

FISH AND WILDLIFE RESTORATION PLAN
for the
SHEBOYGAN RIVER AREA OF CONCERN



December, 2016

**Wisconsin Department of Natural Resources
Office of Great Waters – Mississippi River, Lake Superior & Lake Michigan**

Cover Photo: American Mink photographed in the Lower Sheboygan River in 2016. Credit: Camille Bruhn.

DISCLAIMER

The Great Lakes Water Quality Agreement (GLWQA) is a non-regulatory agreement between the United States and Canada which describes the commitment of each country to restore and maintain the chemical, physical, and biological integrity of the Waters of the Great Lakes and their intention to prevent further pollution and degradation of the Great Lakes Basin Ecosystem (GLWQA, 2012). The actions identified in this document are needed to meet beneficial use impairment (BUI) removal targets leading to the delisting of the Sheboygan River Area of Concern (AOC). These actions are not subject to enforcement or regulatory actions. Implementation of the recommendations described within should result in fish and wildlife population and habitat benefits.

The actions identified in this document do not constitute a list of preapproved projects, nor is it a list of projects simply related to BUIs or generally to improve the environment. Actions identified in this document are directly related to removing the “degradation of fish and wildlife populations” and “loss of fish and wildlife habitat” BUIs. Removal of these BUIs is needed to delist the AOC.

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EXECUTIVE SUMMARY

The purpose of this Fish and Wildlife Restoration Plan is to outline the path to removing the **“degradation of fish and wildlife populations”** and the **“loss of fish and wildlife habitat”** beneficial use impairments (BUIs) from the Sheboygan River Area of Concern (AOC). The need for this plan was established in the December 2008 *Delisting Targets for the Sheboygan River Area of Concern* which established targets that must be met before a BUI could be considered for removal. This plan defines the cause of the impairments, documents current baseline status of the degradation of fish and wildlife populations and loss of fish and wildlife habitat BUIs, and provides a strategic plan for BUI removal. Restoration goals, objectives, and the activities needed to achieve them have been developed by the Wisconsin Department of Natural Resources and the Sheboygan River AOC Technical Advisory Committee. This plan along with the most current Remedial Action Plan (RAP) Update for the Sheboygan River AOC constitutes a complete strategy for removing all BUIs in the Sheboygan River AOC.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	iv
TABLE OF CONTENTS	v
ACRONYMS	vi
I. INTRODUCTION.....	1
II. CAUSES OF FISH & WILDLIFE POPULATION AND HABITAT IMPAIRMENTS	5
III. BASELINE SURVEYS AND ASSESSMENTS TO DETERMINE CONSERVATION GOALS OR TARGETS.....	7
IV. TAC RESTORATION APPROACH.....	11
V. RESTORATION PROJECTS & MANAGEMENT ACTIVITIES NECESSARY FOR BUI REMOVAL (TIER 1)	12
VI. DOCUMENTING SUCCESS AND MOVING TOWARDS BUI REMOVAL	19
VII. NEXT STEPS.....	23
VIII. PROJECTS NOT REQUIRED FOR BUI REMOVAL (TIER 2)	24
REFERENCES	25
APPENDICES.....	27

FIGURES

Figure 1. Wisconsin's AOC Locations	1
Figure 2. The Sheboygan River Area of Concern (AOC) Boundaries	2
Figure 3. Map of the Habitat Restoration and Protection Projects listed in Table 2.....	14

TABLES

Table 1. Beneficial Use Impairments (BUIs) and sources of impairment for the Sheboygan River AOC	3
Table 2. Tier 1 habitat restoration management actions.....	13

LIST OF APPENDICES

Appendix A	Definitions
Appendix B	Rapid Ecological Assessment
Appendix C	Sediment remediation efforts
Appendix D	Tier 2 habitat restoration projects
Appendix E	Habitat restoration projects – before, during and after

ACRONYMS

AOC	Area of Concern
BUI	Beneficial Use Impairment
C&NW	Chicago & Northwestern (railroad)
FQI	Floristic Quality Index
GLNPO	Great Lakes National Program Office
GLRI	Great Lakes Restoration Initiative
GLWQA	Great Lakes Water Quality Agreement
IBI	Index of Biotic Integrity
MGP	Manufactured Gas Plant
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyls
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
TAC	Technical Advisory Committee
U.S. ACE	United States Army Corps of Engineers
U.S. EPA	U.S. Environmental Protection Agency
WDNR	Wisconsin Department of Natural Resources
WPSC	Wisconsin Public Service Corporation

I. INTRODUCTION

Areas of Concern (AOCs) are severely degraded geographic areas within the Great Lakes designated under the Great Lakes Water Quality Agreement based on impairments to beneficial uses of the waters. These Beneficial Use Impairments (BUIs) identified for each AOC describe impairments that reduce the chemical, physical, and biological integrity of these waters of the Great Lakes. When the BUIs have been restored and the AOC is no longer degraded more than other, comparable non-AOC areas, they are delisted as AOCs. The Sheboygan River AOC is one of five Areas of Concern in Wisconsin (Figure 1). The Sheboygan River AOC includes the lower 14 miles of the Sheboygan River downstream from the Sheboygan Falls Dam including the entire harbor (Figure 2) (WDNR, 2015).

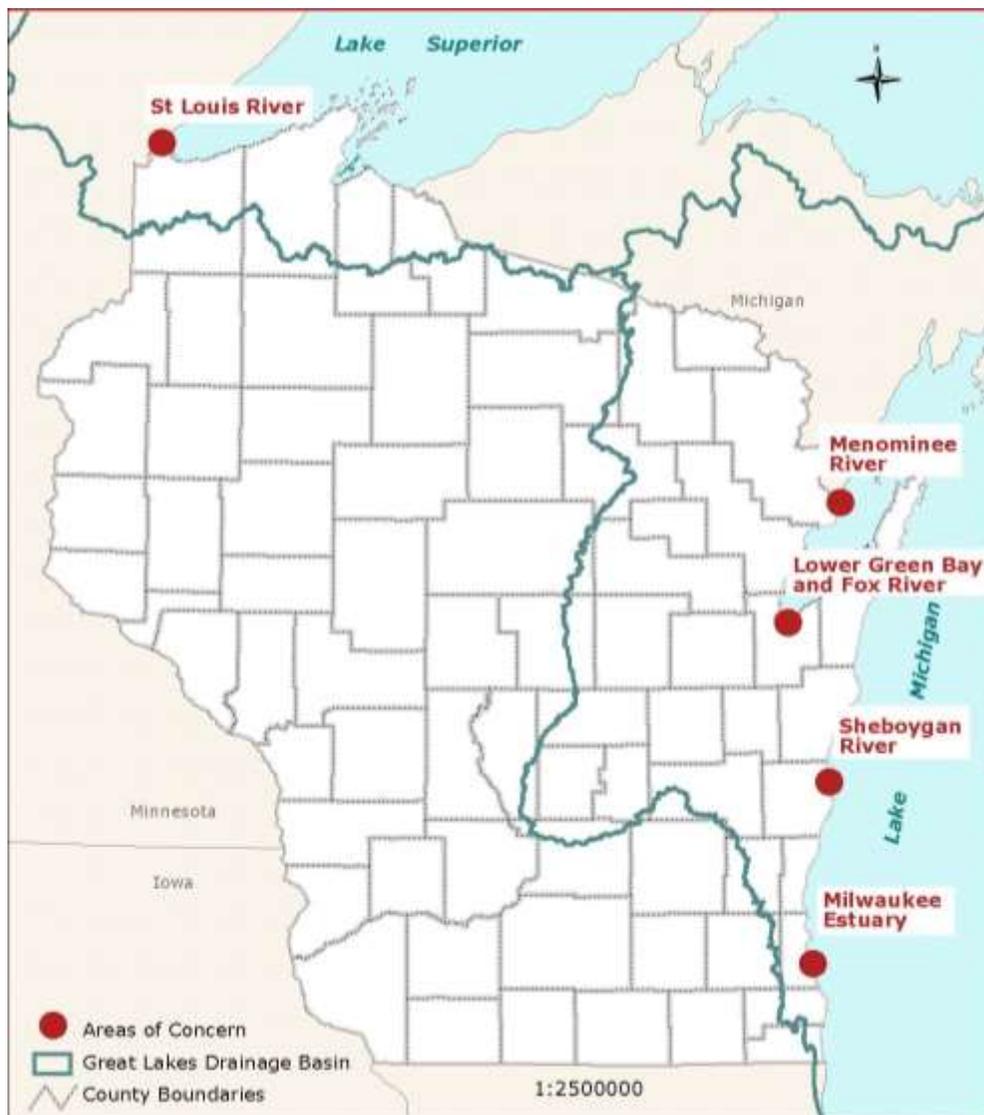


Figure 1: Wisconsin's AOC Locations.

