water-plantain (*Alisma plantago-aquatica*), and water smartweed. This area was formerly farm land and likely used as pasture for farm animals. The presence of narrow-leaved cattail and reed canary grass as dominant species greatly reduces the quality of this natural community. While these communities are low in plant diversity, they are still important for a number of animal species. Given the limited extent of Emergent Marsh and Southern Sedge Meadow within the SRAOC, this is a significant opportunity for future habitat restoration and a priority for the control of invasive species.

Southern Sedge Meadow

Southern Sedge Meadows at one time covered nearly one million acres in Wisconsin, but wetland losses increased with technological advancements in converting wetlands to agriculture in the mid 1900's. Now only about 200,000 acres remain and many of these acres are now dominated by the invasive reed canary grass (Hoffman 2002). A good quality example of Southern Sedge Meadow was found within the **Schuchardt Property** during 2011 natural community surveys. The sedge meadow is embedded within a mosaic of wetland types including an Emergent Marsh, Shrub-carr, and forested wetlands. The herbaceous layer is dominated by common lake sedge (*Carex lacustris*), Canadian blue-joint grass, reed canary grass, common reed grass, and narrow-leaved cat-tails. Other common and characteristic sedge meadow species found include smooth sawgrass (*Cladium mariscoides*), orange jewelweed, spotted Joe-Pye-weed (*Eupatorium maculatum*), tussock sedge (*Carex stricta*), swamp aster (*Aster puniceus*) and northern water-horehound (*Lycopus uniflorus*).

The meadow and marsh complex is ditched, altering the hydrology, and perhaps aiding in the advance of invasive species like reed canary grass and narrow-leaved cattail. Invasive species are not a major component of the wetlands, but management to control these while in a manageable populations is critical. Monitoring of invasive species before and after management would be beneficial to ensure activities are helping to meet overall restoration objectives. Several important SGCN birds found in the SRAOC, or with the potential to occur here, utilize these open wetlands and shrubby sedge meadows. Enhancing the size and extent of these wetland communities where appropriate in the SRAOC would benefit these uncommon bird species; other associated wetland species, and could improve water filtration.

Figure 6: Landcover for the SRAOC from the Wisconsin DNR Wisland GIS Coverage (WDNR 1993).



Northern Mesic Forest

There are small but good-quality examples of Northern Mesic Forests within the SRAOC on a narrow and steep east-facing slope on **UW – Sheboygan** campus and on the **Kohler Property** along the river on an area of slight elevation from the surrounding Floodplain Forest. The Northern Mesic Forest on the UW – Sheboygan campus is small in size and has poor context, as the areas up and down slope are developed with buildings and parking areas, but is good-quality with a closed canopy of 12-18” diameter at breast height (dbh) sugar maple, northern red oak, basswood, white ash (*Fraxinus americana*), and American beech. The characteristic conifer (eastern hemlock, eastern white pine) component is lacking in this stand and some more “southerly” elements are present. The shrub layer is sparse with chokecherry (*Prunus virginiana*), alternate-leaved dogwood (*Cornus alternifolia*), and common buckthorn (*Rhamnus cathartica*) noted. The herbaceous layer is moderately dense and rich with Virginia waterleaf (*Hydrophyllum virginianum*), yellow trout-lily (*Erythronium americanum*), wild leek (*Allium tricoccum*), and large-flowered trillium (*Trillium grandiflorum*) common.

A fairly mature, closed canopy, second growth stand of Northern Mesic Forest was found on the **Kohler Property** with a closed canopy of 16 to 20” dbh sugar maple, white oak, eastern white pine, northern red oak, and American beech. The subcanopy was moderate with sugar maple, American beech, and eastern white pine and the shrub layer was sparse, but included non-native invasive species such as Japanese barberry in sizable populations and scattered common buckthorn. The herbaceous layer is moderately dense including a rich display of spring ephemerals including yellow trout lily, spring beauty, toothwort, and other rich herbs including wild leeks and Virginia waterleaf. Invasive groundlayer plants such as garlic mustard and dame’s rocket were also common. This good-quality and isolated stand is one of the few remaining remnants of what was a common forest type historically along the lower stretch of the Sheboygan River. There are scattered seeps, Ephemeral Ponds, and good amounts of coarse woody debris found within the mesic forest adding to the importance of this area.

Southern Dry Forest

One small example of a moderate-quality Southern Dry to Dry-mesic Forests was noted along the steep west-facing slopes at the **Schuchardt Property**. The canopy is dominated by large diameter northern red oaks with white oak, bur oak (*Quercus macrocarpa*), and small amounts of paper birch (*Betula papyrifera*) and box elder (*Acer negundo*). The non-native invasive tree black locust (*Robinia pseudoacacia*) is also present. The shrub layer is dominated by showy bush honeysuckle (*Lonicera x bella*), common and glossy buckthorn (*Rhamnus frangula*), and Japanese barberry. The slopes appear to be formerly grazed resulting in the herbaceous layer being degraded. Invasive species including garlic mustard and dame’s rocket dominate the groundlayer. Other common groundlayer species are broad-leaf enchanter’s-nightshade (*Circaea lutetiana* subsp. *canadensis*), calico aster (*Aster lateriflorus*), Jack-in-the-pulpit (*Arisaema triphyllum*), Pennsylvania sedge (*Carex pensylvanica*), and white avens (*Geum canadense*). There are seepage areas along these slopes with potential for pickerel frogs (*Lithobates palustris*) and uncommon plants. These areas are important for recharging the hydrology of the wetlands and Willow Creek within this small basin.

An abundance of white-tailed deer (*Odocoileus virginianus*) was noted through field observation and extensive worn trails in the upland forests of the Schuchardt Property. Herbivory by white-tailed deer has been identified as having major impacts on tree and herb species in northern forests of the Lake States (e.g., Schulte et al. 2007, WDNR 2006c, WDNR 2004, Rooney et al. 2004, Rooney and Waller 2003, Alverson et al. 1988), and the Michigan Society of American Foresters (2006) recently released a position statement addressing the need to control the impacts caused by white-tailed deer. In addition to direct impacts on plants, deer density has been shown to negatively impact species richness and abundance levels of songbirds that nest in the intermediate canopy layer (DeCalesta 1994, McShea and Rappole 2000). Excessive deer herbivory is also known to inhibit reproduction of certain trees, especially those species that are preferred forage including oaks.

Floodplain Forest

Floodplain Forests were uncommon historically, occupying only about 1-3% of the Central Lake Michigan Coastal Ecological Landscape (Finley 1976). The acreage of Floodplain Forests in Wisconsin has been steadily increasing from 1% historically to about 9% of all forest land currently (WDNR 2010c). Floodplain Forests were the most commonly encountered forest type within the SRAOC, occurring at numerous survey locations including the **Kohler Property, Schuchardt Property, Wildwood Island, and UW – Sheboygan**. Floodplain Forests found within the SRAOC are of moderate quality and small in size with poor surrounding forest context. All have a history of disturbance that includes grazing, logging, and removal of downed woody debris for firewood collection. Canopies have moderate to high canopy cover with dominant trees noted as white and green ash, box elder, cottonwood (*Populus deltoides*), and crack willow (*Salix fragilis*). Canopy tree diameter largely falls in the 10-16" dbh range with larger diameter trees found at the **Schuchardt Property** (12-24" dbh) and a few very large diameter (up to 30") cottonwood and willow at the **UW – Sheboygan** campus. Shrub layer at all properties is sparse to moderate and dominated by common buckthorn with showy bush honeysuckle and American black currant (*Ribes americanum*). Common herbaceous layer species are Canadian wood-nettle (*Laportea canadensis*), Virginia waterleaf, false mermaid (*Floerkea proserpinacoides*), and moneywort (*Lysimachia nummularia*) several non-native invasives are prevalent including reed canary grass, garlic mustard, and dame's rocket. Forested riparian corridors are an important part of the stream ecosystem benefitting water quality, plants, and wildlife.

In reviewing 1937 aerial photographs of the project area, it is evident that very little Floodplain Forest has been present along this stretch of river for 80 years or more. Prior to settlement in Wisconsin, data show the project area as largely forested (Schulte and Mladenoff 2011; Finley 1976) but it is not known how extensive the Floodplain Forest was along this stretch of the Sheboygan River. It is believed Floodplain Forest communities occur along large rivers, usually stream order three or higher, that flood periodically (Epstein et al. 2002). The lower Sheboygan River is a stream order five, but due to the prevalence of invasive species and numerous dams minimizing hydrological fluctuations, the extent of Floodplain Forest here appears uncertain.

Surrogate Grassland

Sustaining Surrogate Grasslands represents an important opportunity in the Central Lake Michigan Coastal Ecological Landscape. These grasslands now comprise the vast majority of grassland habitat in the state. Surrogate Grasslands are similar in structure to the prairies that once occurred more commonly in Wisconsin. They include agricultural habitats such as hayfields, small grains (oats, wheat, and barley), row crops (corn, soybeans, and potatoes), fallow fields, old fields, pastures, and set-aside fields (e.g., CRP) planted to non-native cool-season grasses (such as smooth brome [*Bromus inermis*], timothy [*Phleum pratense*], reedtop [*Agrostis gigantea*], orchard grass [*Dactylis glomerata*], bluegrass [*Poa* sp.], and quackgrass [*Elytrigia repens*]) or native warm-season grasses (such as big blue-stem [*Andropogon gerardii*], little blue-stem [*Schizachyrium scoparium*], yellow Indian grass [*Sorghastrum nutans*], switch grass [*Panicum virgatum*], and side-oats grama [*Bouteloua curtipendula*]), and low-diversity planted prairies. Examples of other surrogate prairie grasslands include orchards, city and county parks, golf courses, and airports.

Grassland small mammals and birds fared the best at utilizing Surrogate Grasslands, such as hayfields and pastures, for their survival needs. However, with conversion from pastures and hayfields to more row crop agriculture, some grassland birds and small mammals have also been dramatically declining over the last 30 years. For example, grassland birds as a group are the fastest declining bird group in Wisconsin and across the midwest (Herkert 1995). Grassland patch size is critical to providing habitat for viable populations of grassland species. Therefore, considering the surrounding landscape and connecting open habitats would benefit larger numbers of grassland obligates. Some estimates show patch sizes of greater than 100 hectares must be maintained for conservative species to be present (pers.

comm. D. Sample). Surrogate Grasslands supporting grassland birds were found on the **Kohler Property** along I-43 north of the Sheboygan River and grassland parcels south of the river connected to the Black Wolf Run Golf Course. Continued development and encroachment of trees and shrubs in the lower Sheboygan River corridor threatens these last remaining Surrogate Grassland habitats.

Warmwater River

Warmwater rivers are flowing waters with maximum water temperatures typically greater than 25 degrees Celsius. They usually have watershed areas greater than 500 square miles and mean annual flow rates of more than 200 cubic feet per second. Natural, periodic flood flows, most often driven by spring snow melt and rains, are important to the health of floodplain forests and wetlands and to the maintenance of self-sustaining populations of wetland-spawning fish, such as walleye (*Sander vitreus*) and northern pike (*Esox lucius*). A rich fish fauna, dominated by warmwater species in the families Cyprinidae, Catostomidae, Ictaluridae, Centrarchidae, and Percidae, occurs within the river. The aquatic life dependent upon these rivers and their floodwaters, also supports a variety of mammalian and avian species. Free-flowing, undammed rivers are critical in the existence and perpetuation of widely distributed populations of certain species, especially sturgeon and several species of mollusks that require a far-ranging fish host to complete their life cycle. Dams established for a variety of purposes (power generation, navigation, flood control and recreation) can cause noticeable declines in some mollusks by blocking the movement of their fish hosts.

Aquatic plant surveys were conducted at two sites within the SRAOC with one site (SR 02; see Table 3) using the point-intercept (PI) method protocol. The PI method was designed for lake surveys, so the method was slightly modified for use on this section of the Sheboygan River. Depth, substrate type, aquatic plant species, and individual species density (rake fullness) were recorded at each sample point (Table 3). Only 76 of 106 sample points were included in the data collection, because 30 of the sample points were located in upland areas. This was due to the number of small islands within the sample site. Two species of aquatic plants were found within the sample site, filamentous algae (*Cladophora* sp.) and sago pondweed (*Potamogeton pectinatus*). Filamentous algae were the main species found at the site, located in 37 percent of the sample sites, but in low density. Rake density or fullness, was one out of three. This is the lower of the ratings for density. Sago pondweed was only found at one sample point and accounted for 1.3 percent aquatic plant coverage. Rake density was also one. The only site having a healthy population of native aquatic macrophytes was on the Sheboygan River, upstream of the Weedens Creek confluence (SR06). This site has a moderate sized area of floating-leaf pondweed (*Potamogeton natans*).

Table 3. Summary of aquatic plant survey data for site SR 02 on the Sheboygan River. Sample points within upland areas were not included in survey.

Total sample points	106
Sample points within upland areas	30/106 (28%)
Sample points included in survey	76
Filamentous algae	28/76 (37%)
Sago pondweed	1/76 (1.3%)
Gravel substrate	48/76 (63%)
Sand substrate	13/76 (17%)
Muck substrate	15/76 (20%)
Depth range	0.1 – 4.5 feet
Average depth	1.6 feet

Rare Species and High Quality Natural Communities of Sheboygan and Sheboygan Falls Townships

Numerous rare species and high-quality examples of natural communities have been documented within the townships of Sheboygan (015N 023E) and Sheboygan Falls (015N 022E). Table 4 shows the rare species and high-quality natural communities currently and historically¹ known from these townships. See Appendix C for summary descriptions for the species and natural communities that occur in these townships. Various sources were used to determine the Watch List species and SGCN present and this may not be a complete list. State status is based on the NHI Working List published June 2011.

Table 4. Documented rare species and high-quality natural communities for the townships of Sheboygan and Sheboygan Falls. Years listed in “Last Obs Date” column indicate the most recent documented observation. More than one element occurrence of a particular species or natural community may be at each property. For an explanation of state and global ranks, as well as state status, see Appendix A. Species with a “W” in the “Tracked by NHI” column are on the Watch List (see Appendix A) and are not mapped in the NHI database.

Common Name	Scientific Name	Last Obs Date	State Rank	Global Rank	State Status	SGCN	Tracked by NHI
ANIMALS							
Aquatic Insects							
A Caddisfly	<i>Hydropsyche cuanis</i>	2011	S3S4	G5	SC/N	Yes	W
A Predaceous Diving Beetle	<i>Lioporeus triangularis</i>	1996	S2S3	GNR	SC/N	Yes	Y
A Riffle Beetle	<i>Stenelmis musgravei</i>	2011	S2S3	GNR	SC/N	Yes	Y
A Water Penny Beetle	<i>Ectopria</i> sp. 2	1988	SU	GNR	SC/N	Yes	W
A Water Scavenger Beetle	<i>Hydrobius melaenum</i>	1970	S4	GNR	SC/N	Yes	W
A Water Strider	<i>Rheumatobates tenuipes</i>	2011	SU	GNR	SC/N	No	W
Eastern Red Damsel	<i>Amphiagrion saucium</i>	2011	S3S4	G5	SC/N	Yes	W
Amphibians							
American Bullfrog	<i>Lithobates catesbeianus</i>	1994	S3	G5	SC	No	W
Northern Leopard Frog	<i>Lithobates pipiens</i>	2011	S4?	G5	SC/H	No	W
Birds							
American Woodcock	<i>Scolopax minor</i>	2011	S3S4B	G5	SC/M	Yes	W
Bald Eagle	<i>Haliaeetus leucocephalus</i>	2008	S4B, S4N	G5	SC/P	Yes	Y
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>	2011	S3S4B	G5	SC/M	Yes	W
Blue-winged Teal	<i>Anas discors</i>	2007	S3S4B	G5	SC/M	Yes	W

¹ Element Occurrences (EO's) may be recorded for locations known to be previously occupied by a species or community, even if current field survey information is lacking. This is particularly useful for documenting locations where the Element might be expected to occur or re-occur at some future time, information that may be important in planning field research and in conducting environmental review. Historical EOs, in some cases, may also be useful for demonstrating the former distribution or pattern of decline of an Element.

Table 4. Documented rare species and high-quality natural communities for the townships of Sheboygan and Sheboygan Falls. Years listed in “Last Obs Date” column indicate the most recent documented observation. More than one element occurrence of a particular species or natural community may be at each property. For an explanation of state and global ranks, as well as state status, see Appendix A. Species with a “W” in the “Tracked by NHI” column are on the Watch List (see Appendix A) and are not mapped in the NHI database.

Common Name	Scientific Name	Last Obs Date	State Rank	Global Rank	State Status	SGCN	Tracked by NHI
Bobolink	<i>Dolichonyx oryzivorus</i>	2011	S4B	G5	SC/M	Yes	W
Brown Thrasher	<i>Toxostoma rufum</i>	2011	S3S4B	G5	SC/M	Yes	W
Dickcissel	<i>Spiza americana</i>	2011	S3B	G5	SC/M	Yes	W
Eastern Meadowlark	<i>Sturnella magna</i>	2011	S3S4B	G5	SC/M	Yes	W
Field Sparrow	<i>Spizella pusilla</i>	2011	S4B	G5	SC/M	Yes	W
Osprey	<i>Pandion haliaetus</i>	2007	S4B	G5	SC/M	Yes	W
Peregrine Falcon	<i>Falco peregrinus</i>	2009	S1S2B	G4	END	Yes	Y
Red-shouldered Hawk	<i>Buteo lineatus</i>	1972	S3S4B, S1N	G5	THR	Yes	Y
Willow Flycatcher	<i>Empidonax traillii</i>	2011	S4B	G5	SC/M	Yes	W
Wood Thrush	<i>Hylocichla mustelina</i>	2011	S4B	G5	SC/M	Yes	W
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	2011	S3B	G5	SC/M	Yes	W
Fishes							
Banded Killifish	<i>Fundulus diaphanous</i>	2008	S3	G5	SC/N	Yes	W
Mammals							
Big Brown Bat*	<i>Eptesicus fuscus</i>	2011	S2S4	G5	THR	No	Y
Deer Mouse	<i>Peromyscus maniculatus</i>	2011	S4	G5	SC/N	No	W
Eastern Red Bat	<i>Lasiurus borealis</i>	2011	S3	G5	SC/N	Yes	W
Hoary Bat	<i>Lasiurus cinereus</i>	2011	S3	G5	SC/N	Yes	W
Little Brown Bat*	<i>Myotis lucifugus</i>	2011	S2S4	G5	THR	No	Y
Silver-haired Bat	<i>Lasionycteris noctivagans</i>	2010	S2S4	G5	SC/N	Yes	W
Mussels							
Elktoe	<i>Alasmidonta marginata</i>	2011	S3	G4	SC/P	No	Y
Ellipse	<i>Venustaconcha ellipsiformis</i>	2011	S3	G4	THR	Yes	Y
Round Pigtoe	<i>Pleurobema sintoxia</i>	2011	S3	G4G5	SC/N	No	W
PLANTS							
American Sea-rocket	<i>Cakile lacustris</i>	1967	S3	G5	SC	n/a	Y
Christmas Fern	<i>Polystichum acrostichoides</i>	2011	S2	G5	SC	n/a	Y
Cooper’s Milkvetch	<i>Astragalus neglectus</i>	1904	S1	G4	END	n/a	Y
Fragrant Sumac	<i>Rhus aromatica</i>	2011	S1	G5	SC	n/a	Y
Forked Aster	<i>Aster furcatus</i>	2011	S3	G3	THR	n/a	Y
Hairy Beardtongue	<i>Penstemon hirsutus</i>	1962	S1	G4	SC	n/a	Y
One-flowered Broomrape	<i>Orobanche uniflora</i>	1934	S3	G5	SC	n/a	Y
Seaside Crowfoot	<i>Ranunculus cymbalaria</i>	1909	S2	G5	THR	n/a	Y

Table 4. Documented rare species and high-quality natural communities for the townships of Sheboygan and Sheboygan Falls. Years listed in “Last Obs Date” column indicate the most recent documented observation. More than one element occurrence of a particular species or natural community may be at each property. For an explanation of state and global ranks, as well as state status, see Appendix A. Species with a “W” in the “Tracked by NHI” column are on the Watch List (see Appendix A) and are not mapped in the NHI database.