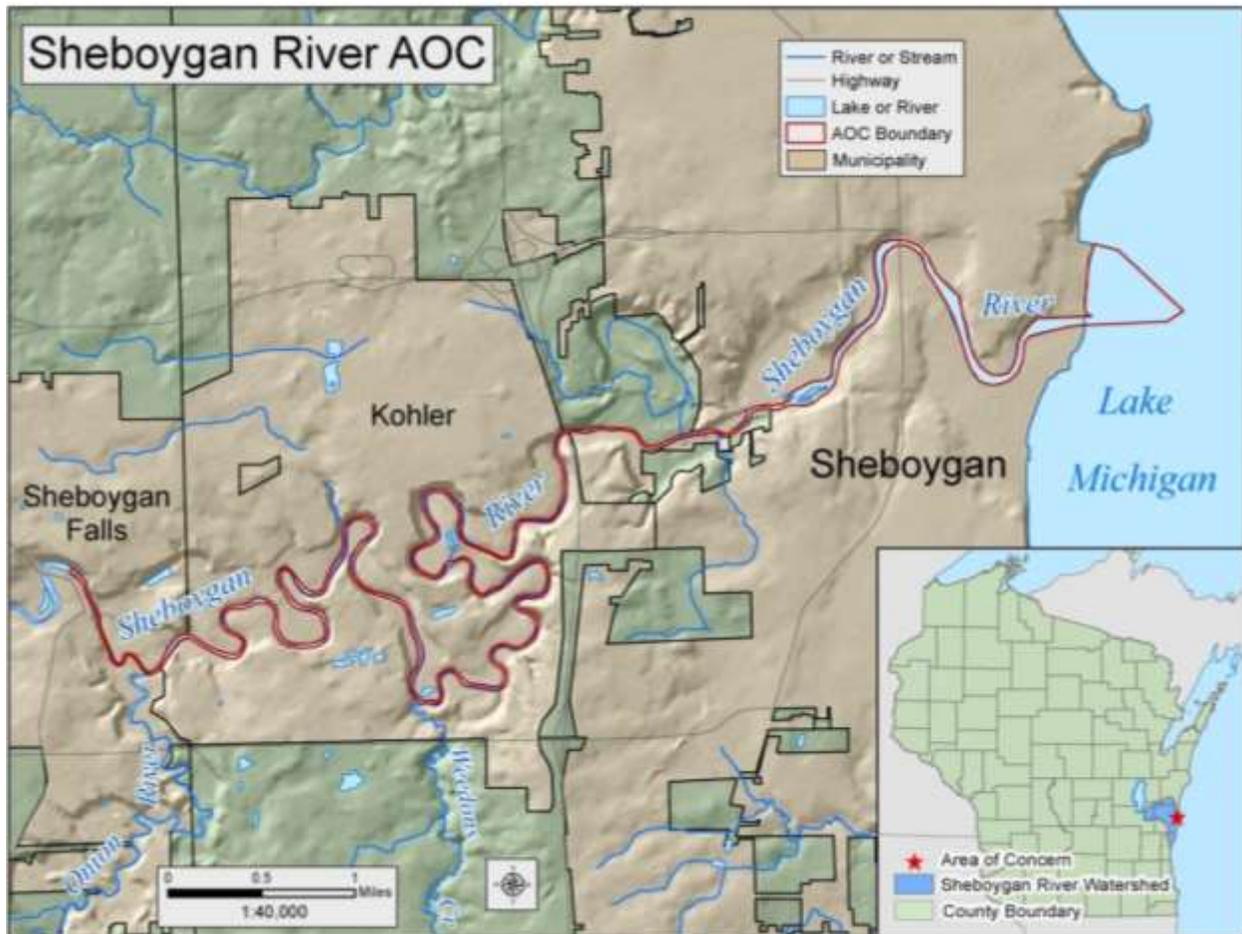


Figure 2: The Sheboygan River Area of Concern (AOC) Boundaries.

Remedial Action Plans (RAPs) are developed to identify BUI sources, develop site specific restoration targets, and document BUI status and removal progress (see the DEFINITIONS in Appendix A for more information). The RAPs provide background information for the AOC, which is summarized below (more detail is available in the RAPs and RAP Updates that have been written for the Sheboygan River AOC; these documents are listed in the “References” section).

The Sheboygan River was designated as an AOC primarily due to polychlorinated biphenyl (PCB) and polycyclic aromatic hydrocarbon (PAH) contamination in Sheboygan River sediments. A primary source of PCBs identified was an industrial facility operated by Tecumseh Products Company and a primary source of PAHs was a manufactured gas plant (MGP) operated by Wisconsin Public Service Corporation (WPSC). Additionally, the Kohler Landfill was historically a source of various pollutants, including volatile organic compounds and heavy metals. The Sheboygan River Remedial Action Plan (WDNR, 1989) and Remedial Action Plan Update (RAP Update; WDNR, 1995) also identified nutrients and solids as significant pollutants for the AOC (WDNR, 2015).

Since designation as an AOC, much progress has occurred to address pollutant sources. The Kohler Landfill was remediated in the late 1990s through the Superfund program. The Sheboygan River Priority Watershed Project (which ran from 1993 to 2003) resulted in

installation of agricultural best management practices throughout the watershed to reduce nonpoint source pollution to the river.

Efforts to improve the Sheboygan River accelerated in 2010 when the United States Environmental Protection Agency (U.S. EPA) selected the Sheboygan River AOC as a focus for BUI removal. Careful planning throughout 2011 led to a great deal of activity in 2012 to remove contaminated sediments and enhance navigation through dredging, enhance habitat, and assess the status of selected BUIs. In 2013, activities focused on attending to the final details of the dredging projects, completing and maintaining the habitat restoration projects, and reviewing data gathered through the assessment projects.

These sources of impairment led to designation of nine of the possible fourteen BUIs for the Sheboygan River AOC. Two BUIs were officially removed in 2015 due to their respective delisting targets having been met as a result of remediation and restoration efforts in the AOC and surrounding watersheds. These impairments and their corresponding sources are summarized in Table 1.

Table 1. Beneficial Use Impairments (BUIs) and sources of impairment for the Sheboygan River AOC. The two BUIs that are addressed with this restoration plan are highlighted in grey.

Beneficial Use Impairments	Causes of Impairment (X)			
	Contaminated Sediments	Non-point Source Pollution (sedimentation, excessive nutrients)	Physical Alteration (dams, urbanization, agriculture)	Invasive or Exotic Species
Restrictions on Dredging Activities (BUI removed in 2015)	X			
Restrictions on Fish and Wildlife Consumption	X			
Degradation of Benthos	X			
Degradation of Fish and Wildlife Populations	X	X	X	X
Loss of Fish and Wildlife Habitat	X	X	X	X
Bird or Animal Deformities or Reproduction Problems	X			
Fish Tumors or Other Deformities	X			
Degradation of Phytoplankton and Zooplankton Populations	X	X		
Eutrophication or Undesirable Algae (BUI removed in 2015)		X	X	

Delisting targets are needed for BUIs because they provide the decision criteria for determining when a BUI may be removed. In 2001, the U.S. Policy Committee published guidance for delisting targets that addressed each BUI. Then, in 2008, the Wisconsin Department of Natural Resources (WDNR), with input from local stakeholders and technical experts, drafted *Delisting Targets for the Sheboygan River Area of Concern* (WDNR, 2008). In this document, delisting targets were established for both the “**degradation of fish and wildlife populations**” and the “**loss of fish and wildlife habitat**” BUIs (highlighted in grey in Table 1). The targets for both of these impairments includes requirements for the establishment of a local fish and wildlife restoration plan for the Sheboygan River AOC. The fish and wildlife restoration plan establishes the framework for evaluating the additional information (gathered via fish and wildlife surveys)

that contributed to the selection of management actions and setting of specific targets . . . The targets necessary for removal of each BUI are listed below:

Degradation of Fish and Wildlife Populations Target

- Approved remedial actions (Superfund and RCRA) for contaminated sediment and floodplains have been fully implemented.
- A local fish and wildlife population management and restoration plan has been developed for the entire AOC that:
 - Defines the causes of all population impairments within the AOC.
 - Establishes site specific local population targets for native indicator fish and wildlife species within the AOC.
 - Identifies all fish and wildlife population restoration programs/activities within the AOC and establishes a mechanism to ensure coordination among all these programs/activities including identification of lead and coordinative agencies.
 - Establishes a time table, funding mechanism, and lead agency responsibility for all fish and wildlife population restoration activities needed within the AOC.
- The programs necessary to accomplish the recommendations of the fish and wildlife management and restoration plan are implemented; and
- Populations of native indicator fish/wildlife species are statistically similar to populations in reference sites with similar habitat but little to no contamination.

Loss of Fish and Wildlife Habitat Target

- A local fish and wildlife habitat management and restoration plan has been developed for the entire AOC that accomplishes the following:
 - Defines the causes of all habitat impairments within the AOC.
 - Establishes site-specific habitat and population targets for fish and wildlife species within the AOC.
 - Identifies primary and secondary habitat restoration goals, management activities, and projects that would adequately restore or rehabilitate fish and wildlife habitat within the Sheboygan River AOC.
- All primary habitat restoration goals, management activities, and projects identified in the fish and wildlife management and restoration plan are implemented, and modified as needed to ensure continual improvement; and
- Waters within the Sheboygan River AOC are not listed as impaired due to aquatic toxicity in the most recent Clean Water Act 303(d) and 305(b) Wisconsin Water Quality Report to Congress (submitted to U.S. EPA every two years).

Therefore, the *Fish and Wildlife Restoration Plan for the Sheboygan River AOC* documents the baseline status of the “**degradation of fish and wildlife populations**” and the “**loss of fish and wildlife habitat**” BUIs and identifies activities necessary for their removal. Restoration goals and objectives, and the activities needed to achieve them, are included in this plan and were established by consensus of the WDNR and the Sheboygan River AOC Technical Advisory Committee (TAC). Members of the TAC include representatives from federal, state, and local agencies, and non-governmental organizations. They assist by providing input regarding project feasibility, existing site conditions, species habitat needs, and habitat restoration opportunities.

This fish and wildlife restoration plan focuses on specific issues that are directly responsible for causing impairments locally within the AOC. It reiterates that the goal of the AOC program is to

restore beneficial uses, not to create a pristine habitat reflective of pre-settlement conditions. However, the implementation of this plan, and subsequent removal of the fish and wildlife BUIs, can be an important step towards a broader and more ambitious restoration effort if the community chooses to strive for improvements beyond removal of the BUIs. This Plan along with the most current RAP Update for the Sheboygan River AOC constitutes a complete strategy for removing all BUIs in the Sheboygan River AOC.

II. CAUSES OF FISH & WILDLIFE POPULATION AND HABITAT IMPAIRMENTS

The reasons for listing the “degradation of fish and wildlife populations” BUI identified in the 1989 RAP included concern that fish populations might be negatively impacted by exotic species, sedimentation, and dams. The 1995 RAP update also raised the possibility that contaminated sediments may have impacted fish populations and their forage base. Although fish populations appeared stable, it was thought that the issues stated above could be having a negative effect (WDNR, 1995). There was also concern that some wildlife species, such as mink, kingfishers and swallows were at decreased population levels in the AOC for the habitat available (WDNR, 1989). Contaminants in the food chain were suspected as the cause of the low population levels (WDNR, 1995).

The reasons for determining in the 1989 RAP that the “loss of fish and wildlife habitat” impairment existed included concern that fish habitat was degraded by sedimentation, dams, agricultural and urban development, and contaminated sediment; placing a greater importance on the remaining natural habitat.

The reasons for listing the BUIs were based on the conditions present when the Sheboygan River was first designated as an AOC in the late 1980s. Since then, there have been many improvements to agricultural runoff, wastewater treatment, and storm water management. The following explanations do not reflect present conditions, but detail the rationale for listing the populations and habitat BUIs in the 1980s.

Contaminated Sediment

Contaminated sediments in rivers and streams create risks to the health of the ecosystem as well as potential risks to human health. Sediments are a primary source of pollutants that travel through the food chain and accumulate in fish and other aquatic organisms, wildlife, and humans (WDNR, 1995).

Some contaminated sediments have a damaging effect on the bottom dwelling communities in close contact with them. These bottom dwelling communities are an important food source for numerous species of fish and wildlife and thus their contamination leads to bioaccumulation of contaminants throughout the food chain. Reproductive failure, population declines, developmental abnormalities, neurobehavioral deficiencies in offspring and genetic effects are observed in aquatic organisms and wildlife contaminated with certain toxicants. Contaminants in sediment are thought to have been a significant source of contamination in fish within the AOC. Adult and embryonic mortality, malignancy or carcinogenic effects, bioaccumulation of contaminants and subsequent biomagnification up through the food chain has been observed in contaminated wildlife. In addition, other more subtle biochemical and physiological changes are associated with contaminant exposure. These changes may reduce the ability of organisms to tolerate environmental changes, stress and disease. As a result of the bioaccumulative nature

of these contaminants, health consumption advisories (do not eat) continue to be issued for resident fish and certain wildlife in the Sheboygan AOC (WDNR, 1995).

Turbidity and Sedimentation

Human practices and land uses directly resulted in the impairments that define the Sheboygan River and harbor as a Great Lakes AOC. The main land uses and practices within the Sheboygan River basin that have contributed to adverse environmental conditions and the establishment of BUIs include agricultural and urban runoff, municipal and industrial point source discharges, wetland removal, and shoreline modification. These led to erosion and sedimentation in the past, and consequently were contributing factors to the AOC's fish and wildlife populations and habitat beneficial use impairments, as well as other BUIs.

Past runoff from agricultural and urban areas within the Sheboygan River basin contributed excess sediment and phosphorus, as compared to native land cover. Such sources of pollutants are generally considered "non-point" sources due to the widespread and diffuse nature of runoff. Approximately two-thirds of the land area of the Sheboygan River basin is used for agricultural purposes such as crops, dairy and livestock (WDNR, 1995). Although only about 4 percent of the land area of the Sheboygan River basin is urban (WDNR, 2001), these areas tend to be concentrated in close proximity to the AOC, and include the Cities of Sheboygan and Sheboygan Falls and the Village of Kohler.

Erosion and sedimentation affect fish and wildlife habitat by causing high value habitat areas to be degraded. Fish and mussels cannot thrive in habitat areas covered in fine sediment; rather, they prefer rocky substrates free of silt and other sediment deposits. Erosion can reduce the quantity and quality of shoreline habitat. These consequences in turn affect the populations of fish, mussels, birds, and other animals because their habitat areas are degraded.

Excess phosphorus and sediment in runoff from both rural and urban areas contributed to BUIs affecting the Sheboygan River AOC, including eutrophication or undesirable algae, degradation of fish and wildlife populations, degradation of benthos, loss of fish and wildlife habitat, and degradation of phytoplankton and zooplankton populations. Urban runoff may also contain metals and petroleum products that wash off of vehicles. Although a source of concern, these pollutants were considered less significant contributors to BUIs in the Sheboygan River AOC.

Localized modifications to land forms can also have adverse effects on the beneficial uses within the watershed. Filling or draining wetlands is one such modification with severe negative consequences. These negative consequences include the loss of the following: fish and wildlife habitat; nutrient removal capacity; and flood storage capacity. Approximately 11 percent of the Sheboygan River watershed is currently covered by wetlands (WDNR, 2001). Other modifications to land forms, such as rechanneling of watercourses or armoring of embankments, also contribute to loss of habitat and can exacerbate flooding. Excess flooding can also cause severe streambank erosion along the riparian corridor.

Habitat Fragmentation

Connectivity between habitat areas was identified by the TAC as an important issue for fish and wildlife populations. Habitat connectivity allows for passage between habitat areas along the Sheboygan River that fish and wildlife use for their livelihood. Connectivity permits animals to move to different habitat types that are suitable for their different life stages and repopulate areas where they were no longer found. Large habitat areas that are connected increase the

space that animals can safely travel without having to pass inhospitable areas such as roads or through residential areas. In addition to limited habitat connectivity, there are three dams remaining within the AOC, including the Sheboygan Falls dam (upstream end of the AOC), the River Bend Dam, and the Waelderhaus Dam. The remaining dams within the AOC and the tributary watersheds affect the river hydraulics, passage of fish and other aquatic organisms, sediment quality and quantity, habitat, and water quality. Sediment that would normally be flushed from the system accumulates behind these dam created impoundments, covering any natural habitat and intensifying areas where contaminated sediment can be accumulated more readily into the food chain. Impoundments created by dams tend to result in increased water temperatures and lower dissolved oxygen in the impounded stream both upstream and downstream of the dam. Dams prohibit the ability of fish and other aquatic organisms to travel upstream throughout the watershed limiting the productivity of the stream/river by reducing food availability and limiting access to upstream spawning and nursing habitat. The Technical Advisory Committee recognized that fish passage was important ecologically, but due to aquatic invasive species policies related to passage upstream as well as private ownership, inclusion as a management action was not a feasible option.

Invasive Species

Several non-native invasive plants are established in the AOC. Riparian and wetland areas of the AOC are vulnerable to the spread of invasive species via dispersal of seed and plant fragments via floods and flowing water. 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. Invasive plant species can create habitats that are not ideal for fish, wildlife and birds. Invasive fish and wildlife species can negatively impact native species by out-competing them for living space and forcing native species out of their habitat ranges. Common invasive plant and animal species found in the Sheboygan River AOC include zebra mussels, round goby, phragmites, buckthorn, garlic mustard, Japanese knotweed, teasel, and dame's rocket.