Common Name	Scientific Name	Last Obs Date	State Rank	Global Rank	State Status	SGCN	Tracked by NHI
Small Skullcap	<i>Scutellaria parvula</i> var. <i>parvula</i>	1904	S1	G4T4	END	n/a	Y
Swamp Bedstraw	<i>Galium brevipes</i>	1933	S1	G4?	SC	n/a	Y
NATURAL COMMUNITIES							
Emergent Marsh		2011	S4	G4		n/a	Y
Ephemeral Pond		2011	SU	GNRQ		n/a	Y
Floodplain Forest		2011	S3	G3?		n/a	Y
Northern Mesic Forest		2011	S4	G4		n/a	Y
Southern Dry Forest		2011	S3	G4		n/a	Y
Southern Sedge Meadow		2011	S3	G4?		n/a	Y
Surrogate Grassland		2011	SNR	GNR		n/a	Y

*This record is not yet mapped in the NHI database or does not meet some NHI methodology for inclusion.

Management Considerations and Opportunities for Biodiversity Conservation

Migratory Birds

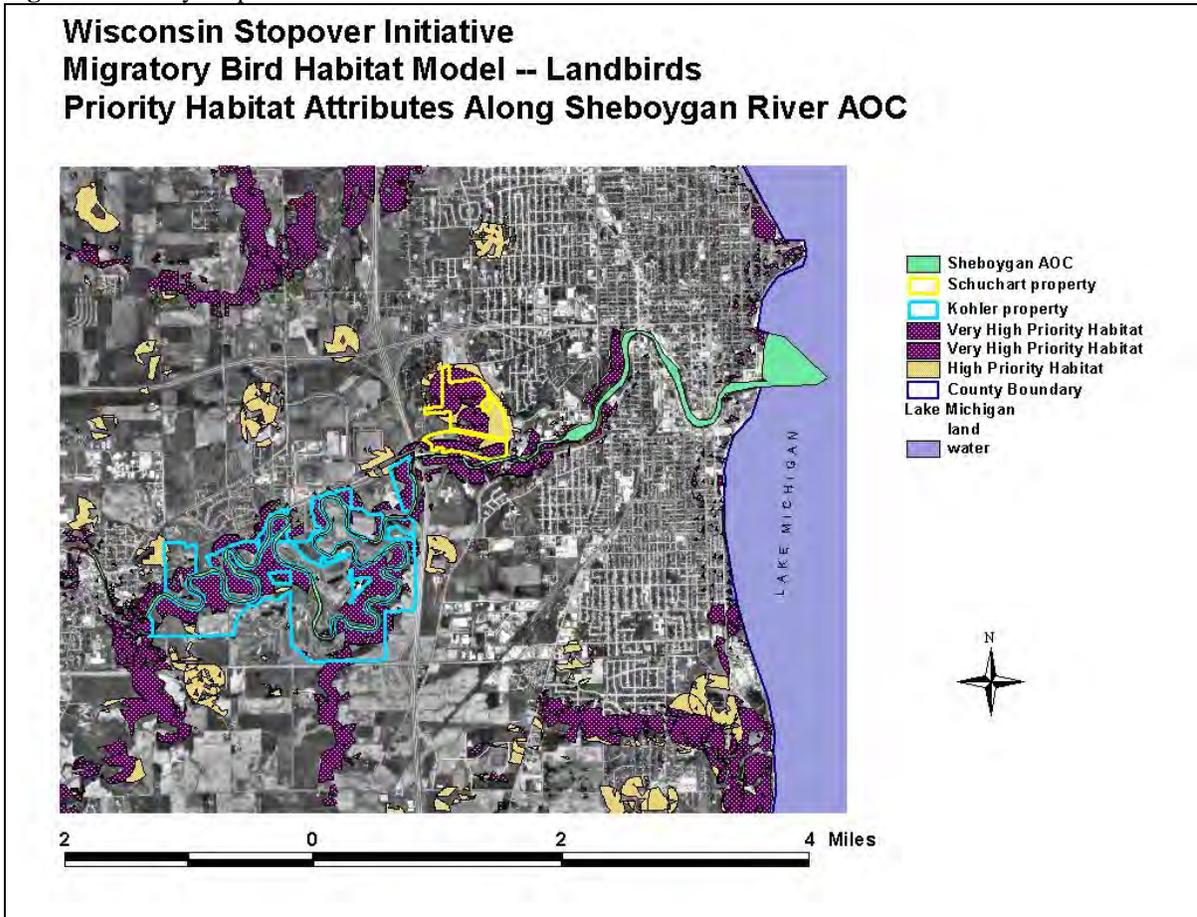
Shoreline areas, such as the wooded bluffs, ravines, and urban parks of the central and southern Lake Michigan coastlines, offer the first available habitat to birds crossing or caught over the lake post-dawn (Idzikowski 2005; Diehl et al. 2003; Mueller et al. unpublished data). Radar analysis has indicated millions of birds arriving and/or returning to shore and to near-shore areas of Milwaukee and elsewhere in the Great Lakes following daybreak (Idzikowski 2005; Diehl et al. 2003). An annual mean of over 25,000 individual landbirds was observed over a four-year period (2000-2003), including both migratory seasons at Cedar Grove, Wisconsin (Mueller et al. unpublished data).

During migration, birds are under physiological stress and mortality may be high, perhaps as high as 85 percent (Sillert and Holmes 2002). If the conservation (and conversion) of migratory stopover habitat is not addressed, there is a strong likelihood that significant resources directed at breeding and wintering ground conservation may be compromised or wasted (Moore 2000). High priority areas for migratory landbird stopover conservation along the Lake Michigan shoreline ranges inland to five miles based upon estimates from migration count data and radar analysis. The SRAOC falls almost entirely within this corridor and has importance as a migratory bird stopover site in need of restoration effort. Currently the SRAOC provides a ‘fire escape’ for migratory birds because there is a large amount of development present in the area, invasive species are displacing native plants on which birds depend on for food and cover, and fragmented forest cover limits habitat availability in the project area. Fire escapes are sites such as city parks or fragmented forests receiving less use because they are resource-poor, yet they are vital during times of stress as places for migrants to seek shelter from predators or storms (Grveles and Matteson 2011). The best migratory bird stopover sites are extensive, intact areas rich in resources and containing a diversity of habitat types providing abundant food, water, and shelter to large numbers of birds on a consistent basis. The best examples of high-quality migratory bird stopover sites near the SRAOC are at Harrington Beach State Park and Kettle Moraine State Forest – North Unit.

As urban development expands in coastal areas, existing properties in a natural state will become increasingly important for providing migrating birds with places to stop, rest, and refuel. Important considerations for upcoming restoration efforts in the SRAOC to aid in attracting migratory landbirds includes providing areas of food, water, and shelter. Identifying areas to connect and promote larger blocks of older forests with un-even aged structure and a developed native shrub component in close proximity to water where aquatic insects are emerging would meet all of these needs. Specific areas (see Figure 7) and applications geared toward enhancing migratory bird habitat within the project area should include controlling invasives within the forested blocks of the **Kohler Property**, promoting and enlarging the oak forests and wetland communities at the **Schuchardt Property** and **Wildwood Island**, connecting forest cover and providing good numbers of fruit-producing native, low shrubs along the river at city and county park lands (**Kiwanis Park**). In addition, efforts are underway and should be finalized to designate urban areas along the SRAOC as a “Bird City Wisconsin”. Bird City Wisconsin participants can learn how to protect and manage green space, landscape with native plants in backyards and parks, adopt architecture and lighting systems that reduce bird collisions, and many other tools hospitable to breeding, wintering, and migrating birds seeking safe places to

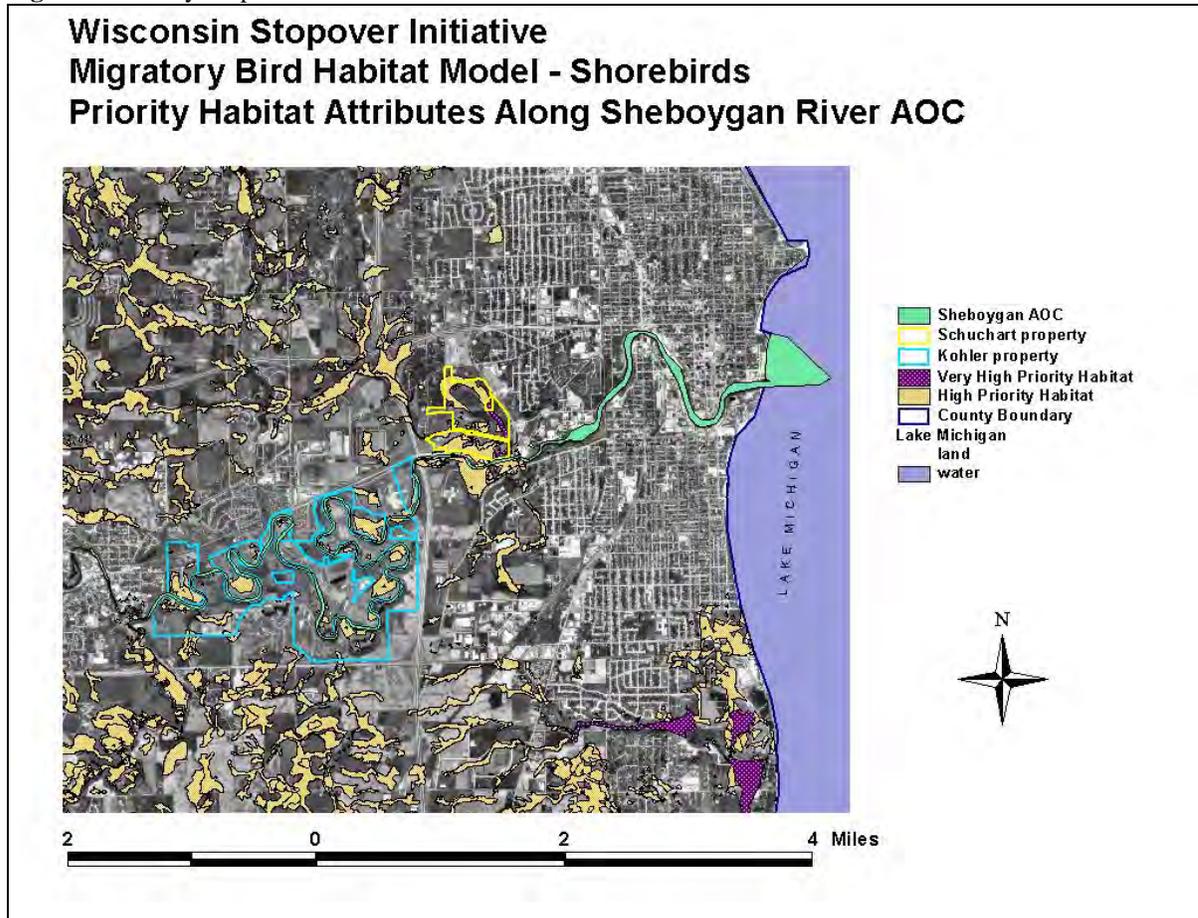
spend time and find food. More information is available online at: <http://www.birdcitywisconsin.org/Index.htm>.

Figure 7: Priority Stopover Habitat for Landbirds within the SRAOC



Long-term management activities benefitting migratory shorebirds and waterfowl within the SRAOC could focus on wetland restoration or construction (see Figure 8 & 9). Many of the farm fields in close proximity to the SRAOC occur on hydric soils, giving them the potential for being drained and restored to wetlands. Creating large (>16 hectare) mixed emergent wetlands adjacent to the river is advisable as the combination of diverse wetlands and open water rank as the highest priority stopover habitat type for waterfowl, waterbirds, and shorebirds. Two areas of particular potential for wetland restoration are crop lands at the east and west ends of the **Kohler Property** and the very high priority emergent marsh / open water wetland and crop fields at the **Schuchardt Property**. Consideration could be given to removing drain tiles allowing for restoration of additional wetland habitat and controlling invasive species present in the existing wetlands. Creating shoals, where feasible, in Lake Michigan at or near the mouth of the Sheboygan River could provide perching places for waterbirds and support foraging opportunities for them during migration.

Figure 8: Priority Stopover Habitat for Shorebirds within the SRAOC



Breeding Birds

Historically much of the SRAOC was dominated by mesic forests of American beech, sugar maple, basswood, red and white oak (see Fig. 5; Finley 1976; Schulte and Mladenhoff 2001). Very little forest cover remains on the lower Sheboygan River or in the SRAOC. Some small, remnant stands of second-generation Northern Mesic Forest are present, along with a narrow corridor of Floodplain Forest. Much of the landscape has been transformed through urban development and other areas are largely in agricultural production, leaving the forests highly fragmented with edge habitats and open areas most common. The breeding bird communities of the SRAOC largely reflect these landscape changes with common woodlot and urban birds being most prevalent. Some conservative forest species are located in low numbers in the largest block of forest habitat within the SRAOC.

There are good amounts of shrub and Surrogate Grassland habitats found within the fragmented landscapes of the SRAOC. Uncommon and declining bird species are utilizing these habitats, representing an important conservation opportunity for the project area. Grassland and shrubland birds, a group of species of critical conservation need in Wisconsin, would benefit from a diversity of grassland habitat in large unfragmented tracts. Structural diversity within the grassland, including scattered patches of shrubs, short and tall grass, amount of residual herbaceous duff, a mix of grasses and forbs, and a management rotation of type, intensity, and frequency, is also important. Wisconsin plays a vital role in the conservation of several of these

grassland / shrubland species as the state makes up a high percentage of their global range (see Table 5) and they should be considered high priority species for the SRAOC.

Table 5: Area of Importance - Area of Importance reflects the relative importance of Wisconsin to a species and its conservation, based on the abundance of the species in the state relative to other areas (WDNR 2006b).

Common Name	Wisconsin Status	Area of Importance	Significance
American woodcock	SGCN; Special Concern	5	Present in highest relative abundance within species' range
bobolink	SGCN; Special Concern	4	Present in high relative abundance, relative to other parts of species' range
brown thrasher	SGCN; Special Concern	5	Present in highest relative abundance within species' range
willow flycatcher	SGCN; Special Concern	4	Present in high relative abundance, relative to other parts of species' range
eastern meadowlark	SGCN; Special Concern	4	Present in high relative abundance, relative to other parts of species' range
field sparrow	SGCN; Special Concern	4	Present in high relative abundance, relative to other parts of species' range
savannah sparrow	None, Moderate Declines in State and Global Range	4	Present in high relative abundance, relative to other parts of species' range
American kestrel	None, Conflicting Trend Data	5	Present in highest relative abundance within species' range

Grassland bird species are exhibiting one of the most significant declines of any suite of bird species in Wisconsin and across the Midwest (Herkert 1995). The major cause for this decline has been the alteration and loss of breeding habitat (Robbins et al 1996). Estimates show patch size of greater than 100 hectares must be maintained for conservative bird species to be present as a viable population (pers. comm. D. Sample). There are likely no opportunities for a large-scale grassland bird project in the SRAOC, but an assemblage of conservative grassland bird obligates is present and could be a focus of management and restoration efforts. The context of the surrounding landscape should be assessed to determine if grassland tracts could be connected to develop and protect larger grassland areas. Focal areas based on 2011 surveys and aerial photos appear to be an area of undeveloped habitat along the I-43 corridor. Much of this land is made up of **Kohler Property** and includes some Surrogate Grassland areas and a golf course north of State Highway 28 with fallow fields and row crops to the south making a larger grassland patch. There is a grassland area just north of the river between County Highway A and Lower Falls Road at the Kohler landfill supporting good numbers of grassland birds. This area is connected to additional open grass habitats to the north at the Kohler Design Center and connecting to open fields and wetlands at the **Schuchardt Property**.

These existing grassland areas support several conservative grassland obligate bird species including eastern meadowlark (*Sturnella magna*), bobolink (*Dolichonyx oryzivorus*), and dickcissel (*Spiza americana*), along with more common, but also with declining populations (clay-colored sparrow [*Spizella pallida*] and savannah sparrow [*Passerculus sandwichensis*]). These species have the potential to increase in density and potentially improve nest productivity if the grasslands are connected with open areas allowing for a larger matrix of treeless habitats. Suitable open areas could include pastures, hayfields (cut late summer), idle grasslands, and even row crops which can be a suitable buffer when compared to woodlots or hedgerows.

Belted Kingfisher Nest Monitoring

Belted kingfishers are a fairly common riparian species found throughout the United States, and feed heavily upon small fish. Breeding Bird Survey data suggest significant population declines range-wide and non-significant declines in Wisconsin (Sauer et al. 2005). They are a priority wetland species in all three Bird Conservation Regions in Wisconsin (Rosenberg 2004).

In 2011, biologists monitored nests of these fish-eating birds found along the SRAOC for possible effects of contamination on reproduction or offspring health. No gross physical deformities were documented in any of the belted kingfisher chicks. Approximately 13 young were fledged from these four nest burrows. Success of the nests was mixed with one nest destroyed by a predator and one hatching less than half of the eggs laid. The small sample size and incomplete nesting data limit any conclusions related to hatching and fledgling success. It would appear that a limiting factor for belted kingfishers within the SRAOC is access to suitable banks for nesting.