III. BASELINE SURVEYS AND ASSESSMENTS TO DETERMINE CONSERVATION GOALS OR TARGETS

Through meetings with the Technical Advisory Committee in 2010, the group moved forward into the planning process for determining fish and wildlife related actions in the AOC. In order to develop the fish and wildlife restoration plan as called for in the 2008 delisting targets, it was necessary to document the status of fish and wildlife populations and habitat through surveys and collection of data. The TAC assisted in the development of a Great Lakes Restoration Initiative (GLRI) grant request for this purpose. This grant was funded and as a result WDNR led the implementation of a number of fish and wildlife surveys.

Extensive monitoring and surveys were conducted throughout the Sheboygan River AOC in 2011 and 2012 utilizing GLRI funding. These monitoring surveys were designed to provide baseline information to support the development of delisting strategies. These strategies are documented in this fish and wildlife restoration plan to comprehensively address the "degradation of fish and wildlife populations" and "loss of fish and wildlife habitat" beneficial use impairments for the Sheboygan River AOC. This data gathering effort included a rapid ecological assessment using historical and current data, as well as conducting new field surveys

to fill data gaps. Outputs include field survey data reports that were finalized within the rapid ecological assessment report for the AOC (WDNR, 2012).

Baseline field surveys conducted through the grant included the following:

Aquatic Resources

Monitoring of several streams within the Sheboygan River AOC boundary was conducted by WDNR staff to develop a baseline for physical, chemical, and biological characteristics. Sixteen new sites were surveyed from April through November 2011 and included fish populations, benthic macroinvertebrate communities, and stream habitat. Eight survey sites were located on the Sheboygan River and eight sites were located along tributaries to the Sheboygan River. Three sites were on Willow Creek, two sites on Weedens Creek, and three sites located on the Onion River. Data were included from three aquatic survey sites on the Onion River conducted in 2009 and 2010 as well. A total of 19 monitoring sites were included in the stream surveys. In addition to these aquatic surveys, one fyke netting survey on the Sheboygan River was conducted to determine presence of northern pike during spawning period. Two aquatic macrophyte surveys were also done within the Sheboygan River AOC (WDNR, 2012)

Data derived from these surveys provide valuable information on the physical, chemical, and biological condition of streams. Overall, the stream sites rated fair to excellent for fish and macroinvertebrate communities and stream habitat. There were a few sites that rated poor or very poor for fish and macroinvertebrate communities. These “poor” or “very poor” ratings may be attributed to degraded habitat. Aquatic plant surveys were also limited because of degraded habitat including turbidity and high flow levels. A total of 14 northern pike were documented during the fyke netting survey. 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 significant benefit to this species (WDNR, 2012).

Mussel Surveys

Dare Ecosystem Management, LLC conducted shoreline, wading, and snorkel surveys at 14 sites on the Sheboygan River in 2011. Surveys identified all live mussel species present as well as evidence of species historically present. The overall health of the mussel community within the Sheboygan River AOC 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. Low numbers of juvenile species were seen or collected and the park areas along the river had very little upland vegetated buffer areas. Overall, the entire river, from Taylor Avenue to Sheboygan Falls, has a good possibility for mussel populations (Dare, 2011c).

Small Mammal Surveys

Small mammal trapping occurred in the Sheboygan River AOC in 2011-2012, to provide information about contamination in the terrestrial food chain. Common small mammals were collected for contaminant analysis (PCBs, polybrominated diphenyl ethers or PBDEs, metals, and organochlorine pesticides) that reflect local conditions within the Sheboygan River AOC floodplain. This provided an idea of the current extent of contamination of small mammals within the Upper and Middle River floodplain areas. Mink were also trapped from both the AOC and an uncontaminated area upstream in order to compare the number of mink captured in the AOC to a control area and to analyze PCB contamination within the populations (Strom, 2013).

Small mammal populations from several different species groups and feeding niches within the AOC did accumulate PCBs. The small sample size of the collection prevents any robust statistical analysis, but higher PCB concentrations in samples from white footed mice that were related to specific floodplains, suggests certain floodplains may be more contaminated than others. Likewise, while sample size is too small to infer any PCB related population level effects, data suggests that individuals within several different species groups could be experiencing adverse impacts as a result of exposure to PCBs within the AOC (Strom, 2013).

Bat Surveys

Two mobile water-based acoustic bat surveys were conducted by WDNR staff along two stretches of the Sheboygan River AOC 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. Maintaining diverse forest flora and reducing non-native plants are important for promoting invertebrate prey diversity and therefore promoting foraging opportunities for bats. Edge habitat, along fields and rivers, is important for all five bat species found in the Sheboygan River AOC. Bats have also been known to accumulate contaminants, such as PCBs, within their fat reserves by eating insects that have been exposed to contaminants. Additional data is needed to better understand the bat population within the AOC (WDNR, 2012).

Breeding Bird Surveys

Three priority areas were established within the Sheboygan River AOC. In June 2011, point-count survey methods were used by a contractor at 37 sites within these three priority areas to collect information on breeding birds present. A total of 808 individuals of 70 species, including 10 species of greatest conservation need were identified. Breeding behavior was observed for 11 species. The timing of the surveys (June) suggests many of the species observed are breeding in the Sheboygan River AOC (Baughman, 2011).

Much of the landscape within the Sheboygan River AOC has been transformed through urban development and agricultural production, leaving the forests highly fragmented with edge habitats and open areas most common. The breeding bird communities of the AOC largely reflect these landscape changes with common woodlot and urban birds being most prevalent. There are good amounts of shrub and Surrogate Grassland habitats found within the fragmented landscapes of the AOC. 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 habitats in large unfragmented tracts (WDNR, 2012).

Belted Kingfisher Nest Monitoring

In 2011, WDNR staff identified and monitored four belted kingfisher nests in the Sheboygan River AOC. Nests were observed using a video probe during the nesting period. Approximately 13 young were fledged from the four nests. No obvious deformities were observed in the nest monitoring effort. Success of the nests were mixed, with one nest destroyed by a predator and one nest hatching less than half of the eggs laid. Conclusions related to hatching and fledgling success are limited because of the small sample size and incomplete nesting data. It would appear that a limiting factor for belted kingfishers within the AOC is access to suitable banks for nesting (WDNR, 2012).

Mid-Winter Bird Surveys

The purpose of this survey, conducted by WDNR staff, was to gather information on bird species presence/absence and their relative abundance in the Sheboygan River AOC during the winter. A different suite of birds use this area in the winter compared to the summer breeding birds and migratory birds. This survey, combined with other bird surveys, gives a more complete picture of year-round species use of the AOC area (WDNR, 2012).

Bird species were observed during seven individual day surveys. The majority of the surveys were conducted by a single observer at 12 sites along the Sheboygan River. There was approximately two weeks between each of the seven surveys from December 20th, 2010 to March 25th, 2011. A total of 50 different species and 5,107 individuals were recorded over the entire survey period. The weather during the survey period could be characterized as fairly normal for this time of year. Therefore, these results should be representative of a normal year, but would be different in years with unusually mild or severe weather patterns (Katsma, 2012).

Herptile Surveys

Surveys were conducted by a contractor at 16 sites within the Sheboygan River AOC during the spring and summer of 2011 to evaluate habitat conditions and record the presence of common and rare herptiles (Dare, 2011a). A survey of the Schuchardt property (a high value area targeted for conservation) was also conducted (Dare, 2011b). Herptile surveys were focused in small part on an inventory of the AOC 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 (WDNR, 2012).

Eleven species were found within the Sheboygan River AOC, which included one Special Concern species, the Northern Leopard Frog (*Lithobates pipiens*) (Dare, 2011a). The Schuchardt property inventory documented four common species (Dare, 2011b). No State Threatened or Endangered species were found during any of the surveys.

Natural Community and Rare Plant Inventory

In 2011, WDNR staff field surveyed six sites and also reviewed historic records using the WI Natural Heritage Inventory. Natural communities were inventoried and the abundance of plant species presence was recorded. Eight natural communities are present within the Sheboygan River AOC that are identified as “Major” or “Important” opportunities for protection, restoration, or management (WDNR, 2012). Ten rare plant species are known from the Sheboygan River AOC, including two State Endangered, two State Threatened, and six Special Concern species (WDNR, 2012).

Rapid Ecological Assessment for the Sheboygan River Area of Concern

The intensive monitoring effort listed above supported the development of a Rapid Ecological Assessment for the Sheboygan River Area of Concern (Appendix B; WDNR, 2012). This report was intended to be used as a source of information for developing the Fish and Wildlife Restoration Plan for the Sheboygan River AOC. The regional ecological context for the Sheboygan River AOC is also provided to assist in developing this plan.

The primary objectives of this project were to collect biological inventory information relevant to the development of a Fish and Wildlife Restoration Plan for the Sheboygan River AOC and to analyze, synthesize, and interpret this information for use by the TAC. 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.

Targeted Invasive Species Mapping and Treatment Plan

The Targeted Invasive Species Mapping and Treatment Plan project was completed by a contractor, Cedarburg Sciences, during the 2011 field season. The goal of the project was to restore a diverse native plant community in the targeted areas that provides habitat to a range of fish and wildlife species. Populations of Japanese Knotweed (*Polygonum cuspidatum*), giant reed grass (*Phragmites australis*), garlic mustard (*Alliaria petiolate*), and common and glossy buckthorn (*Rhamnus cathartica* and *Rhamnus frangula*) were identified and mapped. Treatment strategies within the project area were then developed in cooperation with WDNR staff and the Sheboygan River AOC TAC committee (Cedarburg Science, 2011).

IV. TAC RESTORATION APPROACH

From 2010 through 2012 the TAC developed a strategy and identified corresponding management actions to remove the fish and wildlife related BUIs. This process began with developing the surveys and information-gathering activities above to provide baseline information. While these surveys were underway the group simultaneously began discussing known areas, habitats and species to target with conservation actions. A possible action list was drafted, which was eventually further refined into the Tier 1 and 2 actions included in this plan. The TAC was guided by the following: known sources of the impairments; the delisting targets; and the fish and wildlife population and habitat goals and objectives stated in the Sheboygan River Remedial Action Plans (1989, 1995). The latter included the goals to maintain and enhance a diverse community of terrestrial and aquatic life and their necessary habitat; maintain a diverse resident fishery; protect natural areas (green space) along the waterway and enhance habitat for aquatic and terrestrial communities; and determine specific actions.

As more historical and contemporary information became available and as constraints on where habitat restoration could be undertaken within the AOC boundaries were better understood, the TAC further refined the goals and actions needed to address the BUIs. The refinement of needed actions took into account some of the water quality improvements made since the Sheboygan River was designated an Area of Concern and that fish passage, though important, might not be feasible given a number of constraints. The following conservation goals categories focused and guided the site-specific habitat restoration management actions:

Tier 1 Project Conservation Goal Categories:

1. Migratory Bird Stopover Habitat
2. Shorebird Stopover and Breeding Habitat
3. Resident Breeding Bird Habitat
4. Warmwater Fisheries Community Habitat
5. Herptile Habitat
6. Riparian Emergent Wetlands
7. Riparian Forested Floodplains
8. Coldwater Fisheries Community Habitat

These targeted habitats and species groups are incorporated to address the need for site specific local population targets called for in the delisting targets. Numerical site specific population goals for individual species were determined to be both unrealistic to set and in some cases impossible to measure with any statistical certainty.

These broad conservation goals were used to guide planning at the local site level and select the management actions necessary to remove the “loss of fish and wildlife habitat” and “degradation of fish and wildlife populations” BUIs. The following fundamental strategies were selected to address these conservation goals: restoring and enhancing connectivity, protecting high quality habitats, increasing the quantity of habitat, restoring habitat along riverbanks and riparian areas, reducing erosion and sedimentation, creating and restoring in-river habitat, controlling invasive plant species and enhancing native plant communities. Seven habitat restoration projects were developed using these strategies to address each of these project conservation goals. These projects and the metrics to determine that they have successfully met AOC goals are described in the next two sections.

V. RESTORATION PROJECTS & MANAGEMENT ACTIVITIES NECESSARY FOR BUI REMOVAL (TIER 1)

More than \$80 million was invested in cleaning up contaminated sediments and restoring fish and wildlife habitat from 2011 through 2016. Throughout 2011, Sheboygan AOC partners worked together to plan for the significant cleanup and restoration activities that occurred in 2012 and 2013. Restoration activities improved fish and wildlife habitat while contaminated sediment removal projects reduced toxicity associated with fish and wildlife populations.

Fish and Wildlife Habitat Restoration

The fish and wildlife management actions included in this plan were developed through a consensus-based process with the TAC. These actions were selected as the best possible combination of actions to carry out the strategies identified in a manner that addressed the conservation goals to restore the habitat and fish and wildlife populations within the AOC. These Tier 1 projects listed in Table 2 are the management actions identified as necessary to adequately restore fish and wildlife populations and remove the “degradation of fish and wildlife populations” and “loss of fish and wildlife habitat” BUIs. Many activities were considered as potential management actions for the AOC. Those that were not selected as Tier 1 projects are included in a Tier 2 proposed projects list which can be found in Appendix D at the end of this document.

Many of these restoration activities are ongoing or complete before this plan was finalized. Therefore, this plan goes beyond the requirements outlined in the delisting targets and includes information on how they were designed and implemented. As a reminder the minimum requirements of this plan include:

- Defines the causes of all habitat and population impairments within the AOC.
- Establishes site-specific habitat and local population targets for native indicator fish and wildlife species within the AOC.
- Identifies primary and secondary habitat restoration goals, management activities, and projects that would adequately restore or rehabilitate fish and wildlife habitat within the Sheboygan River AOC.

- Identifies all fish and wildlife population restoration programs/activities within the AOC and establishes a mechanism to ensure coordination among all these programs/activities including identification of lead and coordinative agencies.
- Establishes a timetable, funding mechanism, and lead agency responsibility for all fish and wildlife population restoration activities needed within the AOC.

Table 2 lists the habitat and population management activities, lead coordinating agency and coordinating partners, timetable, and goals and targets addressed.

Table 2. Tier 1 habitat restoration management actions.

Project	Lead Agency	Funding Source (Estimated Costs)	Project Status/Date Completed	Intended Amount of Habitat Restored, Protected or Enhanced (Approximate)	Project Conservation Goals*
Kiwanis Park Shoreline Restoration	Wisconsin DNR City of Sheboygan Sheboygan County	GLRI \$2,115,000	Substantial completion, 2013 Maintenance, 2016	3/4 mile of shoreline habitat	1, 2, 3, 4, 5
Taylor Drive & Indiana Avenue Riparian Area & Wetland Restoration	Wisconsin DNR City of Sheboygan Sheboygan County	GLRI \$795,000	Substantial completion, 2013 Maintenance, 2016	10 acres of wetland, shoreline and riparian habitat	1, 2, 3, 4, 5, 6
Wildwood Island Area Restoration	Wisconsin DNR City of Sheboygan Sheboygan County	GLRI \$790,000	Substantial completion, 2013 Maintenance, 2016	1500 feet of shoreline and 15 acres of island and riparian habitat	1, 2, 3, 4, 5, 6
Shoreline Stabilization in Problem Areas	Wisconsin DNR City of Sheboygan Sheboygan County	GLRI \$292,000	Complete, 2013	1000 feet (over 10,000 square feet) of shoreline and riparian habitat	1, 2, 3, 4, 5
In-Stream Habitat Improvements	Wisconsin DNR City of Sheboygan Sheboygan County	GLRI \$144,000	Complete, 2013	up to 1 mile of warmwater fish community habitat	4
Targeted Invasive Species Control	Wisconsin DNR	GLRI \$132,500	Complete, 2016	Up to 12 acres of invasive species controlled	1, 2, 3, 5, 6, 7
Schuchardt Property Conservation Plan	Wisconsin DNR City of Sheboygan	GLRI \$40,000	Complete, 2011	Not Determined	1, 2, 3, 4, 5, 6, 7, 8

* Project Conservation Goals

- | | |
|--|--|
| 1. Migratory Bird Stopover Habitat | 5. Herptile Habitat |
| 2. Shorebird Stopover and Breeding Habitat | 6. Riparian Emergent Wetlands |
| 3. Resident Breeding Bird Habitat | 7. Riparian Forested Floodplains |
| 4. Warmwater Fisheries Community Habitat | 8. Coldwater Fisheries Community Habitat |