Lake Michigan Near Shore Mid-Winter Birds

The objective of this survey was to gather information on bird species presence / absence and their relative abundance in the SRAOC during the winter. The survey provides a better understanding of which species most commonly use the SRAOC in the winter months. A different suite of birds use this area in the winter compared to the summer breeding birds and migratory birds. This survey, when combined with the other bird surveys and waterfowl stopover modeling efforts (Figure 9), gives us a more complete picture of year-round species use of the SRAOC.

Wintering bird surveys expanded upon methods used for the Mid-Winter Waterfowl Surveys, which are performed every January in cooperation with the U.S. Fish & Wildlife Service Division of Migratory Bird Management (see <http://www.fws.gov/birddata/databases/mwi/aboutmwi.htm>). The methods for the surveys also included non-waterfowl and non-open water sites (when open water was not available), and occurred bi-weekly throughout the winter season.

There were a total of 50 different species and 5107 individuals recorded over the entire survey period. The five species most commonly observed (see Table 6) were common goldeneye (*Bucephala clangula*), mallard (*Anas platyrhynchos*), herring gull (*Larus argentatus*), common merganser (*Mergus merganser*), and scaup species (*Aythya* spp.). The scaup encompasses both the greater scaup (*Aythya marila*) and the lesser scaup (*Aythya affinis*), which can be difficult to distinguish, especially at a distance. The five most commonly observed passerine birds were black-capped chickadee (*Poecile atricapillus*), house sparrow (*Passer domesticus*), mourning dove (*Zenaida macroura*), American crow (*Corvus brachyrhynchos*), and dark-eyed junco (*Junco hyemalis*).

Table 6. Most Commonly Encountered Birds during Winter Surveys of the SRAOC

Species	Total Numbers	SRAOC River Segments Where Most Commonly Found
Common Goldeneye	1314	Harbor
Mallard	772	Throughout
Herring Gull	519	Harbor, Lower
Common Merganser	368	Harbor
Scaup spp.	321	Harbor
Unknown Duck	296	Harbor
Canada Goose	202	Throughout

Tundra Swan*	195	Throughout
Unknown Gull	186	Harbor
Black-capped Chickadee	116	Throughout
House Sparrow	106	Throughout
Mourning Dove	91	Middle, Upper
American Crow	83	Throughout
Dark-eyed Junco	74	Middle, Upper
American Robin**	68	Throughout

*Only found after 3/25/11

**Only found after 3/10/11

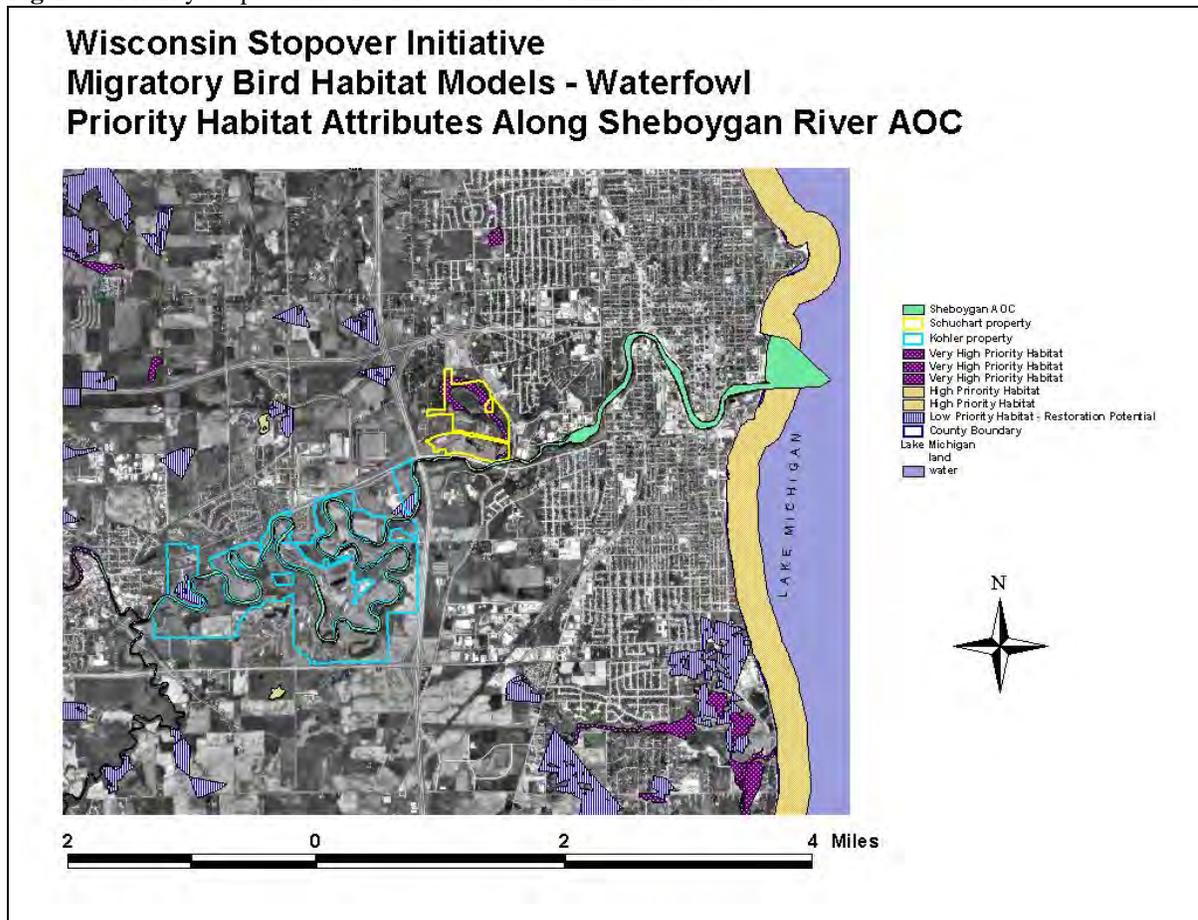
The common goldeneye is a species of Special Concern within the state of Wisconsin (NHI working list) and yet was the most commonly recorded bird species in the SRAOC. This is significant because it is exposed to the same contaminants that have resulted in scaup being listed in a contaminant advisory in Wisconsin. It is unknown whether this exposure would have an effect on their survival or reproductive capacity. [*There was a small die-off, of undetermined causes, in goldeneye along the Lake Michigan coast during the winter of 2009/2010.*]

Observations of individual birds followed a general increase during the survey period until the count on February 9, 2012. This date had the lowest average temperature and highest average wind speeds of the seven counts that were performed. These conditions may have contributed to a slowing or even reversal in the upward trend in bird observations for some of the river segments. This is best illustrated with the counts between the Inner Harbor and the Outer Harbor segments. Within the Inner Harbor, the highest count of individual birds for the entire survey period occurred on the day of these weather extremes. On the same day, the fewest number of individual birds were observed using the Outer Harbor river segment. After this extreme weather event, most segments had an increase in individual observations and returned to their original upward trend in counts. An increase in counts would be expected as the spring progresses and birds migrate northward. Again, the Inner Harbor was an exception. Counts in this segment increased to a high on February 9, 2012 and decreased thereafter.

The Outer Harbor had the highest counts of individual birds on every survey date, except for the survey on February 9, 2012, and had the highest count for the overall survey. The other segments had fewer than half as many individual observations as the Outer Harbor. At the end of the survey period, the segments ranked in the following order for bird observations: Outer Harbor, Inner Harbor, Middle River, Lower River, and Upper River. This follows a general trend of decreasing numbers of individual birds as you travel upstream from the harbor.

The diversity of species observed within each segment generally increased throughout the survey period. This trend is expected as migratory species return in the spring. River segments were ranked by species diversity as follows, from highest diversity to lowest: Middle River, Upper River, Lower River, Outer Harbor, and Inner Harbor. This follows a generalized trend of decreasing species diversity as you travel downstream and is related to the diversity of habitat found along the river.

Figure 9: Priority Stopover Habitat for Waterfowl within the SRAOC



Bat Conservation

Two mobile water-based surveys were conducted along two stretches of the lower Sheboygan River within the SRAOC in 2011 and one survey in 2010 during the summer residency period. Presence / absence surveys detected five of the seven resident species currently known from Wisconsin, and included two state Threatened and three Special Concern species.

Because they feed on insects, bats are an important component of healthy ecosystems. Opportunities to promote bat habitat include providing resources for roosting, foraging, and drinking. Three of the five resident bats of the SRAOC may be roosting nearby under loose, peeling bark and in crevices and cavities in trees. Often these attributes are found in older forests with snags of varying decay level, size, and height. It is recommended when converting habitat (re-vegetation projects) that snags are left or created (girdling) as adequate roosting habitat appears to be limited, especially within the highly urbanized areas. Maintaining diverse forest flora and reducing non-native plant abundance is important for promoting invertebrate prey diversity and thus promoting foraging opportunities for bats (WDNR 2006b).

Foraging is done in and along small to medium forest openings or gaps, such as ponds, natural and artificial openings, roads, or water courses and provides foraging opportunities for both migrating and resident bats. It is still unknown to what extent large lake shorelines (Lake Michigan) in Wisconsin are used in both commuting and residents bats. More research is needed to fully explain the roles of restored areas along river corridors. Although, since water resources

are used for drinking, travel, and foraging, maintaining high-water quality and access to water is important for protecting bat populations. Wide buffers around water, including rivers, streams, and wet meadows, are important for bats and other wildlife species using these areas (Taylor 2006).

Edge habitat is important for all five bat species found in the SRAOC. When migrating from wintering caves to summer habitat, or commuting from roosts to feeding grounds, bats use the landscape in a manner that keeps them protected from wind and predators. Instead of flying across a field because it is the shortest distance, bats will often take longer routes that include edge habitat. This behavior may allow the bat more feeding opportunities because food is more abundant around edge habitat, and protect the bats from wind and potential predators (Limpens and Kapteyn 1991) Commuting along edge habitat may also assist the bats with navigation and orientation through use of linear edges as landmarks (Verboom and Huitema 1997).

Bats have been known to accumulate contaminants within their fat reserves by eating insects that have been exposed to pesticides and other contaminants. The accumulation of such harmful chemicals can be deleterious to bats during hibernation as well as during pregnancy. Since two-thirds of the SRAOC is in agricultural production and the river has documented high levels of toxic chemicals, a reduction in pollutants from these sources may in fact directly benefit bats. If pollution within the watershed, related to pesticide use on agricultural areas and PCB contaminants within the river, could be reduced and the persistence of resultant pollutants is remediated within the SRAOC, bat survivability may increase (although this would be very difficult to measure without sufficient datasets). A future study may be warranted.

Small Mammals and Mink Study

A coarse comparison of small mammal survey data was conducted in the SRAOC in 2011-12 (see Table 7). Seeley (1993) conducted the initial survey in the floodplains of the SRAOC and attempted to estimate relative abundance of terrestrial small mammals in the area compared to control sites further up river. The most recent survey of small mammals was done to collect small mammal samples for contaminant monitoring but relative abundance was not estimated (Miller 2012).

In 1993, 40 small mammal specimens were submitted for contaminant analysis for PCBs. Although not expected, it was discovered that all 19 small mammals from the SRAOC had detectable levels of PCB congeners but only one of the 21 from control sites had detectable levels of PCBs. This demonstrated that the PCB contaminants found in the sediments of the floodplains had been taken up into the terrestrial food chain along the SRAOC.

Common small mammals found in 1993 within the SRAOC included white-footed mice, meadow voles, shrew spp. and chipmunks. More deer mice (*Peromyscus maniculatus*) than white-footed mice (*P. leucopus*) were reported in 1993 but all but one *Peromyscus* sp. was white-footed mice in 2011. Both red-backed voles (*Clethrionomys gapperi*) and meadow voles (*Microtus pennsylvanicus*) were reported from 1993 but only a few meadow voles were trapped in 2011. Chipmunks (*Tamias striatus*) were abundant in the wooded areas in both studies. In addition, only a few jumping mice (*Zapus hudsonicus*) were caught in the SRAOC during both studies.

In 1993, 17 shrews were caught in the control areas versus one shrew that was caught in the SRAOC (Table 7). Most of these were masked shrews (*Sorex cinereus*) with only three short-tailed shrews (*Blarina brevicauda*) caught. In the latest survey, only one masked shrew was

caught in the control site but three were caught in the SRAOC. In addition, five short-tailed shrews were caught in the AOC and none in the control area.

Table 7. Comparison of Small Mammals Captured in 1993 and 2011-12

<u>Site Name</u>	<u>Species</u>	<u>Year</u>	<u>Number Captured</u>	<u>Year</u>	<u>Number Captured</u>
AOC	White-footed Mouse	2011-12	23	1993	11
Control	White-footed Mouse	2011-12	11	1993	7
AOC	Deer Mouse	2011-12	1	1993	35
Control	Deer Mouse	2011-12	0	1993	26
AOC	Eastern Chipmunk	2011-12	13	1993	35
Control	Eastern Chipmunk	2011-12	0	1993	0
AOC	Short-tailed Shrew	2011-12	6	1993	0
Control	Short-tailed Shrew	2011-12	0	1993	3
AOC	Masked Shrew	2011-12	3	1993	1
Control	Masked Shrew	2011-12	1	1993	14
AOC	Meadow Vole	2011-12	4	1993	33
Control	Meadow Vole	2011-12	0	1993	25
AOC	Meadow Jumping Mouse	2011-12	1	1993	2
Control	Meadow Jumping Mouse	2011-12	0	1993	4

Weasel species were difficult to capture in both studies. One long-tailed weasel (*Mustella frenata*) was caught in 1993. A short-tailed weasel (*Mustella erminea*) and one mink (*Mustella vison*) were caught in the SRAOC during the latest survey. There were two mink and no weasels caught in the control area in the 2011 survey.

Other mammals that have been reported in the AOC include grey squirrels (*Sciurus carolineansis*), red squirrels (*Tamiasciurus hudsonicus*), cottontail rabbits (*Sylvilagus floridanus*), opossum (*Didelphus virginiana*), woodchucks (*Marmota monax*), and an abundance of raccoons (*Procyon lotor*). Four muskrats (*Ondatra zibethicus*) were caught incidental to trapping for mink in the SRAOC in 2011. Other mammals present in the SRAOC include red fox (*Vulpes vulpes*), grey fox (*Urocyon cinereoargenteus*) coyotes (*Canis latrans*), and white-tailed deer (*Odocoileus virginianus*).

Contaminant analyses of specimens collected during the current study are anticipated to be completed in the spring of 2012.

Aquatic Resources

Freshwater mussels are particularly sensitive to anthropogenic changes in waterways and therefore present good opportunities to evaluate the condition of streams and lakes. A healthy community consists of a diverse population with numerous year classes indicating reproduction is taking place. Populations that only consist of older, larger individuals suggest that the mussels are no longer reproducing, indicative of a relatively recent degradation of the resource (Galarneau 1999).

The overall health of the mussel community within the SRAOC varied from poor to excellent quality at various sites within the river. Water quality, flow rate, substrate suitability, historic species survivability, and evidence of reproduction were found to be important contributors to this variation in quality (Dare 2011). Fourteen sites were evaluated, three of which had poor

health, few individuals, little habitat available, and no evidence of recruitment. Two sites, **Rochester Park** and the **Kohler Property** along County Highway A, had excellent mussel community health, demonstrating good substrate and water quality, good species richness, and evidence of reproduction and recruitment. Two additional sites within the **Kohler Property** had good mussel communities and two other sites (**Taylor Avenue** and **Esslingen Park**) had good community health ratings. Overall, the entire river upstream from Taylor Avenue to Sheboygan Falls has a good possibility for mussel populations (Dare 2011). This may be related to the more natural vegetation buffering of the river in these areas. Additionally, non-native zebra (*Dreissena polymorpha*) and quagga mussels (*Dreissena bugensis*) are currently only found downriver in the Sheboygan Harbor.

Overall, the current mussel community was largely made up of four common species: white heelsplitter (*Lasmigona complanata*), fatmucket (*Lampsilis siliquoidea*), creeper (*Strophitus undulates*), and giant floater (*Pyganodon grandis*). Three rare or uncommon mussels were found in the SRAOC. Potential exists for other rare and uncommon species to be found within the SRAOC and continued surveys and monitoring of mussels in the river should be a priority. One concern for the long-term mussel community within the SRAOC, is the low numbers of juvenile mussels collected during survey efforts.

Fishes, Benthic Macroinvertebrate, and Stream Habitat

Aquatic surveys of the SRAOC, as well as tributaries within its project boundaries, were conducted to establish a baseline for community and habitat characteristics in these waters. Surveys included fish and benthic macroinvertebrate communities and stream habitat. Data derived from these surveys provide valuable information on the physical, chemical, and biological condition of streams. Monitoring was done from April through November 2011 and used standardized protocols.

Site selection was done to allow for spatial coverage of the SRAOC area and included the tributaries where fish passage existed. Four individual water bodies were chosen for the study and included the Sheboygan River upstream to the Sheboygan Falls Dam, Willow Creek, Weedens Creek, and the Onion River upstream to the Hingham Dam. Sixteen individual sites were monitoring for fish, macroinvertebrate, and habitat; and data from 2009 and 2010 were included for three sites on the Onion River. This was done for better spatial coverage of the Onion River. Therefore, a total of 19 sites were monitored or data included in the survey.

In 2011, sites were surveyed with electrofishing equipment following standard WDNR Fisheries Management Electrofishing protocols. Surveys estimated Index of Biotic Integrity (IBI; Table 8) appropriate for the waterbody and catch rate of gamefish. A total of four intolerant warmwater fish species were documented within the SRAOC (banded darter, northern hog sucker, rock bass and smallmouth bass). There were 31 native fish species found within the SRAOC that were tolerant/intermediate, warmwater/transitional species. Four introduced species were also documented from within the SRAOC including the common carp, chinook salmon, round goby, and steelhead.

Benthic macroinvertebrate communities rated excellent to poor in the Sheboygan River and its tributaries (Table 8). WDNR recently began using the Macroinvertebrate Index of Biotic Integrity (M-IBI) developed by Weigel (2003). The M-IBI is composed of various metrics used to interpret macroinvertebrate sample data. The majority of M-IBI scores in the SRAOC rated fair with some sites as poor, good or excellent (Table 8). A stream habitat rating is also included in Table 8 with streams ranking from excellent to fair in the SRAOC.

Table 8. Fish Community and Benthic Macroinvertebrate Index of Biotic Integrity (IBI), and Stream Habitat Ratings for Sheboygan River Area of Concern.