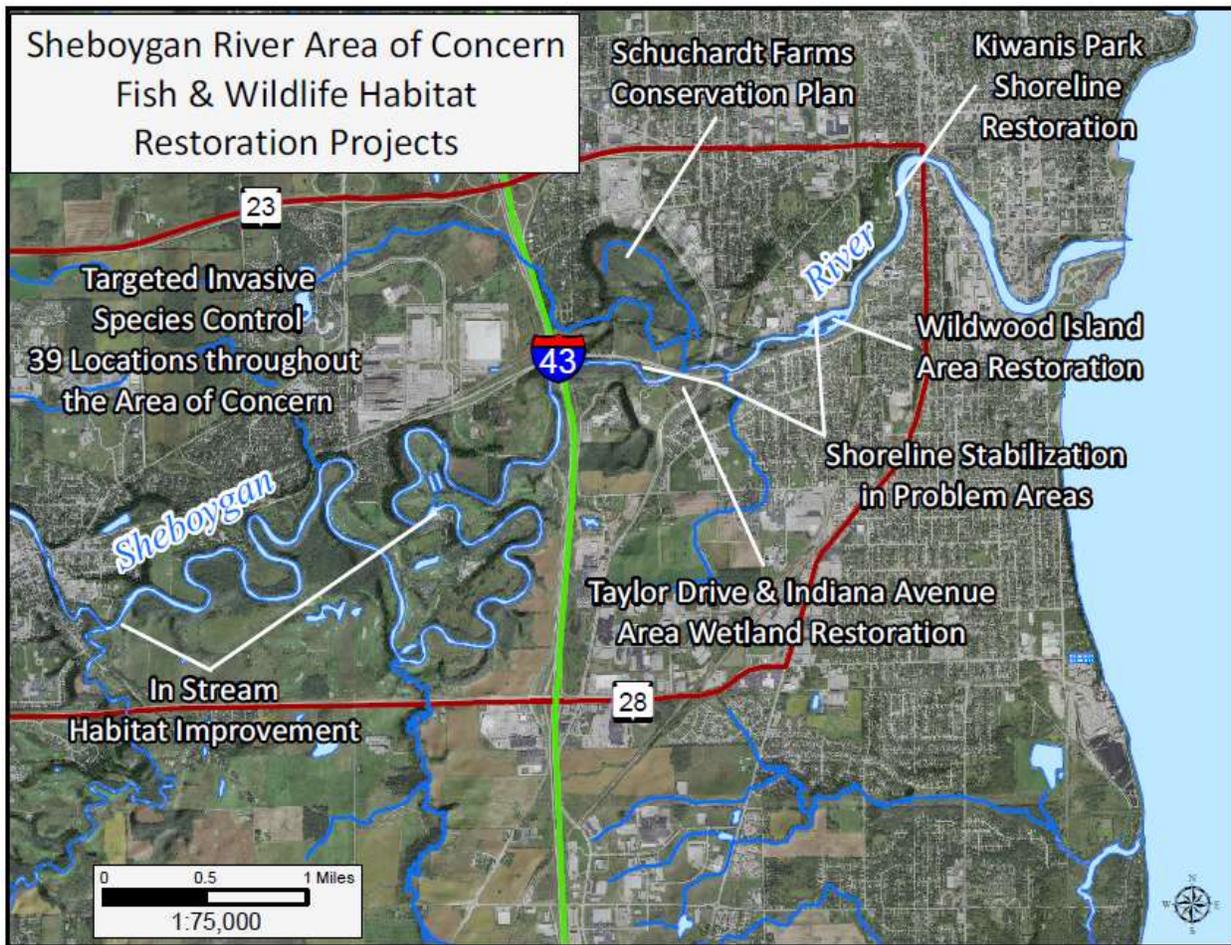


Figure 3: Map of the Habitat Restoration and Protection Projects listed in Table 2.

The following is a brief description of the individual projects that were implemented (Table 2). Project locations are illustrated in Figure 3.

Kiwanis Park Shoreline Restoration

The shoreline and habitat of the Sheboygan River along Kiwanis Park in Sheboygan was degraded by erosion, vegetation removal, non-native species and placement of unnatural materials such as concrete rubble. Good quality tree and shrub habitat and quality riparian buffers were missing from the landscape along the Sheboygan River. Quality riparian habitat is beneficial to many bird species for nesting and brood rearing, as well as for general water quality. This type of habitat is also one of the most used habitat types during bird migration. The Lake Michigan shoreline is a heavily used migration route for songbirds, diurnal and nocturnal raptors, shorebirds and waterfowl. The proximity of the site to Lake Michigan makes this area crucial for migratory bird habitat (WDNR, 2011).

Stream substrate was primarily a monotypic bed of small gravel, sand, and silt. Macrophyte growth was absent, possibly due to scour from high stream flows, increased turbidity during the growing season, or grazing by common carp. The shoreline was developed with little vegetated

buffer and some bank erosion. As a result, nearshore fish and wildlife habitat was significantly degraded (WDNR, 2011).

The park is the largest tract of shoreline available in the lower AOC for this type of holistic riparian and shoreline community restoration work. Replacing the degraded shoreline with quality habitat that would benefit birds, fish, and other wildlife would also benefit the river's water quality (WDNR, 2011).

The causes of habitat impairment addressed by this project include: shoreline/stream bank erosion, sedimentation, fragmentation, invasion by non-native plants, urban land use, storm water runoff, and vegetation removal (WDNR, 2011).

The project goals were:

- Restore ¾ mile of riparian and shoreline habitat in the Kiwanis Park area.
- Naturalize the shoreline, replace unnatural rip-rap material and retrofit storm water outfalls to reduce erosive flows.
- Re-establish habitat and provide a native vegetative buffer along the shoreline.
- Extend connectivity between habitat areas along the river.

The project conservation goals addressed by this project include: habitat for migratory bird stopover, shorebird stopover and breeding habitat, resident breeding bird habitat, warmwater fisheries community habitat, and herptile habitat (WDNR, 2011).

Taylor Drive & Indiana Avenue Riparian Area, Taylor Drive Wetland Restoration, Esslingen Park, and Roy Sebald Natural Area

The mitigation wetland was degraded and was significantly impacted by storm water runoff, flash flooding, and was heavily used by resident Canada goose populations. The habitat in the eastern wetland appeared to be good, but was not connected well to the river because of fish/aquatic organism passage barriers formed by the culvert under Indiana Avenue and connecting it to the navigable tributary stream. The riparian area next to the outlet of the stream was commonly used by fishermen as an access point to the river. This area had little cover and some invasive vegetation. Adjacent riparian emergent wetland habitats are rare in the lower portions of the Sheboygan River; therefore, restoring this type of habitat would increase fish and wildlife uses at various life stages (WDNR, 2011).

The causes of habitat impairment addressed by this project include: shoreline/stream bank erosion, excessive flows, sedimentation, fragmentation, invasion by non-native plants, urban land use, and storm water runoff and pollutants (WDNR, 2011).

The project goals were:

- Create connectivity between the Sheboygan River and riparian wetlands.
- Improve fish and wildlife habitat within the wetland complex.
- Address storm water impacts to the wetland.

The project conservation goals addressed by this project include: habitat for migratory bird stopover, shorebird stopover and breeding habitat, resident breeding bird habitat, warmwater fisheries community habitat, herptile habitat, and riparian emergent wetlands (WDNR, 2011).

Wildwood Island Area Restoration

The Wildwood Island complex is the only undeveloped island feature in the AOC. The island complex and adjacent riparian areas are publically owned (by the Bureau of Land Management of the U.S. Department of the Interior) and consist of approximately 20 acres of aquatic and riparian floodplain habitat. It provides a natural refuge for fish and wildlife due to its isolated location and backwater setting. Significant erosion existed along the banks of the island and adjoining riparian lands, resulting in riparian habitat loss, degradation of fish spawning areas, and sedimentation. The erosion appeared to have an accelerated rate since upstream development occurred. The riparian areas were also degraded with invasive plant species (buckthorn, purple loosestrife, and phragmites) and other low-quality tree species (box elder, willow, and cottonwood), which reduced the overall habitat value for the target wildlife species (WDNR, 2011).

The causes of habitat impairment addressed by this project include: shoreline/stream bank erosion, sedimentation, fragmentation, and invasion by non-native plants (WDNR, 2011).

The project goals were:

- Stabilize approximately 1,500 linear feet of sloughing banks on and adjacent to the island to protect existing riparian habitats.
- Remove target invasive species (phragmites, purple loosestrife, and buckthorn) from approximately 15 acres to improve wildlife habitat.
- Establish approximately 3 acres of emergent vegetation to enhance northern pike spawning habitat.
- Improve habitat for resident and migratory birds including waterfowl, terns, black-crowned night heron, green heron, songbirds, and raptors.

The project conservation goals addressed by this project include: habitat for migratory bird stopover, shorebird stopover and breeding habitat, resident breeding bird habitat, warmwater fisheries community habitat, herptile habitat, and riparian emergent wetlands (WDNR, 2011).

Shoreline Stabilization in Problem Areas

This project addressed sedimentation in sections of unstable and eroding riverbanks that were adversely impacting aquatic communities (fish and benthos) and associated wildlife populations in the Sheboygan River AOC. Eroding soil is a significant source of degradation to rivers. The eroded soil impacts water quality, transports excess nutrients into the river and smothers benthic organisms (WDNR, 2011).

The causes of habitat impairment addressed by this project include: sedimentation, disturbance by erosion, and displacement of native plant communities. The causes of erosion are the result of both natural and man-made conditions (WDNR, 2011).

The project goals were:

- Reduce or eliminate bank and soil erosion in several problem areas throughout the AOC.
- Stabilize these riparian areas in a manner that creates suitable habitat.

The project conservation goals addressed by this project include: habitat for migratory bird stopover, shorebird stopover and breeding habitat, resident breeding bird habitat, warmwater fisheries community habitat, and herptile habitat (WDNR, 2011).

Approximately 1,260 feet of unstable and eroding shoreline was stabilized by this project.

In-Stream Habitat Improvements

The in-stream habitat improvements were aimed at improving habitat in sedimented areas and replacing lost structure. Sediment reduction can be achieved through the placement of scour structures. A common practice is to place large boulders as scour structures to speed water flow and increase turbulence in a localized area thus increasing the rate that fine sediment is scoured away from that area. Greater scour deepens the channel and exposes habitat (WDNR, 2011).

Often coupled with the placement of scour structures is the addition of in-stream cover. Cover is a term that describes characteristics of objects in a stream that provide shelter or hiding places for fish. Abundance and biomass of warmwater game fish in a section of stream tend to be positively related to the amount of cover present. Any number of objects can be cover for fish, but in this instance, local fish managers recommended logs and large woody debris to keep with natural aesthetics and functionality. Logs and large woody debris were pinned in place by the boulders installed as scour structures or otherwise secured to the riverbanks to prevent unwanted movement downstream. Depending on habitat enhancement locations, riparian landowner permission was needed to carry out habitat work. (WDNR, 2011).

The causes of habitat impairment addressed by this project include: loss and degradation of fish habitat due to development, dams, and sedimentation (WDNR, 2011).

The project goals were:

- Survey fish habitat limitations in the Sheboygan River AOC.
- Design and construct habitat improvements aimed at increasing habitat quality and complexity within the Sheboygan River AOC.

The project conservation goals addressed by this project include: warmwater fisheries community habitat (WDNR, 2011).

Approximately 2,200 feet of in-stream habitat was improved by this project.

Targeted Invasive Species Control

This project controlled populations of targeted invasive species within the AOC. The targeted species are those that posed the greatest threat to fish and wildlife habitat within the AOC, including Japanese Knotweed (*Polygonum cuspidatum*), Giant Reed Grass (*Phragmites australis*), Garlic Mustard (*Alliaria petiolata*), and Buckthorn (*Rhamnus spp.*). Populations of these invasive species were dispersed throughout the entire AOC as well as adjacent wetland and floodplain habitats (WDNR, 2011).

This project benefited habitat for fish and wildlife species such as northern pike, migratory birds, and amphibians, specifically in the near-shore, floodplain, and wetland areas throughout the AOC. Phragmites outcompetes native vegetation, alters the water regime through increased evaporation and trapping of sediments, and results in loss of food and shelter for wildlife.

Japanese knotweed inhabits banks and shorelines, creating an impenetrable wall of vegetation, reducing plant diversity, and leaving banks vulnerable to erosion during the winter months when it dies back. Garlic mustard and buckthorn primarily invade forested floodplains adjacent to the Sheboygan River (WDNR, 2011).

The causes of habitat impairment addressed by this project include: invasion by non-native plants and disturbance by erosion or displacement of native plant communities (WDNR, 2011).

The project goals were:

- Use the inventory, mapping, and treatment strategy developed with FY2009 funding to implement invasive species control.
- Monitor success of invasive species eradication.

The project conservation goals addressed by this project include: habitat for migratory bird stopover, shorebird stopover and breeding habitat, resident breeding bird habitat, warmwater fisheries community habitat, herptile habitat, riparian emergent wetlands, and riparian forested wetlands (WDNR, 2011).

Schuchardt Property Conservation Plan

During the summer of 2011, a Conservation Plan was developed for the Schuchardt Farms property in Sheboygan. The property is a unique natural feature within an urban environment due to its size, habitats, and natural features. Conservation of this property has been identified as a high priority for maintaining and improving fish and wildlife populations and habitat in the lower area of the Sheboygan River. The WDNR partnered with the City of Sheboygan and a contractor to develop a plan to protect important resources on the site, while at the same time develop the property to meet the needs of the city. A local citizen group is interested in working with the City of Sheboygan regarding possible acquisition, preservation and restoration of the Schuchardt Property (Graef et al., 2011).

Contaminated Sediment Removal

Contaminated sediments were present throughout the Sheboygan River AOC, which shares the same boundaries with the Sheboygan River and Harbor Superfund site. PCBs are the contaminants of concern throughout the 14 miles of the AOC with PAHs and heavy metals also present in the lower reaches. Two additional Superfund sites are nested within the larger Superfund site and the AOC: Kohler Landfill and Camp Marina (a former manufactured gas plant). Remediation of contaminated sediments occurred over several time periods within the last 30 years and throughout different sections of the river (Appendix C).

For remediation purposes related to the Sheboygan River and Harbor Superfund site, the U.S. EPA divided the river into four sections. The Upper River extends from the Sheboygan Falls Dam downstream four miles to the Waelderhaus Dam in Kohler. The Middle River extends seven miles from the Waelderhaus Dam to the Chicago & Northwestern (C&NW) railroad bridge. The Lower River extends three miles from the C&NW Bridge to the Pennsylvania Avenue Bridge in Sheboygan. The Inner Harbor includes the section from the Pennsylvania Avenue Bridge to the river's outlet to the Outer Harbor.

The Upper River sediments were remediated in accordance with Superfund requirements in 2006 and 2007 where 20,728 cubic yards of sediment was removed. Following characterization of river sediments in 2009, remediation of 63,744 cubic yards of PCB contaminated deposits

occurred in the Lower River and Inner Harbor of the Sheboygan River in 2011 and 2012 under the Superfund program. Some floodplain soils that contained PCB contamination on land owned by Kohler Company were removed under the Superfund program in 2012 as well (WDNR, 2014).

The primary site of PAH contamination is known as the Camp Marina site near Boat Island just above Pennsylvania Avenue in the Lower Sheboygan River. It was remediated by the Wisconsin Public Service Corporation under a Superfund alternatives process in 2011. The project removed 23,240 cubic yards of sediment (WDNR, 2014).

The Kohler Company Landfill was designated a Superfund Site in 1983 and is located in the Middle River. Shallow groundwater beneath the site was contaminated and surface water runoff and its associated sediments were historically found to contain PAHs and heavy metals. An approved final remedy installed in 1996 intercepts contaminated groundwater for treatment at the City of Sheboygan treatment plant (WDNR, 1995).

In 2012, a Great Lakes Legacy Act (Legacy Act) Betterment dredging project was initiated by U.S. EPA, WDNR, City of Sheboygan and Sheboygan County. This project took place in the Lower River and removed 147,822 cubic yards of contaminated sediment left behind after the Superfund actions were complete (WDNR, 2014). After additional contaminated sediments were removed through the Legacy Act Betterment action, a 6 inch clean sand cover was placed on the river bottom to further address residuals that were present post-dredging.

Lastly, a navigational dredging project was designed by the U.S. Army Corps of Engineers (U.S. ACE) where sediments in the lower portion of the river between the 8th Street Bridge and the outer harbor were dredged in 2012 and completed in 2013, improving the navigation of this area of the river (WDNR, 2014).

A Sheboygan Dredging Workgroup met regularly to coordinate the details of the ongoing sediment dredging projects. The City of Sheboygan, Sheboygan County, WDNR, U.S. ACE, and U.S. EPA worked closely together to plan both the Legacy Act Dredging and the Strategic Navigational Dredging projects. The dredging projects resulted in a healthier river system for people and wildlife and improved navigation for recreational boating and commercial shipping.

VI. DOCUMENTING SUCCESS AND MOVING TOWARDS BUI REMOVAL

The Technical Advisory Committee met in July of 2012, to discuss broad conservation goals and how to measure success that will lead to removal of the “degradation of fish and wildlife populations” and the “loss of fish and wildlife habitat” BUIs. The TAC developed a “measures of success table” related to each BUI which was modified to include specific goals and targets for projects and assessments. This fish and wildlife restoration plan describes the specific conditions that need to be met in order to propose removal of the populations and habitat BUIs.

Degradation of Fish and Wildlife Populations BUI:

Each part of the target for the “Degradation of Fish and Wildlife Populations” BUI must be met in order for the BUI to be removed. This BUI can be recommended for removal when the following conditions are met:

- A. Remedial Actions are carried out. This work has been completed (see Appendix C).
- B. This document fulfills the target requirement for a Fish & Wildlife Restoration Plan,
 - 1. It clearly defines the original rationale for listing of the population’s impairment from the original RAP.
 - 2. It establishes site specific local population targets (refer to criteria below).
 - 3. It identifies areas of opportunity that were chosen to address populations of fish and wildlife.
 - 4. It identifies the population’s project goals that were developed to address the impairment.
 - 5. Federal funding was secured with the City of Sheboygan and the WDNR to lead and coordinate restoration activities.
- C. The programs, or projects, for restoration of fish and wildlife populations are implemented.
- D. Populations of indicator fish and wildlife species are similar to populations in reference sites.