Site	Fish Community IBI	Macroinvertebrate IBI	Stream Habitat Rating
Sheboygan River 01	Good	Fair	Fair
Sheboygan River 02	Good	Fair	Fair
Sheboygan River 04	Excellent	Fair	Good
Sheboygan River 05	Excellent	Fair	Excellent
Sheboygan River 06	Excellent	Fair	Good
Sheboygan River 07	Excellent	Excellent	Fair
Sheboygan River 08	Fair	Good	Good
Sheboygan River 09	Excellent	Fair	Excellent
Willow Creek 01	Very Poor	Fair	Good
Willow Creek 02	Very Poor	Good	Good
Willow Creek 03	Good	Fair	Fair
Weedens Creek 01	Fair	Fair	Good
Weedens Creek 02	Poor	Fair	Fair
Onion River 01	Good	Fair	Good
Onion River 02	Excellent	Good	Excellent
Onion River 03	Good	Poor	Fair
Onion River 04	Good	Fair	Fair
Onion River 05	Good	Fair	Good
Onion River 06	Fair	Poor	Good

Notable findings during fish surveys include the identification of corridors for migratory fish in spring and fall within downstream portions of the SRAOC. Although no quantitative data was collected, qualitative observations of numerous species stacking up at the Waelderhaus Dam (the 1st barrier upstream of Lake Michigan) do exist. In spring, these species include: northern pike, walleye, white sucker, steelhead and three redhorse species. The fall run would include brown trout, chinook salmon, coho salmon and steelhead. Fyke net surveys near the intersection of Taylor Drive and Indiana Avenue documented a total of 14 northern pike. The presence of spawning size northern pike in this backwater area supports the idea that the creation of spawning marshes along the Sheboygan River may be of great benefit to this species. Additionally, young of the year northern pike and steelhead smolt are found at Weedens Creek, indicating this stream may function as a nursery area for these and other species. Future monitoring would be important to determine the significance of these findings. Finally, the documentation of a salmonid smolt in Willow Creek during surveys is encouraging and was confirmed by a separate survey conducted by WDNR staff from the Southern Lake Michigan Fisheries Team.

In summary, based on these recent surveys and observations, the fish communities of the Sheboygan River within the AOC are relatively healthy when considering species abundance and

diversity. However, consumption advisories for certain fish species within the Sheboygan River remain, due to elevated PCB levels found in fish tissue. While a true coldwater fish community wasn't documented at Willow Creek, the potential to support one remains. Challenges within Willow Creek watershed include a highly urbanized setting contributing to a flashy flow regime leading to degraded stream habitat. Fish communities of Weedens Creek are somewhat degraded as upstream reaches of the stream are impacted by agricultural practices and downstream reaches are subject to a severely flashy regime causing erosion issues. Overall, the presence of young of the year fish is encouraging and warrants future monitoring. Fish communities in the Onion River are relatively healthy and balanced, although river habitat changes related to land use practices, probably have had the largest impact on the health of the fish communities. This issue is an overriding one throughout the Sheboygan River watershed.

Ecological Priorities for SGCN

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

Natural Community Management Opportunities

The Wisconsin Wildlife Action Plan (WAP) (WDNR 2006b) identifies 28 natural communities for which there are “Major” or “Important” opportunities for protection, restoration, or management in the Central Lake Michigan Coastal Ecological Landscape. Eight of these natural communities are present on the SRAOC:

- Emergent Marsh
- Ephemeral Pond
- Floodplain Forest
- Northern Mesic Forest
- Southern Sedge Meadow
- Surrogate Grasslands
- Warmwater Rivers
- Warmwater Streams

Invasive Plants

Several non-native invasive plants are well-established in the SRAOC. Riparian and wetland areas of the SRAOC are the most vulnerable to the impacts of invasive species. Non-native invasive species thrive in disturbed areas, but also may invade and compromise high-quality natural areas. They establish quickly, tolerate a wide range of conditions, are easily dispersed, and are free of the diseases, predators, and competitors that kept their populations in check in their native range.

A targeted invasive species survey was completed in August and September of 2011. The survey encompassed approximately 1,390 acres of near-shore riparian area and floodplain along the Sheboygan River (referred to as project area). Populations of Japanese knotweed (*Polygonum cuspidatum*), common reed grass (*Phragmites australis*), garlic mustard, and common and glossy buckthorn were identified and mapped (Table 9).

Table 9: Populations of Targeted Invasive Species Identified and Mapped in SRAOC with their Abundance in the Project Area

Common Name	Scientific Name	Abundance	Acreage in Project
-------------	-----------------	-----------	--------------------

			Area
Buckthorn spp.	<i>Rhamnus</i> spp.	Abundant	206
Garlic Mustard	<i>Alliaria petiolata</i>	Abundant	96.7
Common Reed Grass	<i>Phragmites australis</i>	Low	5.1
Japanese Knotweed	<i>Polygonum cuspidatum</i>	Low	1.75

Source: Cedarburg Science Target Invasive Species Mapping and Treatment Plan

Other non target invasive plants that were identified in the project area include autumn olive (*Elaeagnus umbellata*), black locust, common burdock (*Arctium minus*), creeping-Charlie (*Glechoma hederacea*), crown-vetch (*Securigera varia*), dame’s rocket (*Hesperis matronalis*), exotic honeysuckles (*Lonicera* spp.), Japanese barberry, multiflora rose (*Rosa multiflora*), Queen Anne’s-lace (*Daucus carota*), reed canary grass, teasels (*Dipsacus* spp.), thistles (*Cirsium* spp.), tree-of-heaven (*Ailanthus altissima*), purple loosestrife (*Lythrum salicaria*) and wild parsnip (*Pastinaca sativa*).

Control efforts for all non-native invasive species will be conducted in the three habitat restoration sites and in the Schuchardt property. Treatment of targeted invasive species throughout the project area will also be undertaken. Common reed grass and Japanese knotweed populations are the highest priority with the goal of eradication of all populations. These populations are mainly dense monocultures and are threatening the wetland and riparian communities. Buckthorn and garlic mustard infestations may be too widespread in the SRAOC and in the surrounding landscape to eliminate. Treatment of these targeted invasive species will be focused on containment and protection of the habitat restoration sites and high value Conservation Sites. These populations range in density and are threatening the woodland communities.

The **Kohler Property** within the project area consists of approximately 781 acres along the Sheboygan River. The approximate extent of the targeted invasive species includes common reed grass (0.08 acres), Japanese knotweed (1.32 acres), garlic mustard (59.31 acres), and buckthorn (153.58 acres). Many areas have buckthorn and garlic mustard co-occurring. The **Schuchardt Property** is also invaded with the target species. The woodland and wetland communities within the property contain high densities of buckthorn and garlic mustard. Both common reed grass and Japanese knotweed have also been identified on the property, occurring in smaller populations.

The Sheboygan River within the SRAOC has a low amount of aquatic plant growth. Eurasian water-milfoil (*Myriophyllum spicatum*) and curly pondweed (*Potamogeton crispus*) have been documented in the Sheboygan river system but have not been a major problem in the SRAOC due to poor conditions for macrophyte growth including turbidity and high flow levels.

Recommended actions to preserve natural communities within the SRAOC include following up after the described treatment of invasive species and continued monitoring for future treatments. Educating landowners about the potential impacts of invasive species on their property will benefit future invasive species control.

Conservation Sites: Site-specific Opportunities for Biodiversity Conservation

Two ecologically important sites were identified on the SRAOC. These “Conservation Sites” were delineated because they generally encompass the best examples of 1) rare and representative natural communities, 2) documented occurrences of rare species or SGCN populations, and/or 3) opportunities for ecological restoration or connections. These sites warrant high protection and restoration consideration during the development of the property Fish and Wildlife Habitat Management and Restoration Plan. This report is meant to be considered along with other information when identifying opportunities for various management regimes and restoration efforts during future activities occurring throughout the SRAOC.

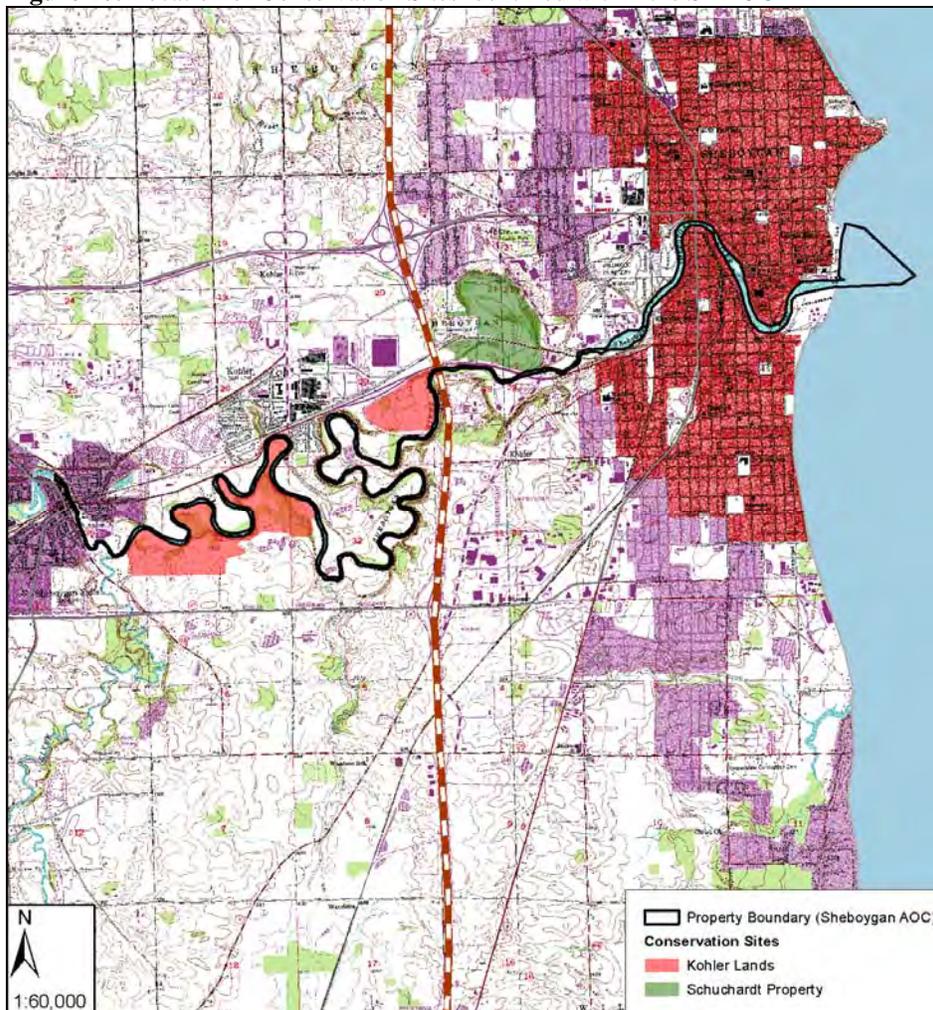
Descriptions for each of the Conservation Sites can be found in Appendix E.

Sheboygan River Area of Concern Conservation Sites

SRAOC01. Kohler Property

SRAOC02. Schuchardt Property

Figure 10: Location of Conservation Sites identified within the SRAOC



Future Needs

This project was designed to provide a rapid assessment of the biodiversity values for the SRAOC. Additional efforts could help to inform future adaptive management efforts, along with providing useful information regarding the natural communities and rare species contained in the SRAOC.

- Invasive species monitoring and control – establishing an invasive species monitoring protocol will be critical for the SRAOC. Public and private lands throughout Wisconsin are facing major management problems because of serious infestations of highly invasive species such as emerald ash borer (*Agrilus planipennis*), gypsy moth (*Lymantria dispar*), garlic mustard, reed canary grass, European buckthorns, and Eurasian honeysuckles. In order to protect the biodiversity values of the SRAOC, a comprehensive plan will be needed for detecting and rapidly responding to new invasive threats.
- Emerald ash borer monitoring and control -- The emerald ash borer is of major concern for the SRAOC as a population has been detected in Ozaukee County. Floodplain Forest makes up a considerable percentage of forest cover along the Sheboygan River and ash species are a component of the forest canopy putting them at risk for invasion. Monitoring for symptoms of EAB and rapid response to new invasions is necessary to slow or halt the spread and protect the ash resource and the forest diversity.
- Locations and likely habitats should be identified for conducting additional rare plant and animal surveys during appropriate seasons. Breeding bird surveys were not done at the Schuchardt Property and other parcels within the SRAOC. These would be a high priority for future work.
- Migratory bird surveys should be done focusing on spring and fall migratory bird concentration areas and bird abundance.
- Inventory and mapping of all Ephemeral Ponds within in the SRAOC would be an important consideration for the SRAOC.
- Further survey of seepage areas for pickerel frogs and rare plants should be considered.
- Locate and protect summer bat roost locations.
- Additional inventory and monitoring of mussel community health as the lower Sheboygan River continues to recover from contamination. An assessment of the mussel population post-dredging should be a high priority.
- Future monitoring would be important to determine the significance of the presence of young of the year northern pike and steelhead smolt at Weedens Creek, and determining if this area is functioning as a nursery area for these and other species.
- Future monitoring of Willow Creek for salmonid smolt and coldwater species would be warranted as changes occur in the watershed.
- Future monitoring of the Sheboygan River for both fish community and contaminant level changes post-dredging / post-instream habitat improvements.
- An assessment to quantify effects of surrounding land uses (nonpoint pollution, streambank erosion) on water quality in the SRAOC.
- Utilize target species and monitoring protocols to determine if fish and wildlife habitat improvements have effectively addressed the Beneficial Use Impairments existing within the SRAOC.

Glossary

adaptive management - a formal, structured approach to dealing with uncertainty in natural resource management, using the experience of management as an ongoing and continually improving process.

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

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

ecological priority – the natural communities (habitats) in each Ecological Landscape that are most important to the Species of Greatest Conservation Need, as identified in the Wisconsin Wildlife Action Plan (WDNR 2006b). Three sources of data were used to derive this information: 1) the probability that a species will occur in a given landscape, 2) the degree to which a species is associated with a particular natural community, and 3) the degree to which there are opportunities for sustaining a given natural community in any given Ecological Landscape. See dnr.wi.gov/land/er/wwap/explore/tool for more information.

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

element occurrence - an Element Occurrence (EO) is an area of land and/or water in which a rare species or natural community is, or was, present. An EO should have practical conservation value for the Element as evidenced by potential continued (or historic) presence and/or regular recurrence at a given location. For species, the EO often corresponds with the local population, but when appropriate may be a portion of a population (e.g., a single nest territory or long distance dispersers) or a group of nearby populations (e.g., metapopulation). For communities, the EO may represent a stand or patch of a natural community or a cluster of stands or patches of a natural community. Because they are defined on the basis of biological information, EOs may cross jurisdictional boundaries (modified from <http://whiteoak.natureserve.org/eodraft/index.htm>)

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

Migratory Bird Stopover Site – describes a site comprising a set of habitats that birds select during migration. Ideal stopover sites provide accessible water, protection, and food so that birds can not only survive but also regain energy lost during their travels (Duncan 2002).

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

National Hierarchical Framework of Ecological Units (NHFEU) – a land unit classification system developed by the U.S. Forest Service and many collaborators. As described by Avers et al (1994): “The NHFEU can provide a basis for assessing resource conditions at multiple scales. Broadly defined ecological units can be used for general planning assessments of resource capability. Intermediate scale units can be used to identify areas with similar disturbance regimes. Narrowly defined land units can be used to assess specific site conditions including: distributions of terrestrial and aquatic biota; forest growth, succession, and health; and various physical conditions.”

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

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

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

Subsection – This is a level in the NHFEU that is intermediate in scale. Subsections are characterized by distinctive glacial landforms (e.g., outwash or moraine), soils, and broadly, by vegetation. The 16 Ecological Landscapes developed by the WDNR are largely based on NHFEU Subsections (see *Ecological Landscape*).

Species List

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

Common Name	Scientific Name
Animals	
American Crow	<i>Corvus brachyrhynchos</i>
Belted Kingfisher	<i>Cyrcle alcyon</i>
Big Brown Bat	<i>Eptesicus fuscus</i>
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>
Black-capped Chickadee	<i>Poecile atricapillus</i>
Blue-winged Teal	<i>Anas discors</i>
Bobolink	<i>Dolichonyx oryzivorus</i>
Clay-colored Sparrow	<i>Spizella pallida</i>
Common Carp	<i>Cyprinus carpio</i>
Common Goldeneye	<i>Bucephala clangula</i>
Common Merganser	<i>Mergus Merganser</i>
Creepers	<i>Strophitus undulates</i>
Dark-eyed Junco	<i>Junco hyemalis</i>
Dickcissel	<i>Spiza americana</i>
Eastern Meadowlark	<i>Sturnella magna</i>
Emerald Ash Borer	<i>Agrilus planipennis</i>
Fairy Shrimp	<i>Eubranchipus spp.</i>
Fatmucket	<i>Lampsilis siliquoidea</i>
Giant Floater	<i>Pyganodon grandis</i>
Greater Scaup	<i>Aythya marila</i>
Gypsy Moth	<i>Lymantria dispar</i>
Herring Gull	<i>Larus argentatus</i>
House Sparrow	<i>Passer domesticus</i>
Lesser Scaup	<i>Aythya affinis</i>
Little Brown Bat	<i>Myotis lucifugus</i>
Mallard	<i>Anas platyrhynchos</i>
Mourning Dove	<i>Zenaida macroura</i>
Northern Pike	<i>Esox lucius</i>
Pickereel Frog	<i>Lithobates palustris</i>
Quagga Mussel	<i>Dreissena bugensis</i>
Round Pigtoe	<i>Pleurobema sintoxia</i>
Savannah Sparrow	<i>Passerculus sandwichensis</i>
Walleye	<i>Sander vitreus</i>
White Heelsplitter	<i>Lasmigona complanata</i>
Wood Frogs	<i>Rana sylvatica</i>
Zebra Mussel	<i>Dreissena polymorpha</i>
Plants	
American Beech	<i>Fagus grandifolia</i>
Basswood	<i>Tilia americana</i>
Black Locust	<i>Robinia pseudoacacia</i>
Box Elder	<i>Acer negundo</i>
Blue-joint Grass	<i>Calamagrostis canadensis</i>
Cat-tails	<i>Typha spp.</i>
Common Buckthorn	<i>Rhamnus cathartica</i>

Common Reed Grass	<i>Phragmites australis</i>
Dame's Rocket	<i>Hesperis matronalis</i>
Eastern Hemlock	<i>Tsuga canadensis</i>
Eastern White Pine	<i>Pinus strobus</i>
Elms	<i>Ulmus</i> spp.
Filamentous Algae	<i>Cladophora</i> sp.
Garlic Mustard	<i>Alliaria petiolata</i>
Glossy Buckthorn	<i>Rhamnus frangula</i>
Green Ash	<i>Fraxinus pennsylvanica</i>
Honeysuckles	<i>Lonicera</i> spp.
Japanese Barberry	<i>Berberis thunbergii</i>
Japanese Knotweed	<i>Polygonum cuspidatum</i>
Narrow-leaved Cat-tail	<i>Typha angustifolia</i>
Northern Red Oak	<i>Quercus rubra</i>
Orange Jewelweed	<i>Impatiens capensis</i>
Purple Loosestrife	<i>Lythrum salicaria</i>
Reed Canary Grass	<i>Phalaris arundinacea</i>
Sago Pondweed	<i>Potamogeton pectinatus</i>
Showy Bush Honeysuckle	<i>Lonicera x bella</i>
Sugar Maple	<i>Acer saccharum</i>
Virginia Waterleaf	<i>Hydrophyllum virginianum</i>
Water Smartweed	<i>Polygonum amphibium</i>
White Oak	<i>Quercus alba</i>
Wild Leek	<i>Allium tricoccum</i>
Yellow Trout-lily	<i>Erythronium americanum</i>

Reference List

- Alverson, W.W., D.M. Waller, and S.L. Solheim. 1988. Forests Too Deer: Edge effects in Northern Wisconsin. *Conserv. Biol.* 2:348-358.
- Burzynski, M. 2000. Sheboygan River Food Chain and Sediment Contaminant Assessment. Final project report to U.S. EPA Grant #GL-995681. Available online: <http://www.epa.gov/glnpo/sediment/FoodChain/index.html>
- Cleland, D. T., Avers, P. E., McNab, W. H., Jensen, M. E., Bailey, R. G., King, T., & Russell, W. E. (1997). National Hierarchical Framework of Ecological Units. In M. S. Boyce & A. Haney (Eds.), *Ecosystem Management Applications for Sustainable Forest and Wildlife Resources* (1997th ed., pp. 181-200). New Haven, Connecticut: Yale University Press. Retrieved from http://files.dnr.state.mn.us/natural_resources/ecs/nhfeu.pdf
- Curtis, J. T. 1959. *The Vegetation of Wisconsin*. University of Wisconsin Press, Madison, WI. 657 pp.
- Dare, J. 2011. Qualitative Unionid Mussel Surveys and Habitat Assessment of the Sheboygan River AOC; Sheboygan County, Wisconsin. A report conducted for the Natural Heritage Inventory, Bureau of Endangered Resources.
- Diehl, R. H., Larkin, R. P., and Black, J. E. 2003. Radar observations of bird migration over the Great Lakes. *The Auk* 120(2): 278-290.
- Ecosystem Management Planning Team (EMPT). 2007. Table of Opportunities for Sustain Natural Communities by Ecological Landscape. Available online: <http://dnr.wi.gov/landscapes/ecoloppstable.pdf>
- Epstein, E., E. Spencer, and D. Feldkirchner. 2002a. A Data Compilation and Assessment of Coastal Wetlands of Wisconsin's Great Lakes. Natural Heritage Inventory Program. WDNR. Madison, WI.
- Epstein, E.J., E.J. Judziewicz, and E.A. Spencer. 2002b. Wisconsin Natural Community Abstracts. Department of Natural Resources, Bureau of Endangered Resources, Madison, WI. Available online: dnr.wi.gov/org/land/er/communities/
- Finley, R.W. 1976. Original Vegetation Cover of Wisconsin. Map compiled from General Land Office
- Galarneau, S. 1999. Mussel Survey – Sheboygan River Upstream and Downstream of the Franklin Impoundment.
- Grveles, K. and S. Matteson. 2008. Implementing a strategy for protecting bird migration stopover habitats in the western Great Lakes: 2008-2112, WI DNR, Unpublished report.
- Grveles, K. and S. Matteson. 2011. Respite for Migratory Birds: Saving Great Lakes Stopover Sites. Wisconsin Natural Resources. August 2011. pp. 4-9.

- Heinz, G. H., Swineford, D. M., and Katsma, D. E. 1984. High PCB residues in birds from the Sheboygan River, Wisconsin. *Environmental Monitoring and Assessment* 4(2): 155-161.
- Herkert, J. R. 1995. An Analysis of Midwestern Breeding Bird Population Trends: 1966-1993. *American Midland Naturalist* 134(1): 41-50.
- Hetzel, R. 1995. Bird, Mammal, and Herptile Survey and Report for the Sheboygan River Area of Concern. A Report to the Wisconsin Department of Natural Resources.
- Hoffman, R. 2002. Wisconsin's Natural Communities: How to Recognize Them, Where to Find Them. The University of Wisconsin Press, Madison, WI.
- Hubert, V. L. 1988. The breeding bird community of the Pigeon River floodplain, Sheboygan County, Wisconsin. Master's Thesis: University of Wisconsin-Madison.
- Humphrey, S. R., and Cope, J. B. 1976. Population ecology of the little brown bat, *Myotis lucifugus*, in Indiana and northcentral Kentucky. *American Society of Mammalogists Special Publication* 4: 1-81.
- Idzikowski, J. 2005. Radar Ornithology: Implications for a New Technology. *The Passenger Pigeon*. Vol. 67, No. 1: 49-51.
- Last, L. 2011. Quality Assurance Project Plan: Sheboygan AOC Pathway to Delisting Habitat BUI's – Survey and Assessment. Prepared for: U.S. Environmental Protection Agency. Project Proposal Number: EPAGLNPO-2010-TX-1-807-421.
- Limpens, J. G. A., and Kapteyn, K. 1991. Bats, their behavior and linear landscape elements. *Myotis* 29: 39-48.
- Masterson, John. 2006. Willow Creek Baseline Monitoring Report – Sheboygan River Basin. WDNR Report. 18 pages.
- Masterson, John. 2008. Request for Reclassification of Willow Creek, Sheboygan County as Class II Trout Water. WDNR Report.
- Michigan Society of American Foresters. 2006. Position statement on white-tailed deer management in Michigan. <http://michigansaf.org/Business/PosStates/Deer.htm>
- Moore, F. R (ed.). 2000. Stopover ecology of Nearctic-Neotropical landbird migrants: habitat relations and conservation implications. *Studies in Avian Biology* No. 20. Cooper Ornithological Society: Camarillo, CA.
- Robbins, S. D., Sample, D. W., Rasmussen, P. W., and Mossman, M. J. 1996. The breeding bird survey in Wisconsin: 1966-1991. *Passenger Pigeon* 58:81-179.
- Rooney, T.P. and D.M. Waller. 2003. Direct and indirect effects of deer in forest ecosystems. *Forest Ecology & Management* 181:165-176.
- Rooney, TP, SM Wiegmann, DA Rogers, and DM Waller. 2004. Biotic impoverishment and homogenization in unfragmented forest understory communities. *Conservation Biology* 18:787-798.

- Rosenberg, K.V. 2004. Partners in Flight Continental Priorities and Objectives Defined at the State and Bird Conservation Region Levels: Wisconsin. Cornell Lab of Ornithology. May, 2004.
- Sauer, J.R., J.E. Hines, and J. Fallon. 2005. The North American Breeding Bird Survey, Results and Analysis 1966 - 2005. Version 6.2.2006. USGS Patuxent Wildlife Research Center, Laurel, MD.
- Schulte, L. A., & Mladenoff, D. J. (2001). The Original US Public Land Survey Records: Their Use and Limitations in Reconstructing Presettlement Vegetation. *Journal of Forestry* 99(10): 5-10.
- Schulte, L.A., D.J. Mladenoff, T.R. Crow, L. Merrick, and D.T. Cleland. 2007. Homogenization of northern U.S. Great Lakes forests as a result of land use. *Landscape Ecology* 22:1089-1103.
- Seeley, A. L. 1993. Small mammal populations along PCB contaminated sections of the Sheboygan River, Wisconsin. Summer internship project for the Wisconsin Department of Natural Resources through the University of Wisconsin, Stevens Point.
- Sillett, T. S., and Holmes, R. T. 2002. Variation in survivorship of a migratory songbird throughout its annual cycle. *Journal of Animal Ecology* 71(2): 296-308.
- Taylor, D. A. R. 2006. Forest Management and Bats. Copyright Bat Conservation International. Available online: <http://www.batcon.org/pdfs/ForestMgmtandBats.pdf>.
- United States Census Bureau. 2010. U.S. Census Bureau. Available online: <http://factfinder.census.gov/home/saff/main.html>
- Verboom, B., and Huitema, H. 1996. The importance of linear landscape elements for the pipistrelle *Pipistrellus pipistrellus* and the serotine bat *Eptesicus serotinus*. *Landscape Ecology* 12(2): 117-125.
- Weber, J., R. Poff, and C.W. Threinen. 1968. Surface Water Resources of Sheboygan County. Wisconsin DNR. Madison, WI.
- Weigel, B.M. 2003. Development of stream macroinvertebrate models that predict watershed and local stressors in Wisconsin. *Journal of the North American Benthological Society*. v. 22., p. 123-142.
- Wisconsin Department of Natural Resources [WDNR]. In Prep. DRAFT Ecological Landscapes of Wisconsin. State of Wisconsin, Dept. of Nat. Resources, Handbook. 1805.1. Madison, WI
- Wisconsin Department of Natural Resources [WDNR]. 1993. Wisconsin DNR Wiscland GIS coverage.
- Wisconsin Department of Natural Resources [WDNR]. 2001a. Water resources of the Sheboygan River basin. Supplement to *The state of the Sheboygan River basin*. May, 2001. Available online: http://dnr.wi.gov/water/basin/sheboygan/WATERRESOURCES_JUNE_2001.pdf
- Wisconsin Department of Natural Resources [WDNR]. 2001b. The State of the Sheboygan River Basin. Oct. 2001. Pub. # WT-669-2001. Available online: http://dnr.wi.gov/water/basin/sheboygan/Sheboygan_Final_10_01.pdf

- Wisconsin Department of Natural Resources [WDNR]. 2004. Wisconsin's Statewide Forest Plan: Ensuring a Sustainable Future. Available online: <http://dnr.wi.gov/forestry/assessment/>.
- Wisconsin Department of Natural Resources [WDNR]. 2006a. Wisconsin Land Legacy Report: an inventory of places critical in meeting Wisconsin's future conservation and recreation needs. Madison, WI.
- Wisconsin Department of Natural Resources [WDNR]. 2006b. Wisconsin Wildlife Action Plan. Available at <http://dnr.wi.gov/org/land/er/wwap/plan/>.
- Wisconsin Department of Natural Resources [WDNR]. 2006c. Old-growth and Old Forests Handbook. In preparation. Madison, WI.
- Wisconsin Department of Natural Resources [WDNR]. 2010. Wisconsin's Statewide Forest Strategy. Available online: <http://dnr.wi.gov/forestry/assessment/strategy/overview.htm>.
- Wisconsin Natural Heritage Working List*. Wisconsin Department of Natural Resources. Web. <<http://dnr.wi.gov/org/land/er/wlist/>>.

Additional Resources

Numerous online resources are available for learning more about the rare species, natural communities, and ecological concepts contained within this report. These are just a few of the resources that we recommend.

- 1. Bureau of Endangered Resources' Animals, Plants, and Communities Web Pages.** Information for plants, animals, and natural communities on the Wisconsin Working List, as well as Species of Greatest Conservation Need from the Wisconsin Wildlife Action Plan. For reptiles and amphibians, information for more common species is also provided here. At this time, the level of detail available varies among species; some have detailed factsheets while others have only a short paragraph or a map. These pages will continue to evolve as more information becomes available and are the Bureau of Endangered Resources' main source of information for species and communities.
dnr.wi.gov/org/land/er/biodiversity/
- 2. Wisconsin Natural Heritage Inventory Working List.** The Wisconsin Natural Heritage Working List contains species known or suspected to be rare in the state and natural communities native to Wisconsin. It includes species legally designated as "Endangered" or "Threatened" as well as species in the advisory "Special Concern" category. This Web page offers a printable pdf file and a key to the Working List for use in conjunction with the information provided in #1 above. *dnr.wi.gov/org/land/er/wlist/*
- 3. Ecological Landscapes of Wisconsin Handbook.** Wisconsin's 16 Ecological Landscapes have unique combinations of physical and biological characteristics such as climate, geology, soils, water, or vegetation. This handbook will contain a chapter for each of these landscapes with detailed information about their ecology, socioeconomics, and ecological management opportunities. An additional introductory chapter will compare the 16 landscapes in numerous ways, discuss Wisconsin's ecology on the statewide scale, and introduce important concepts related to ecosystem management in the state. The full handbook is in development as of this writing, and chapters will be made available online as they are published. Currently, a set of Web pages provide brief Ecological Landscape descriptions, numerous maps, and other useful information, including management opportunities for natural communities and Species of Greatest Conservation Need. *dnr.wi.gov/landscapes/*
- 4. The Wisconsin Wildlife Action Plan.** This plan is the result of a statewide effort to identify native Wisconsin animal species of greatest conservation need. The plan also presents priority conservation actions to protect the species and their habitats. The plan itself is available online, and there are several online tools to explore the data within the plan. The Web pages are closely integrated with the pages provided in items #1 and #3 above. The Wildlife Action Plan Web pages are quite numerous, so we recommend the following links as good starting points for accessing the information.
 - the plan itself: *dnr.wi.gov/org/land/er/wwap/*
 - explore Wildlife Action Plan data: *dnr.wi.gov/org/land/er/wwap/explore/*
 - Wildlife Action Plan Implementation:
dnr.wi.gov/org/land/er/wwap/implementation/

5. **Wisconsin's Biodiversity as a Management Issue - A Report to Department of Natural Resources Managers.** This now out-of-print report presents a department strategy for conserving biological diversity. It provides department employees with an overview of the issues associated with biodiversity and provides a common point of reference for incorporating the conservation of biodiversity into our management framework. The concepts presented in the report are closely related to the material provided in this report, as well as the other resources listed in this section.
dnr.wi.gov/org/es/science/publications/rs915_95.htm

8. **Water Resources of the Sheboygan River Basin** (WDNR 2001a) a supplement to the **State of the Sheboygan River Basin Report** (WDNR 2001b) intended to provide a mechanism for identifying natural resource needs, priorities and recommendations for the Sheboygan River Basin. The reports highlighted the strategic priorities of the WDNR, their partners and the public for the conservation and management of important natural resources in the Sheboygan River basin for the next several years. The supplement **Water Resources of the Sheboygan River Basin** provided detailed water quality data to support the summary information and recommendations in the **State of the Sheboygan River Basin Report**.
 - The state of the Sheboygan River Basin report:
http://dnr.wi.gov/water/basin/sheboygan/Sheboygan_Final_10_01.pdf
 - The water resources of the Sheboygan River Basin report:
http://dnr.wi.gov/water/basin/sheboygan/WATERRESOURCES_JUNE_2001.pdf

9. The **Sheboygan River Area of Concern (AOC)** encompasses the lower Sheboygan River downstream from the Sheboygan Falls Dam, including the entire harbor and nearshore waters of Lake Michigan. The AOC serves as a sink for pollutants carried from three watersheds: the Sheboygan River, Mullet River and Onion River. Pollutants of concern, both conventional and toxic, have been identified as suspended solids, fecal coliform bacteria, phosphorus, nitrogen, polychlorinated biphenyls (PCBs), Polynuclear AromaticHydrocarbons (PAHs) and heavy metals. The Sheboygan River Basin is located in portions of five counties. Industrial, agricultural and residential areas line the rivers of the basin. Agriculture is the dominant land use in the area, totaling 67%. The Sheboygan, Onion and Mullet River Basins contain three cities, eleven villages and seven towns. The cities of Sheboygan and Sheboygan Falls and the Village of Kohler are all located within the AOC. <http://www.epa.gov/greatlakes/aoc/sheboygan.html#pagetop>

10. **Invasive Species Report of the Sheboygan River AOC** was prepared to identify target invasive species for the AOC and map the extent of these populations in the project area. This and many other resources related to the efforts taking place within the Sheboygan River AOC are located here:
<http://dnr.wi.gov/org/water/greatlakes/priorities/sheboygan.htm>

Appendix A

Natural Heritage Inventory Overview and General Methodology

This biotic inventory and analysis was conducted by the Wisconsin Natural Heritage Inventory (NHI) program. The Wisconsin NHI program is part of the Wisconsin DNR's Bureau of Endangered Resources and a member of an international network of Natural Heritage programs representing all 50 states, as well as portions of Canada, Latin America, and the Caribbean. These programs share standardized methods for collecting, processing, and managing data for rare species, natural communities, and certain other natural features (e.g., bird rookeries). NatureServe, an international non-profit organization, coordinates the network. This appendix provides a general overview of the methodology we use for these projects. Please see the NatureServe Web site for more detailed information about standard methods used by the Heritage Network (www.NatureServe.org) for locating, documenting, and ranking rare species and natural community occurrences.

General Process Used when Conducting Biotic Inventories for Master Planning

The Wisconsin NHI Program typically uses a "coarse filter-fine filter" approach to conducting biotic inventory projects for master planning. This approach begins with a broad assessment of the natural communities and aquatic features present, along with their relative quality and condition. The area's landforms, soils, topography, hydrology, current land uses, and the surrounding matrix are also evaluated using Geographic Information Systems (GIS) and other electronic and hardcopy data sources. Data that describe conditions for the area prior to Euro-American settlement are often used during this step and at other times to further understand the ecological capabilities of the area. Often, we consult with local managers, biologists, or others familiar with the ecology of the area when preparing for an inventory project. The goals for this step are to identify the important ecological attributes and biological processes present, as well as to focus our inventory efforts.

The level of survey intensity varies based on the size and ecological complexity of the property or group of properties, as well as the resources available. For larger properties such as state forests, biotic inventory efforts typically take more than one year. Ideally, taxa surveys are conducted following a coarse-filter analysis that sometimes include extensive natural community surveys. There is often time for "mop-up work" during the year following the completion of the main survey effort, whereby additional surveys are conducted for areas that could not be reached the first year or for which new information has become available. For smaller properties, a "Rapid Ecological Assessment" often takes the place of a full-scale biotic inventory. The level of effort for these projects varies based on the needs of the study area, although surveys are almost always completed during one field season. Coarse filter work for rapid assessments is often done based on GIS data, aerial photos, data acquired from previous efforts, and information from property managers and others knowledgeable about the area.

Taxa-specific surveys can be costly and intensive and sometimes must be completed during a very narrow period of time. For example, bird surveys must be completed within an approximately one-month time window. For this and several other reasons, ***our surveys cannot locate every rare species occurrence within a given area.*** Therefore, it is important to use resources as efficiently as possible, making every effort to identify the major habitats present in the study area from the start. This approach concentrates inventory efforts on those sites most likely to contain target species to maximize efficient use of resources. Communication among biologists during the field season can help identify new areas of interest or additional priorities for surveys. The goal is to locate species populations with the highest conservation value whenever possible.

After all of the data are collected, occurrences of rare species, high-quality natural communities, and certain other features are documented, synthesized, and incorporated into the NHI Database. The NHI program refers to this process as “mapping” the data and uses a tabular and spatial database application designed specifically for the Heritage Network. Other secondary databases are also used by the Wisconsin NHI Program for storing additional species and community information such as species lists, GPS waypoints, photos, and other site documentation.

Once the data mapping and syntheses are completed, the NHI Program evaluates data from the various department biologists, contractors, and other surveyors. This information is examined along with many other sources of spatial and tabular information including topographic maps, various types of aerial photography, digital soil and wetland maps, hydrological data, forest reconnaissance data, and land cover data. Typically, GPS waypoints and other spatial information from the various surveys are superimposed onto these maps for evaluation by NHI biologists.

In addition to locating important rare species populations and high-quality natural community occurrences, the major products culminating from all of this work are the “Primary Sites.” These areas contain relatively undisturbed, high-quality, natural communities; provide important habitat for rare species; offer opportunities for restoration; could provide important ecological connections; or some combination of the above factors. The sites are meant to highlight, based on our evaluation, the best areas for conserving biological diversity for the study area. They often include important rare species populations, High Conservation Value Forests, or other ecologically important areas.

The final report describes the Primary Sites, as well as rare or otherwise notable species, and other ecological opportunities for conserving or enhancing the biological diversity of the study area. The report is intended for use by department master planning teams and others and strives to describe these opportunities at different scales, including a broad, landscape context that can be used to facilitate ecosystem management.

Select Tools Used for Conducting Inventory

The following are descriptions of standard tools used by the NHI Program for conducting biotic inventories. Some of these may be modified, dropped, or repeated as appropriate to the project.

File Compilation: Involves obtaining existing records of natural communities, rare plants and animals, and aquatic features for the study area and surrounding lands and waters from the NHI Database. Other databases with potentially useful information may also be queried, such as: forest reconnaissance data; the DNR Surface Water Resources series for summaries of the physical, chemical, and biological characteristics of lakes and streams (statewide, by county); the Milwaukee Public Museum's statewide Herp Atlas; the Wisconsin Breeding Bird Atlas; other NHI “atlas” and site databases; museum/herbarium collections for various target taxa; soil surveys; geological surveys; and the department's fish distribution database.

Additional data sources are sought out as warranted by the location and character of the site, and the purpose of the project. Manual files maintained within the Bureau of Endangered Resources, including the State Natural Area files, often contain information on a variety of subjects relevant to the inventory of natural features for an area.

Literature Review: Field biologists involved with a given project consult basic references on the natural history and ecology of the area, as well as any documented rare species. This sometimes broadens and/or sharpens the focus of the inventory efforts.

Target Elements: Lists of target elements including natural communities, rare plants and animals, and aquatic features are developed for the study area. Field inventory is then scheduled for the times when these elements are most identifiable or active. Inventory methods follow accepted scientific standards for each taxon.

Compilation of Maps and Other Spatial Data: USGS 7.5 minute topographic quadrangles, most often in digital form, serve along with aerial photos as the base maps for field survey and often yield useful clues regarding access, extent of area to be surveyed, developments, and the presence and location of special features. These are used in conjunction with numerous GIS layers, which are now a basic resource tool for the efficient and comprehensive planning of surveys and the analysis of their results.

WDNR wetland maps consist of aerial photographs upon which all wetlands down to a scale of 2 or 5 acres have been delineated. Each wetland polygon is classified based on characteristics of vegetation, soils, and water depth. These polygons have been digitized for most counties, and the resulting GIS layers can be superimposed onto other maps.

Ecoregion GIS layers are useful for comprehensive projects covering large geographic areas such as counties, national and state forests, and major watersheds. These maps integrate basic ecological information on climate, landforms, geology, soils, and vegetation. Ecological Landscapes provide the broad framework most often used in Wisconsin; however smaller units, including Landtype Associations, can be very helpful for evaluating ecoregions at finer scales.

Aerial photographs: These provide information on a study area not available from maps, paper files, or computer printouts. Examination of both current and historical photos, taken over a period of decades, can be especially useful in revealing changes in the environment over time. The Wisconsin NHI Program uses several different types of both color and black and white air photos. Typically, these are in digital format, although paired photos in print format can be valuable for stereoscopic viewing. High-resolution satellite imagery is often cost-prohibitive but is available for some portions of the state and is desirable for certain applications.

Original Land Survey Records: The surveyors who laid out the rectilinear Town-Range-Section grid across the state in the mid-nineteenth century recorded trees by species and size at all section corners and along section lines. Their notes also included general impressions of vegetation, soil fertility, and topography, and note aquatic features, wetlands, and recent disturbances such as windthrow and fire. As these surveys typically occurred prior to extensive settlement of the state by Europeans, they constitute a valuable record of conditions prior to extensive modification of the landscape by European technologies and settlement patterns. The tree data are available in GIS format as raw points or interpreted polygons, and the notes themselves can provide helpful clues regarding the study area's potential ecological capabilities.

Interviews: Interviews with scientists, naturalists, land managers or others knowledgeable about the area to be surveyed often yield invaluable information.

Global Positioning Systems (GPS): Small, portable GPS units are now a routine piece of field equipment used for virtually all NHI survey work. Collecting coordinates (waypoints) facilitates mapping and makes it easy to quickly communicate specific locations among biologists. Often waypoints are paired with photos and/or other information and stored in a waypoint tracking database.

Aerial Reconnaissance: Fly-overs are desirable for large sites, and for small sites where contextual issues are especially important. When possible, this should be done both before and after ground level work. Flights are scheduled for those times when significant features of the study area are most easily identified and

differentiated. They are also useful for observing the general lay of the land, vegetation patterns and patch sizes, aquatic features, infrastructure, and disturbances within and around the site

Wisconsin Natural Heritage Working List Explanation

The Wisconsin Natural Heritage Working List contains species known or suspected to be rare in the state and natural communities native to Wisconsin. It includes species legally designated as "Endangered" or "Threatened" as well as species in the advisory "Special Concern" category. Most of the species and natural communities on the list are actively tracked and we encourage data submissions on these species. This list is meant to be dynamic - it is updated as often as new information regarding the biological status of species becomes available. See the Endangered Resources Program web site for the most recent Natural Heritage Inventory Working List (<http://dnr.wi.gov/org/land/er/wlist/>).

Key

Scientific Name: Scientific name used by the Wisconsin Natural Heritage Inventory Program.

Common Name: Standard, contrived, or agreed upon common names.

Global Rank: Global element rank. See the rank definitions below.

State Rank: State element rank. See the rank definitions below.

US Status: Federal protection status in Wisconsin, designated by the Office of Endangered Species, U.S. Fish and Wildlife Service through the U.S. Endangered Species Act. LE = listed endangered; LT = listed threatened; XN = non-essential experimental population(s); LT,PD = listed threatened, proposed for de-listing; C = candidate for future listing.

WI Status: Protection category designated by the Wisconsin DNR. END = endangered; THR = threatened; SC = Special Concern.

WDNR and federal regulations regarding Special Concern species range from full protection to no protection. The current categories and their respective level of protection are SC/P = fully protected; SC/N = no laws regulating use, possession, or harvesting; SC/H = take regulated by establishment of open closed seasons; SC/FL = federally protected as endangered or threatened, but not so designated by WDNR; SC/M = fully protected by federal and state laws under the Migratory Bird Act.

Special Concern species are those species about which some problem of abundance or distribution is suspected but not yet proved. The main purpose of this category is to focus attention on certain species before they become threatened or endangered.

Global & State Element Rank Definitions

Global Element Ranks:

G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single state or physiographic region) or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.

G4 = Apparently globally secure, though it may be quite rare in parts of its range, especially at the periphery.

G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

GH = Of historical occurrence throughout its range, i.e., formerly part of the established biota, with the expectation that it may be rediscovered.

GU = Possibly in peril range-wide, but their status is uncertain. More information is needed.

GX = Believed to be extinct throughout its range (e.g. Passenger pigeon) with virtually no likelihood that it will be rediscovered.

G? = Not ranked.

Species with a questionable taxonomic assignment are given a "Q" after the global rank.

Subspecies and varieties are given subranks composed of the letter "T" plus a number or letter. The definition of the second character of the subrank parallels that of the full global rank. (Examples: a rare subspecies of a rare species is ranked G1T1; a rare subspecies of a common species is ranked G5T1.)

State Element Ranks

S1 = Critically imperiled in Wisconsin because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the state.

S2 = Imperiled in Wisconsin because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.

S3 = Rare or uncommon in Wisconsin (21 to 100 occurrences).

S4 = Apparently secure in Wisconsin, with many occurrences.

S5 = Demonstrably secure in Wisconsin and essentially ineradicable under present conditions.

SA = Accidental (occurring only once or a few times) or casual (occurring more regularly although not every year); a few of these species (typically long-distance migrants such as some birds and butterflies) may have even bred on one or more of the occasions when they were recorded.

SE = An exotic established in the state; may be native elsewhere in North America.

SH = Of historical occurrence in Wisconsin, perhaps having not been verified in the past 20 years, and suspected to be still extant. Naturally, an element would become SH without such a 20-year delay if the only known occurrence were destroyed or if it had been extensively and unsuccessfully looked for.

SN = Regularly occurring, usually migratory and typically non-breeding species for which no significant or effective habitat conservation measures can be taken in Wisconsin. This category includes migratory birds and bats that pass through twice a year or, may remain in the winter (or, in a few cases, the summer) along with certain lepidoptera which regularly migrate to Wisconsin where they reproduce, but then completely die out every year with no return migration. Species in this category are so widely and unreliably distributed during migration or in winter that no small set of sites could be set aside with the hope of significantly furthering their conservation.

SZ = Not of significant conservation concern in Wisconsin, invariably because there are no definable occurrences in the state, although the taxon is native and appears regularly in the state. An SZ rank will generally be used for long-distance migrants whose occurrence during their migrations are too irregular (in terms of repeated visitation to the same locations), transitory, and dispersed to be reliably identified, mapped, and protected. Typically, the SZ rank applies to a non-breeding population.

SR = Reported from Wisconsin, but without persuasive documentation which would provide a basis for either accepting or rejecting the report. Some of these are very recent discoveries for which the program hasn't yet received first-hand information; others are old, obscure reports that are hard to dismiss because the habitat is now destroyed.

SRF = Reported falsely (in error) from Wisconsin but this error is persisting in the literature.

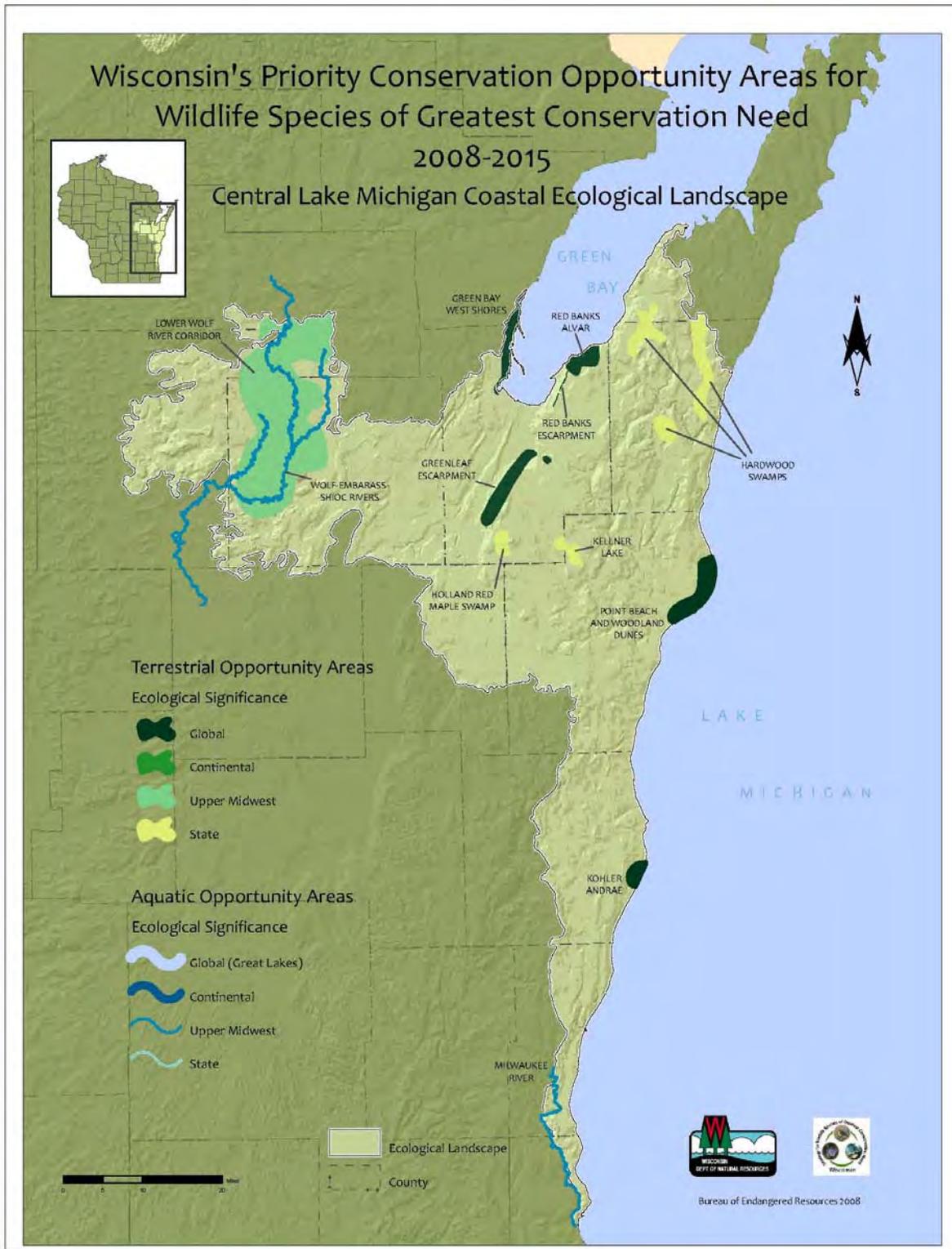
SU = Possibly in peril in the state, but their status is uncertain. More information is needed.

SX = Apparently extirpated from the state.

State Ranking of Long-Distance Migrant Animals:

Ranking long distance aerial migrant animals presents special problems relating to the fact that their non-breeding status (rank) may be quite different from their breeding status, if any, in Wisconsin. In other words, the conservation needs of these taxa may vary between seasons. In order to present a less ambiguous picture of a migrant's status, it is necessary to specify whether the rank refers to the breeding (B) or non-breeding (N) status of the taxon in question. (e.g. S2B,S5N).

Appendix B



Appendix C

Summary Descriptions for Rare Species and High Quality Natural Communities

The following paragraphs give brief summary descriptions for some of the rare species and high quality natural communities documented within Sheboygan and Sheboygan Falls townships. More information can be found on the Endangered Resources Web site (www.dnr.wi.gov/org/land/er/) for several of these species and natural communities.

Rare Animals

A Predaceous Diving Beetle

A predaceous diving beetle (*Lioporeus triangularis*), a State Special Concern beetle. A big river species that lives on wood and under banks over a sand bottom.

A Water Scavenger Beetle

A water scavenging beetle (*Hydrobius melaenum*), a State Special Concern beetle, has been found under banks of small, spring-fed streams.

American Bullfrog

American Bullfrog (*Rana catesbeiana*), a State Special Concern frog, may be found throughout Wisconsin in any permanent body of water - lakes, ponds, rivers, and creeks, although they have a very patchy distribution. In Wisconsin, bullfrogs appear to favor oligotrophic to mesotrophic waters, often breeding where dense submergent vegetation filters out the majority of the suspended solids. Adult bullfrogs overwinter in water to avoid freezing. Bullfrogs are active from April through mid-October. They breed from mid-May through late July or later. Larvae overwinter before transforming the following year or, in rare situations, in their second full year.

Bald Eagle

Bald Eagle (*Haliaeetus leucocephalus*), a bird listed as Special Concern in Wisconsin and Federally protected by the Bald & Golden Eagle Protection Act, prefers large trees in isolated areas in proximity to large areas of surface water, large complexes of deciduous forest, coniferous forest, wetland, and shrub communities. Large lakes and rivers with nearby tall pine trees are preferred for nesting. The breeding season extends from February through August. Favored wintering and roosting habitat includes wooded valleys near open water and major rivers from December through March.

Banded Killifish

Banded killifish (*Fundulus diaphanus*), a State Special Concern fish, prefers clear water of the bays and quiet backwaters of large lakes and medium to large streams with and sparse to no vegetation over gravel, sand, silt, marl, clay detritus or cobble. Spawning occurs from June through mid-August.

Dickcissel

Dickcissel (*Spiza americana*), a bird of Special Concern in Wisconsin. This species prefers open pasture and fields of clover and alfalfa. Grasslands, meadows, and savanna are also important nesting areas. This bird requires vegetation with medium to tall height-density and a significant component of forbs, some stiff-stemmed. Breeding occurs from late May to early August.

Ellipse

Ellipse (*Venustaconcha ellipsiformis*), a mussel presently listed as Threatened in Wisconsin. This species prefers shallow, flowing, clean small streams with stable substrate in the eastern and southern part of the state. It has also been recorded from localized populations in the western part of the state. The host fish are mostly small stream species including the rainbow darter, Johnny darter and mottled sculpin.

Elktoe

Elktoe (*Alasmidonta marginata*), a State Special Concern mussel, is found in various-sized streams with flowing water, sand, gravel or rock substrates that are stable. The known host fishes include widespread species including redbreast, sucker species and rockbass.

Osprey

Osprey (*Pandion haliaetus*) prefer large trees in isolated areas in proximity to large areas of surface water, large complexes of deciduous forest, coniferous forest, wetland, and shrub communities. Large lakes and rivers with nearby tall pine trees are preferred for nesting. The breeding season extends from late April through August.

Peregrine Falcon

Peregrine Falcon (*Falco peregrinus*), a bird listed as Endangered in Wisconsin, prefers relatively inaccessible rock ledges on the sides of steep bluffs and ledges on highrise buildings in urban areas. The recommended avoidance period is from early-April through late July.

Red-shouldered Hawk

Red-shouldered Hawk (*Buteo lineatus*) prefers larger stands of medium-aged to mature lowland deciduous forests, dry-mesic and mesic forest with small wetland pockets. Breeding occurs from mid-March through early August.

Round Pigtoe

Round pigtoe (*Pleurobema sintoxia*), a State Special Concern mussel. In Wisconsin, this species prefers various habitat types. It occurs only in clean water of small streams to large rivers on stable substrate. The known host fish include a number of cyprinid species

Yellow-billed Cuckoo

Yellow-billed Cuckoo (*Coccyzus americanus*) prefer open deciduous woodlands with dense shrubby undergrowth, especially along the backwaters of a major river or slow moving creek. Breeding occurs most often in early June, but can be found as late as mid-August.

Rare Plants

American Sea-rocket (*Cakile lacustris*), a State Special Concern plant, is found on Lake Michigan beaches or, less commonly, on dunes. Blooming occurs early July through early September; fruiting occurs late July through late September. The optimal identification period for this species is early July through late September.

Christmas Fern (*Polystichum acrostichoides*), a State Special Concern plant, is found in rich mesic woods. This species can be identified year-round.

Cooper's Milkvetch (*Astragalus neglectus*), a State Endangered plant, is found on riverbanks, ravines, and lakeshores, especially on dolomite near Lake Michigan. It can also be found in old fields. Blooming occurs throughout June; fruiting occurs throughout July. The optimal identification period for this species is early June through late July.

Forked aster (*Aster furcatus*) was found at Jackson Marsh in 2005. Forked aster is listed as Threatened and occurs only in the southeastern part of the state, ranging only as far north as Sheboygan County. This aster grows in dry to mesic hardwood forests, often on stream sides or slopes with dolomite near the surface.

Hairy Beardtongue (*Penstemon hirsutus*), a State Special Concern plant, is found on dry gravelly and sandy prairies, or in hillside oak woodlands. It is also naturalized on roadsides. Blooming occurs late May through late June; fruiting occurs late July through late August. The optimal identification period for this species is late May through late June.

One-flowered Broomrape (*Orobanche uniflora*), a State Special Concern plant, is found in sandy prairies, thickets, moist woods, and on streambanks. Blooming occurs from April through June. The optimal identification period for this species is mid April through late June.

Seaside Crowfoot (*Ranunculus cymbalaria*), a State Threatened plant, is found in sandy or muddy shores and marshes, ditches and harbors along Lake Michigan, and salted roadsides near the city of Superior. Blooming occurs early June through late August; fruiting occurs late July through late August. The optimal identification period for this species is early June through late August.

Small Skullcap (*Scutellaria parvula* var. *parvula*), a State Endangered plant, is found on dry, often dolomitic, cliffs and prairies. Blooming occurs throughout June; fruiting occurs early July through late August. The optimal identification period for this species is late June through early August.

Swamp Bedstraw (*Galium brevipes*), a State Special Concern plant, is found in southern sedge meadows, black spruce-white cedar swamps, and moist swales behind dunes, fen, low sandy woods. The optimal identification period for this species is late July through September.

Natural Communities

Emergent marsh

These open, marsh, lake, riverine and estuarine communities with permanent standing water are dominated by robust emergent macrophytes, in pure stands of single species or in various mixtures. Dominants include cat-tails (*Typha* spp.), bulrushes (particularly *Scirpus acutus*, *S. fluviatilis*, and *S. validus*), bur-reeds (*Sparganium* spp.), giant reed (*Phragmites australis*), pickerel-weed (*Pontederia cordata*), water-plantains (*Alisma* spp.), arrowheads (*Sagittaria* spp.), and the larger species of spikerush such as (*Eleocharis smallii*). Aquatic plants, including both emergent and submergent aquatic vegetation, form the foundation of healthy and flourishing aquatic ecosystems - both within lakes and rivers and on the shores and wetlands around them. They not only protect water quality, but they also produce life-giving oxygen. Aquatic plants are a lake's own filtering system, helping to clarify the water by absorbing nutrients like phosphorus and nitrogen that could stimulate algal blooms. Plant beds stabilize soft lake and river bottoms and reduce shoreline erosion by reducing the effect of waves and current. Aquatic plants also serve as spawning habitat for fish and amphibians, as shelter for various life stages of a variety of species, and as nesting habitat for birds. Plant beds support populations of aquatic insects that serve as a food base for other species. Seeds and other plant parts provide vital nutrition to a number of waterfowl and other bird species. Healthy, native aquatic plant communities also help prevent the establishment of invasive exotic plants like Eurasian watermilfoil.

Ephemeral Pond

These ponds are depressions with impeded drainage (usually in forest landscapes), that hold water for a period of time following snowmelt and spring rains but typically dry out by mid-summer. Common wetland plants found in this community (as well as other types) include yellow water crowfoot, mermaid weed, Canada bluejoint grass, floating manna grass, spotted cowbane, smartweeds, orange jewelweed, and sedges. They flourish with productivity during their brief existence and provide critical breeding habitat for certain invertebrates, as well as for many amphibians such as wood frogs and salamanders. They also provide feeding, resting and breeding habitat for songbirds and a source of food for many mammals. Ephemeral ponds contribute in many ways to the biodiversity of a woodlot, forest stand and the larger landscape. There have been many definitions and synonyms for the term ephemeral pond (e.g., “vernal pool”). However, they all broadly fit into a community context by the following attributes: their placement in woodlands, isolation, small size, hydrology, length of time they hold water, and composition of the biological community (lacking fish as permanent predators).

Trees adjacent to ephemeral ponds provide a variety of benefits such as maintaining cool water temperatures, preventing premature drying, and adding to the food web. The annual input of leaves from trees around the pool support a detritus-based food web and a variety of invertebrates that are part of that food web.

Floodplain Forest

This is a lowland hardwood forest community that occurs along large rivers, usually stream order 3 or higher, that flood periodically. The best-development occurs along large rivers in southern Wisconsin, but this community is also found in the north. Canopy dominants may include silver maple (*Acer saccharinum*), river birch (*Betula nigra*), green ash (*Fraxinus pennsylvanica*), hackberry (*Celtis occidentalis*), swamp white oak (*Quercus bicolor*), and cottonwood (*Populus deltoides*). Northern stands are often species poor, but balsam-poplar (*Populus balsamifera*), bur oak (*Quercus macrocarpa*), and box elder (*Acer negundo*) may replace some of the missing “southern” trees. Buttonbush (*Cephalanthus occidentalis*) is a locally dominant shrub and may form dense thickets on the margins of oxbow lakes, sloughs and ponds within the forest. Nettles (*Laportea canadensis* and *Urtica dioica*), sedges, ostrich fern (*Matteuccia struthiopteris*) and gray-headed coneflower (*Rudbeckia laciniata*) are important understory herbs, and lianas such as Virginia creepers (*Parthenocissus spp.*), grapes (*Vitis spp.*), Canada moonseed (*Menispermum canadense*), and poison-ivy (*Toxicodendron radicans*) are often common. Among the striking and characteristic herbs of this community are cardinal flower (*Lobelia cardinalis*) and green dragon (*Arisaema dracontium*).

Northern Mesic Forest

Prior to Euro-American settlement, the northern mesic forest covered the largest acreage of any Wisconsin vegetation type. It is still very extensive, but made up of second-growth forests that developed following the Cutover. It forms the matrix for most of the other community types found in northern Wisconsin, and provides habitat for at least some portion of the life cycle of many species. It is found primarily north of the Tension Zone (Figure 2-2), on loamy soils of glacial till plains and moraines deposited by the Wisconsin glaciation. Sugar maple (*Acer saccharum*) is dominant or co-dominant in most stands. Historically, eastern hemlock (*Tsuga canadensis*) was the second most important species, sometimes occurring in nearly pure stands with eastern white pine; both of these conifer species are greatly reduced in today’s forests. American beech (*Fagus grandifolia*) can be a co-dominant with sugar maple in the counties near Lake Michigan. Other important tree species were yellow birch (*Betula allegheniensis*), basswood (*Tilia americana*), and white ash (*Fraxinus americana*). The groundlayer varies from sparse and species poor (especially in hemlock stands) with woodferns, blue-bead lily (*Clintonia borealis*), club-mosses (*Lycopodium spp.*), and Canada mayflower (*Maianthemum canadense*), to lush and species-rich with fine spring ephemeral displays. Historically, Canada yew was an important shrub, but it is now absent from nearly all locations. Historic disturbance regimes were dominantly gap-phase windthrow; large windstorms occurred with long return periods. After old-growth stands were cut,

trees such as quaking and bigtoothed aspens (*Populus tremuloides* and *P. grandidentata*), white birch (*Betula papyrifera*), and red maple (*Acer rubrum*) became abundant and still are important in many second-growth northern mesic forests. Several distinct associations within this complex warrant recognition as communities, and draft abstracts of these are currently undergoing review.

Southern Dry Forest

Oaks are the dominant species in this upland forest community of dry sites. White oak and black oak are dominant, often with admixtures of northern red and bur oaks and black cherry. In the well-developed shrub layer, brambles (*Rubus* spp.), gray dogwood, and American hazelnut are common. Frequent herbaceous species are wild geranium, false Solomon's-seal, hog-peanut, and rough-leaved sunflower. This community type intergrades to oak woodland, which has similar canopy composition but a more open forest floor due to relatively frequent ground fires and possibly also due to grazing by elk, bison, or deer prior to EuroAmerican settlement.

Southern Sedge Meadow

Widespread in southern Wisconsin, this open wetland community is most typically dominated by tussock sedge (*Carex stricta*) and Canada bluejoint grass (*Calamagrostis canadensis*). Common associates are water-horehound (*Lycopus uniflorus*), panicled aster (*Aster simplex*), blue flag (*Iris virginica*), Canada goldenrod (*Solidago canadensis*), spotted joe-pye-weed (*Eupatorium maculatum*), broad-leaved cat-tail (*Typha latifolia*), and swamp milkweed (*Asclepias incarnata*). Reed canary grass (*Phalaris arundinacea*) may be dominant in grazed and/or ditched stands. Ditched stands can succeed quickly to Shrub-Carr. Sedge meadows are most common in glaciated landscapes, where they often border streams or drainage lakes. The southern sedge meadow community occurred with prairie, savanna, and hardwood forest communities, and many of them apparently burned periodically. In the absence of fire, shrubs and trees are able to readily encroach on the open wetlands; encroachment can be exacerbated when wetlands are drained. Many sedge meadows in southeastern Wisconsin are influenced by alkaline groundwater, and occur in complexes with emergent marsh, calcareous fen, wet prairie, wet-mesic prairie, and shrub-carr. Differentiating between these communities can be difficult, as they frequently intergrade.

Least Flycatcher						M	S	L		
Lesser Scaup	L	M		L						
Mudpuppy	S	S								
Northern Harrier				L					M	S
Osprey	L	S								
Prothonotary Warbler						S				
Red-headed Woodpecker						M				
Short-billed Dowitcher				S						
Upland Sandpiper									L	S
Veery						M	M	M		
Vesper Sparrow										L
Whimbrel				M						
Willow Flycatcher						L			M	M
Wood Thrush						M	M	S		
Species that are Moderately Associated with the Central Lake Michigan Coastal Landscape										
Acadian Flycatcher						M		S		
American Bittern				S					M	L
American Golden Plover				M					L	M
Bald Eagle	M	S				L				
Banded Killifish	S		L							
Black-throated Blue Warbler							S			
Blanding's Turtle		M	M	S	S	M		M	M	
Blue-winged Warbler						M		M		
Buff-breasted Sandpiper				M						M
Butler's Garter Snake				S		M			S	
Canada Warbler							M			
Canvasback	L	S		L						
Caspian Tern	S									
Eastern Red Bat		M	M	M	S	M	M	M	M	
Golden-winged Warbler							M	L		
Grasshopper Sparrow										S
Greater Redhorse	M	M	S							
Henslow's Sparrow									L	S
Hoary Bat		M	M	M	S	M	M	L	M	
Hooded Warbler								S		
King Rail				S					M	
Loggerhead Shrike										S
Marbled Godwit				S						M
Northern Long-eared Bat		M	M	M	S	M	M	M	M	
Pickerel Frog		S	S	S	S	M	M	M	S	
Redside Dace			M							
River Redhorse		M								
Rusty Blackbird				M	M	S				
Shoal Chub (Speckled Chub)		S								
Short-eared Owl				L					M	S
Silver-haired Bat		M	M	M	S	M	M	L	M	
Snowy Egret	L			S						
Solitary Sandpiper			M	S	S	S			L	

Western Meadowlark										S
Western Sand Darter		M								
Whip-poor-will						L	L	L		
Wilson's Phalarope				S					L	
Wood Turtle		S	S		M	S	S	M	M	
Yellow-billed Cuckoo						S	L	M		
Yellow-crowned Night-Heron		M		M	S	S				

APPENDIX E

Conservation Sites within the Sheboygan River Area of Concern¹

Two ecologically important sites were identified on the Sheboygan River Area of Concern (SRAOC). These “Conservation Sites” were delineated because they generally encompass the best examples of 1) rare and representative natural communities, 2) documented occurrences of rare species or Species of Greatest Conservation Need (SGCN), and/or 3) opportunities for ecological restoration or connections. These sites warrant high protection and/or restoration consideration during the development of the property Fish and Wildlife Habitat Management and Restoration Plan. This report is meant to be considered along with other information when identifying opportunities for various management regimes and restoration efforts during future activities occurring throughout the SRAOC.

Information provided in the summary paragraphs includes location information, a site map, a brief summary of the natural features present, the site’s ecological significance, and management considerations.

Conservation Sites

SRAOC01. Kohler Property

SRAOC02. Schuchardt Property

¹ A list of species referred to by common name is found at the end of this appendix.

SRAOC01. Kohler Property

Property: Sheboygan River Area of Concern
County: Sheboygan
Landtype Association: 212Zc01. Sheboygan Moraines
Approximate Size (acres): 358

Description of Site

The site is located on both sides of the lower Sheboygan River between the cities of Sheboygan Falls and Sheboygan at the town of Kohler just west of Interstate 43. The surrounding landscape is highly fragmented with high intensity urban development, golf courses, crop lands and fields (old fields, pastures, hay fields) in varying degrees of activity. The site is comprised of small, moderate and good-quality areas of Northern Mesic Forest with sugar maple (*Acer saccharum*), northern red oak (*Quercus rubra*), American beech (*Fagus grandifolia*), and eastern white pine (*Pinus strobus*). There are seeps within the Northern Mesic Forest with ostrich fern (*Matteuccia struthiopteris*) and skunk cabbage (*Symplocarpus foetidus*). In addition, Ephemeral Ponds are scattered throughout these forested areas. Floodplain Forest and floodplain terraces with young white ash (*Fraxinus americana*), larger cottonwood (*Populus deltoides*) with crack willow (*Salix fragilis*) and an old oxbow with white ash and box elder (*Acer negundo*). Steep eroded riverside slopes have degraded Northern Mesic Forest and northern white-cedar (*Thuja occidentalis*) stands. The best quality areas of Northern Mesic Forest and some of the Floodplain Forest have fairly rich herbaceous layers, including spring ephemerals. Invasive species are prevalent in the forested areas including common buckthorn (*Rhamnus frangula*), showy bush honeysuckle (*Lonicera x bella*), garlic mustard (*Alliaria petiolata*), and dame's rocket (*Hesperis matronalis*).

Surrogate Grasslands are present at the site on the west end, adjacent to the golf course, and as fallow fields near the Kohler Design Center. Both areas have small, but functioning patches of grassland due to additional open habitats (golf course, agricultural lands, pastures) adjacent to these areas. The site, with the exception of the river segment, is entirely owned by the Kohler Company.

Significance of Site

Northern Mesic Forest was historically common throughout the project area prior to European settlement, but little forest cover remains in the SRAOC. The largest block of the best quality Northern Mesic Forest remnants along the Sheboygan River's lower portion is present at the site. The presence of Ephemeral Ponds (found nowhere else in the SRAOC) and seepage areas within these forests add to the biodiversity and significance of these stands. Rare plants can be found in association with Forested Seeps. Mole salamanders, wood frogs (*Rana sylvatica*), and fairy shrimp are all dependant upon Ephemeral Pond for the aquatic phase of their lives. Blue-spotted salamanders (*Ambystoma laterale*) were found utilizing these ponds and are indicators of quality older forest habitats with moist, humid closed canopy forests and good amounts of down woody debris.

A rare plant is found within the site and at no other locations on the property. Rare forest birds are found in the Northern Mesic Forest and are likely breeding at the site. The forest and forest edges, within or near the riparian zone, are an important travel corridor for bats and provide

critical cover for migratory birds. The intact forest buffer along the river at the site provides good cover for tree roosting bats, which are found in good abundance along this stretch of river. The forest helps to maintain the water quality of the Sheboygan River, ensuring a diverse aquatic insect presence and likely benefitting a robust fish population. The stretch of river located within the site supports the best fish community in the lower Sheboygan River and an Index of Biological Integrity (IBI) rating of excellent (Pers. comm. T. Motl).

Surrogate Grasslands within the site support good populations of grassland birds, a bird assemblage declining more rapidly than any other suite of birds in Wisconsin and the Midwest (Herkert 1995; Sample and Mossman 1997). Several Species of Greatest Conservation Need (SGCN) and species showing declining population trends are breeding within these grasslands at the site.

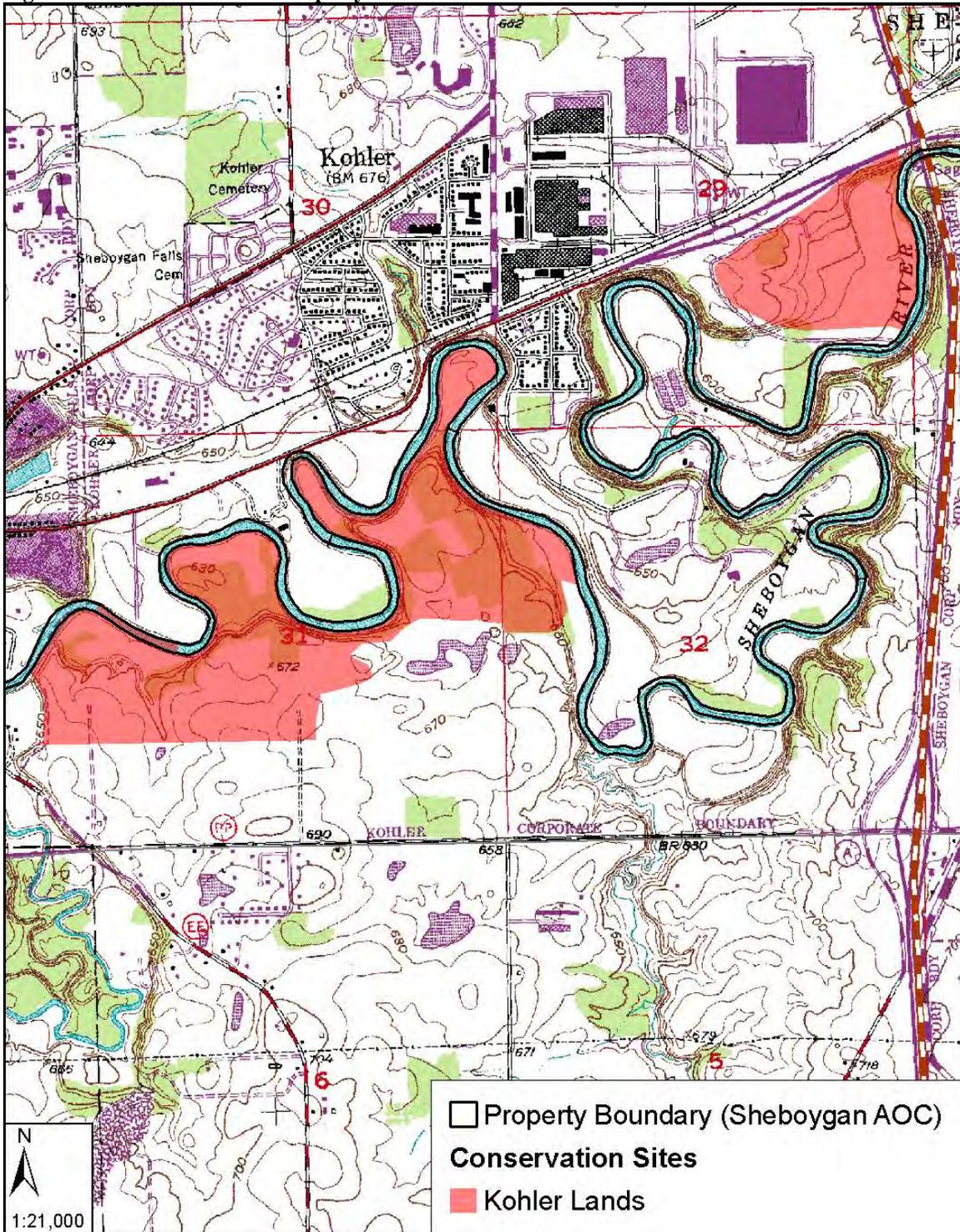
Management Considerations

Passive management, or long timber management rotations and retention of large cavity trees and snags within the Northern Mesic and Floodplain Forest of the site would allow older forest structure to develop to the benefit of bats and migratory and breeding birds. Inventory, mapping, and protection of the numerous Ephemeral Ponds and seeps found within the site should be a priority, as they are particularly susceptible to soil / hydrological disturbance. Continued retention of coarse woody debris in the mesic forests, especially around Ephemeral Ponds, is an important management consideration for salamanders. The forested areas within the site have several non-native invasive species in need of control. Prioritization should include managing populations of common reed grass (*Phragmites australis*) and Japanese knotweed (*Polygonum cuspidatum*) along the river and garlic mustard and common buckthorn within the forested areas of the site. This site represents an opportunity to conserve considerable elements of biodiversity and should rank high for focused control efforts.

Maintaining or providing nesting areas for belted kingfisher (*Ceryle alcyon*) and bank swallows (*Riparia riparia*) on high banks of the Sheboygan River would be an important consideration for the site. Both species are Partners in Flight (PIF) priority species in this region due to regional declines with Wisconsin populations showing a stable or slightly decreasing trend (Rosenburg 2004; Sauer et al. 2005). Good nesting sites (exposed banks along the Sheboygan River) along with foraging habitat associated with grasslands, open water, and agricultural areas are abundant near the site. An elimination or sporadic use of pesticides and improving the water quality are important factors in maintaining healthy populations of both of these species. This is particularly relevant with agriculture, golf courses, and water pollutants and sedimentation common in likely foraging areas at or near the site.

Maintaining the open nature of the two areas of grassland habitat identified within the site on the west and east end of the property would benefit the SGCN birds found here. Connecting these and other grassland habitats, by removing fencerows and brushy edges and eliminating edge habitats will promote a larger functioning grassland habitat patch enhancing population viability of grassland species. Blocks of 80-250 acres are preferable to smaller blocks, and blocks of 250-1,000 acres are the most desirable in smaller grassland landscapes like the SRAOC (Sample and Mossman 1997). Restoring areas with hydric soils in agricultural production near these grassland patches to wetlands would benefit migratory birds, and if restored to open sedge meadows, could enhance the areas for breeding grassland birds.

Figure 1: Location of Kohler Property Conservation Site



SRAOC02. Schuchardt Property

Property: Sheboygan River Area of Concern
County: Sheboygan
Landtype Associations: 212Zc01. Sheboygan Moraines
Approximate Size (acres): 178

Description of Site

The site is an old oxbow of the Sheboygan River with a narrow loop of ditched wetlands with the outer edges of the wetland occurring on fairly steep slopes with disturbed oak forest. Willow Creek runs through the middle of the site and has a narrow strip of forest on its banks with cottonwood, box elder, and ash. The inner portion has areas of alfalfa / hay fields, shrubby-grassy old fields, and ditched wetlands. The surrounding landscape includes high intensity urban development on the western side of the city of Sheboygan with railroad tracks passing through the southern portion of the site and grading into small patches of agricultural lands. The site incorporates the entire property owned by the City of Sheboygan.

The main features of the site are a Southern Sedge Meadow embedded within an Emergent Marsh dominated by cat-tails (*Typha* spp.). The sedge meadow is dominated by common lake sedge (*Carex lacustris*), Canadian blue-joint grass (*Calamagrostis canadensis*), reed canary grass (*Phalaris arundinacea*), and narrow-leaved cat-tails (*Typha angustifolia*). The Emergent Marsh is dominated by cat-tails and reed canary grass with scattered willow (*Salix* spp.) and ash species. There are numerous open, shallow water areas with duckweed (*Lemna* sp.), water-plantain (*Alisma* spp.), and water smartweed (*Polygonum amphibium*). The steep slopes surrounding the marsh / meadow have a moderate-quality example of Southern Dry to Dry-mesic Forest with the canopy dominated by large diameter northern red oaks with white oak (*Quercus alba*), bur oak (*Quercus macrocarpa*), and small amounts of paper birch (*Betula papyrifera*). The shrub layer is dominated by dense common buckthorn. Showy bush honeysuckle and Japanese barberry (*Berberis thunbergii*) are also present. The slopes appeared to be formerly grazed, resulting in the herbaceous layer being degraded, as invasive species dominate the groundlayer including garlic mustard and dame's rocket. Seeps are present on these slopes.

Significance of Site

The site represents one of the only undeveloped, public tracts of any size within the SRAOC and protects wetland communities not found at any other location in the project area. Emergent Marsh and Southern Sedge Meadow are important natural community opportunities within the Central Lake Michigan Coastal Ecological Landscape (WDNR 2006). Forested and wetland seeps are common at the site and are found in an undisturbed condition. A state Special Concern shrub is found at the site and is known from only eight other sites in the state. Modeling done for migratory bird stopover habitats noted the site as a very high priority for protection and restoration due to the existing emergent marsh / open water wetland and crop field (Grveles and Matteson 2008).

Willow Creek (Fig. 2) is the only coldwater tributary to the Sheboygan River within SRAOC project boundaries. The lower 1.6 miles of Willow Creek and its tributaries were reclassified as a Class II trout stream in 2008 to protect the biological integrity of this unique stream (Masterson 2006; Masterson 2008). Native brook trout (*Salvelinus fontinalis*) have also historically been documented here (Masterson 2006; Masterson 2008). This section of the stream includes the

areas immediately downstream of Interstate 43 to the confluence with the Sheboygan River and occurs within the Schuchardt Property Conservation Site (Figure 3).

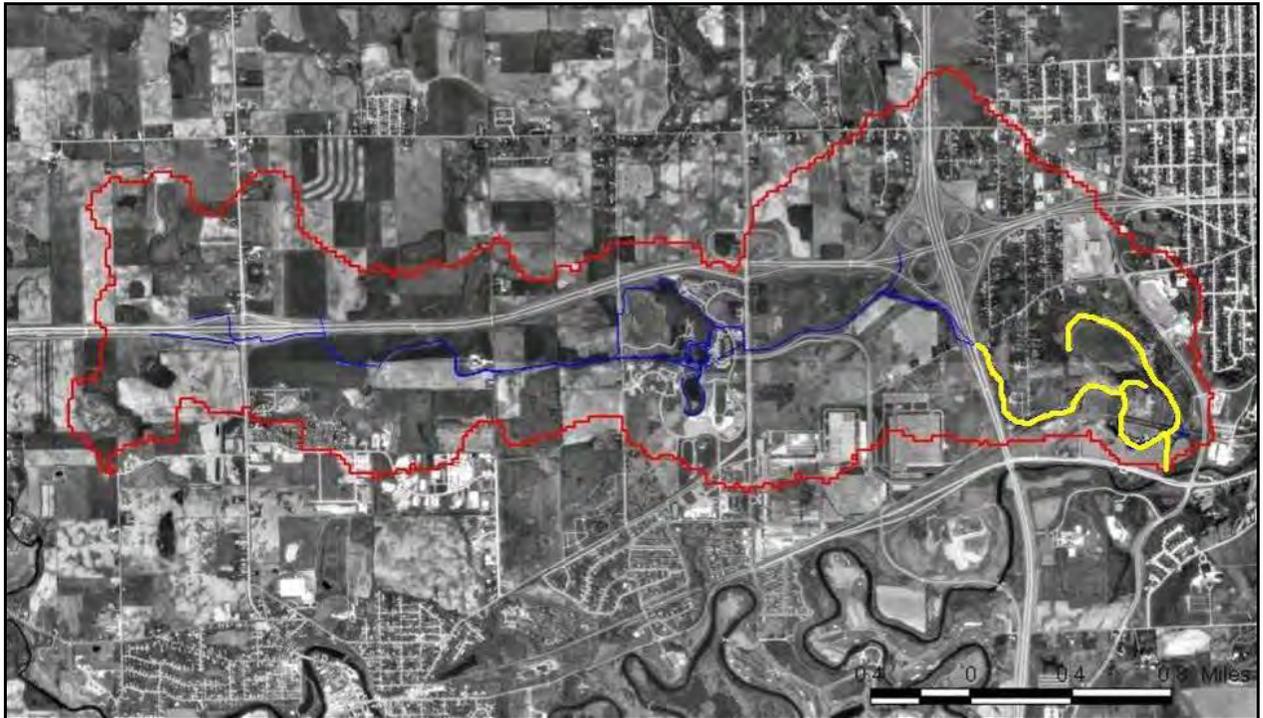


Figure 2: Willow Creek Watershed in Sheboygan County, Wisconsin. Yellow highlighted area delineates section classified as Class II Trout Stream.

Management Considerations

Common buckthorn, dame's rocket, and garlic mustard are major management problems in the forested areas of the site. The wetlands have areas of reed canary grass, common reed grass, and purple loosestrife (*Lythrum salicaria*), but these are still in manageable populations. The alfalfa-hay fields could be planted as prairie restorations to benefit birds, insects, and herptiles.

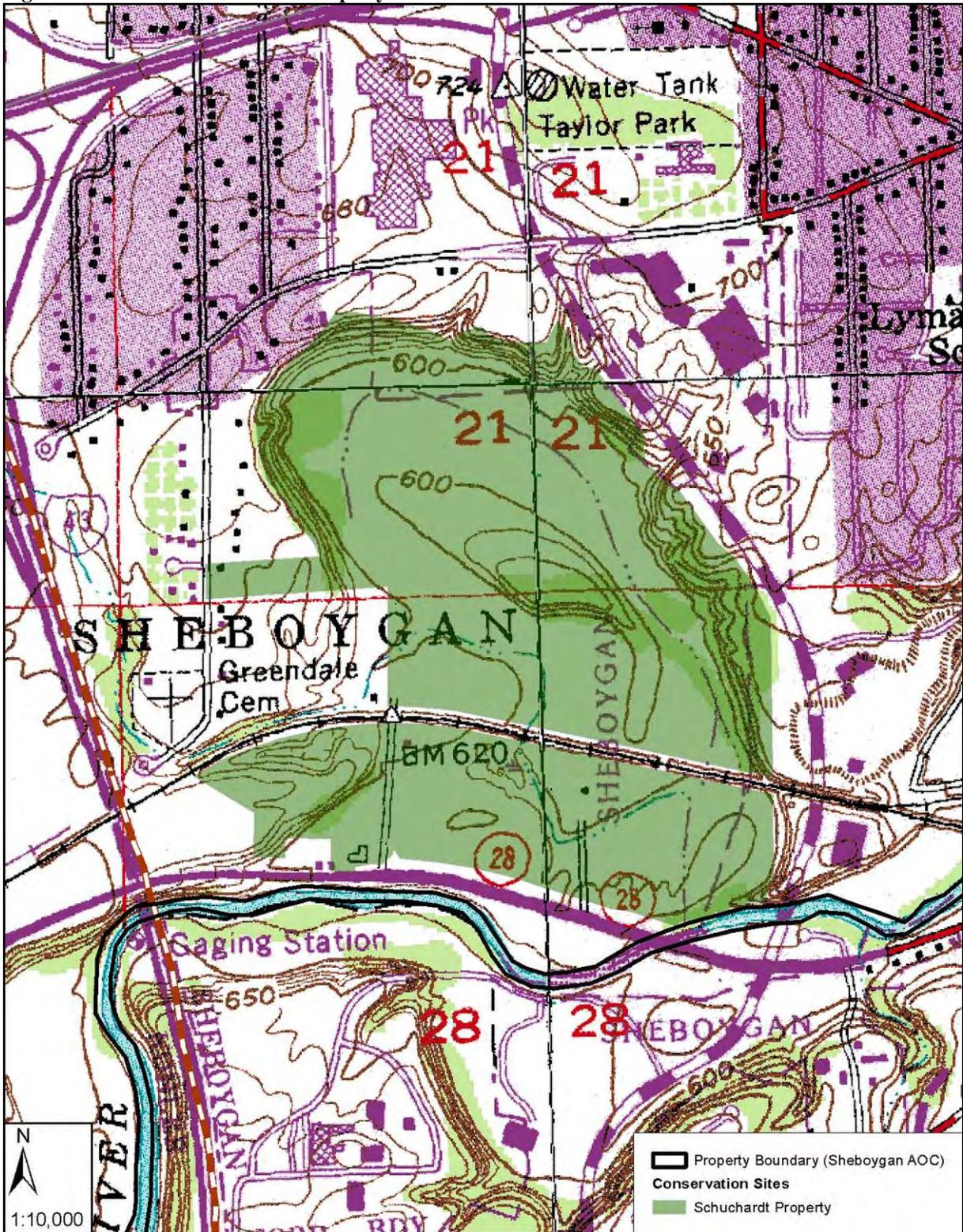
Consideration could be given to removing drain tiles, allowing for restoration of additional wetland habitat by reconnecting the ditched wetland hydrology to Willow Creek, and controlling invasive species present in the existing wetlands, which would benefit this high priority migratory bird stopover site. Breeding bird surveys were not done at the site due to late access permission, but the wetland habitats have good potential to support uncommon breeding birds and should be a priority for future survey, as uncommon grassland and shrubland birds were found adjacent to the site on the Kohler Property. Connecting upland shrub, wet meadow, hay fields, and agricultural fields at the Schuchardt Property to these open grasslands to the west would likely benefit these birds of conservation concern.

Further analysis of the sedge meadow where seeps occur should be completed to determine if this area falls within the Calcareous Fen classification, a globally rare natural community. Sedge fen plant indicators such as marsh fern (*Thelypteris palustris*), fringed brome (*Bromus ciliatus*) and swamp thistle (*Cirsium muticum*) were identified in this area (Graef et al. 2011). All seepage areas found at the site warrant protection and are particularly susceptible to soil / hydrological disturbance. Several rare or uncommon plants have the potential to occur in these areas and the cold groundwater flows increase the likelihood of a self-sustaining native brook trout fishery in

Willow Creek. Special care may be needed when conducting management activities in the nearby uplands.

The benthic macroinvertebrate Index of Biotic Integrity (IBI) rating for Willow Creek within the site at two sampling locations was fair with the stream habitat rating of good and fish community IBI rating at very poor for cold water fish. Stream habitat restoration efforts could focus on limiting bank erosion, channel widening, and creating pools and cover for fish. Restoring wetland function to the area may help with the flashy flow regime degrading the stream habitat and limiting the coldwater fishery. Graef et al. (2011) note, data strongly indicate runoff upstream from the Schuchardt Property is significant and is responsible for the high and flashy flows in Willow Creek causing severe bank erosion and channel enlargement. They recommend implementing an aggressive watershed-level stormwater management plan and promoting infiltration best-management practices.

Figure 3: Location of Schuchardt Property Conservation Site



Species List

List of species referred to by common name in Appendix E.

Common Name	Scientific Name
Plants	
box elder	<i>Acer negundo</i>
common buckthorn	<i>Rhamnus cathartica</i>
common reed grass	<i>Phragmites australis</i>
cottonwood	<i>Populus deltoides</i>
dame's rocket	<i>Hesperis matronalis</i>
garlic mustard	<i>Alliaria petiolata</i>
northern red oak	<i>Quercus rubra</i>
reed canary grass	<i>Phalaroides arundinacea</i>
showy bush honeysuckle	<i>Lonicera x bella</i>
white ash	<i>Fraxinus americana</i>

REFERENCES

- Graef, Ecological Research Partners, Western Great Lakes Bird and Bat Observatory. 2011. Schuchardt Farms Conservation Plan. Prepared for City of Sheboygan. Sept. 2011. 274pp.
- Grveles, K. and S. Matteson. 2008. Implementing a strategy for protecting bird migration stopover habitats in the western Great Lakes: 2008-2112, WI DNR, Unpublished report.
- Herkert, J. R. 1995. An Analysis of Midwestern Breeding Bird Population Trends: 1966-1993. American Midland Naturalist 134(1): 41-50.
- Masterson, John. 2006. Willow Creek Baseline Monitoring Report – Sheboygan River Basin. WDNR Report. 18 pages.
- Masterson, John. 2008. Request for Reclassification of Willow Creek, Sheboygan County as Class II Trout Water. WDNR Report.
- Rosenberg, K.V. 2004. Partners in Flight Continental Priorities and Objectives Defined at the State and Bird Conservation Region Levels: Wisconsin. Cornell Lab of Ornithology. May, 2004.
- Sample, D.W. and Mossman, M.J. 1997. Managing Habitat for Grassland Birds: A Guide for Wisconsin. Bureau of Integrated Science Services. Department of Natural Resources. P.O. Box 7921, Madison, WI 53707. Available at <http://www.npwrc.usgs.gov/resource/birds/wiscbird/index.htm>
- Sauer, J.R., J.E. Hines, and J. Fallon. 2005. The North American Breeding Bird Survey, Results and Analysis 1966 - 2005. Version 6.2.2006. USGS Patuxent Wildlife Research Center, Laurel, MD.
- Wisconsin Department of Natural Resources [WDNR]. 2006. Wisconsin Wildlife Action Plan. Available at <http://dnr.wi.gov/org/land/er/wwap/plan/>.