Assessments of fish and wildlife populations are needed in order to compare the populations to the baseline surveys that were completed in 2011 prior to the habitat restoration projects and to also conclude that fish and wildlife populations are not degraded. The necessary assessments are underway. Long-term monitoring (which would be beyond the scope of the AOC) may be needed to determine trends.

The following criteria will be used to evaluate success of remediation efforts and whether the Degradation of Fish and Wildlife Populations BUI can be removed:

- 1) **Fish** – Assessment should indicate a mean Index of Biotic Integrity (IBI) score on replicated sites that is the same or higher than previous sampling efforts. The IBI scores for the three years of post-remediation sampling will be averaged and compared to the IBI scores from 2011 baseline sampling at the same sites. Post-remediation IBI scores should predominantly fall into the fair to excellent rating. The tributaries that were sampled are not part of the AOC boundaries and no habitat improvements were completed there, so comparisons for purposes of relating to the BUIs will only include sites within the actual AOC boundary on the mainstem of the Sheboygan River. Information on the tributaries was collected to help evaluate the food sources they were supplying to the AOC and the available fish passage opportunities, but this will not contribute to the BUI removal. While fish communities may take some time to fully recover, a mean IBI score the same or higher will indicate that adequate progress has been made for the AOC.
- 2) **Benthic Macroinvertebrates** – Assessment should indicate a mean IBI score on replicated sites that is the same or higher than previous sampling efforts. The IBI scores for the three years of post-remediation sampling will be averaged and compared to the IBI scores from 2011 baseline surveys at the same sites. Post-remediation IBI scores should predominantly fall into the fair to excellent rating. The tributaries that were sampled are not part of the AOC

boundaries and no habitat improvements were completed there, so comparisons for purposes of relating to the BUIs will only include sites within the actual AOC boundary on the mainstem of the Sheboygan River. Information on the tributaries was collected to help evaluate the food sources they were supplying to the AOC, but this will not contribute to the BUI removal. A mean IBI score the same or higher will indicate that adequate progress has been made for the AOC.

3) **Mammals** – Mink surveys will be conducted to assess the population and determine whether it is similar to mink populations in the non-AOC portions of the Sheboygan River with similar habitat. If mink numbers are low in the AOC, an assessment will occur to determine if the causes are related to contamination, in which case more information will be needed, or some other non-AOC related problems.

4) **Birds** – Different types of surveys will be used to assess bird populations and will be used as supporting lines of evidence to inform BUI status. Current 2016 breeding bird surveys should indicate similar or increased numbers of uncommon species when compared to previous 2011 baseline surveys. Bird occupancy, diversity, and abundance before habitat work and after habitat restoration projects were implemented should indicate similar or increased numbers.

5) **Bats** – Bat surveys will provide supporting lines of evidence to inform BUI status. Current 2016 acoustical bat surveys should have similar numbers through presence/absence surveys when compared to previous 2011 sampling efforts and while taken in context of any statewide population or distribution trends (which may provide an indication that there are factors influencing populations that may be beyond the scope of the AOC). A comparison of species diversity and richness should show comparable or increasing numbers of bat species.

6) **Mussels** – Mussel surveys will provide supporting lines of evidence to inform BUI status. Current 2016 surveys should have similar levels of species encountered, distribution and abundance when compared to previous 2011 sampling efforts while taken in context of any statewide population or distribution trends.

7) **Herptiles** – Herptile surveys will provide supporting lines of evidence to inform BUI status. Current 2016 surveys should indicate similar or increased numbers of herptile species compared to 2011 baseline surveys when taken in light of larger statewide issues related to rare and endangered species populations. Surveys in 2016 will use more active methods established for long-term monitoring efforts for herptile species.

Loss of Fish and Wildlife Habitat BUI:

For the “Loss of Fish and Wildlife Habitat” BUI, each part of the target must also be met in order for the BUI to be removed. Assessments of fish and wildlife habitat are needed in order to compare the current habitat conditions to the baseline surveys that were completed in 2011 prior to the habitat restoration projects and to also conclude that fish and wildlife habitat has been increased or improved.

The habitat restoration projects will be generally assessed to observe if the areas are functioning to create the habitat stated in the “Project Conservation Goals.” The habitat restoration projects will also be generally assessed to observe whether habitat has improved and if it can support fish and wildlife species. All restoration projects will undergo a final evaluation in the summer of 2017 to observe if project conservation goals were met with the habitat improvements that were completed in 2013. Documentation will be provided on whether

there is substantive improvement in the following categories sufficient to determine whether this BUI can be removed for the Sheboygan River AOC.

Tier 1 Project Conservation Goal Categories:

1. Migratory Bird Stopover Habitat- observe an increase in acreage provided for migratory bird stopover including riparian areas suitable for migratory birds. Shorelines should be naturalized, good-quality, native tree and shrub habitat should be improved or installed, and native vegetation in riparian buffer and wetland areas should be added or restored.
2. Shorebird Stopover and Breeding Habitat- observe an increase in acreage provided for stopover and breeding including riparian areas and wetlands. Shorelines should be naturalized, mudflat habitats should be created or improved, and riparian areas should be increased in size and planted with native vegetation.
3. Resident Breeding Bird Habitat- observe an increase in acreage provided for breeding birds including forest and open grassland areas. Bird nest box opportunities should be increased. Shorelines should be naturalized, native tree and shrub habitat should be installed or improved, and riparian buffer areas should be increased in size and planted with native vegetation. Efforts to reduce fragmentation of habitat patches should be undertaken by softening edges at transition areas from open to forested habitats.
4. Warmwater Fisheries Community Habitat- observe an increase or improvement in quality in backwater areas and rocky areas for spawning. Boulders and large woody habitat should also be increased for fish cover, habitat areas, and as localized scour structures to increase flow and water turbulence to aid in sediment transport. Emergent and floating leaf macrophyte coverage should increase for fish habitat as well.
5. Herptile Habitat- observe an increase or improvement in herptile habitat, including providing rocky or other cover for snakes, basking logs for turtles, downed woody debris in forests, and fishless ponds for salamanders, and increasing wetland acreage for frogs and toads. Connections should be made or improved between the wetlands and the river, the wetlands and open grasslands, and the forest and ephemeral ponds to allow safe movement of reptiles and amphibians during various life stages.
6. Riparian Emergent Wetlands- observe an increase or improvement in high quality wetlands that provide important habitat for many species. Wetland connections to the river should be created or improved. Habitat and water quality improvements should be made in the wetland. Native plants should be established in the wetland and surrounding uplands. Buffers should be improved in quality or increased in area.
7. Riparian Forested Floodplains- observe an increase or improvement in forested floodplains that provide benefits for water quality, plants, and wildlife. Increased amounts of downed woody debris should be noted. Invasive plant species should be greatly reduced in coverage and native plant species should be established. Riparian buffer vegetation should also be improved in quality.
8. Coldwater Fisheries Community Habitat- this conservation goal is related to the coldwater stream present on the Schuchardt property. Improvements in coldwater habitat quality and riparian buffer vegetation quality could be observed on the Schuchardt property if the Conservation Plan is implemented.

Habitat established as part of the habitat project planning process will be evaluated and compared to data collected prior to establishment of habitat improvements within the AOC. Surveys of invasive vegetation cover, fish habitat, and macrophytes are underway to document the successful completion of habitat restoration projects. In addition to the measures and criteria that will be used to assess the conservation goal categories above, the following broad measures will also be used to evaluate success of remediation efforts and whether the Loss of Fish and Wildlife Habitat BUI can be removed:

1) **Riparian Habitat** – An evaluation of habitat remediation projects should indicate an overall increase in habitat connectivity, which will be measured by acres enhanced, created, or restored for the following: migratory bird stopover habitat, shorebird stopover and breeding habitat, resident breeding bird habitat, herptile habitat, riparian emergent wetlands, and riparian forested floodplains. The habitat restoration projects will be assessed to observe if the areas are functioning to improve or create the habitat stated in the “Project Conservation Goals.” Areas will be assessed to provide information regarding what was improved or created and what species the areas can provide habitat for.

2) **Aquatic Habitat** – An evaluation of habitat projects should indicate the amount of habitat enhanced, created, or restored for: warmwater fisheries community habitat and coldwater fisheries community habitat. Qualitative fish habitat assessments should indicate a mean increase in overall rating and aquatic macrophyte surveys should indicate a mean Floristic Quality Index (FQI) value on replicated sites that is higher than values from previous sampling efforts in 2011. While overall rating and FQI scores will naturally vary over time, an increase will indicate adequate progress for the AOC. Areas will be assessed to provide information regarding what was improved or created and what species the areas can provide habitat for.

3) **Invasive Species** -- Greatly reduced coverage should be documented for invasive vegetation. The selected sites should also have re-seeding or natural growth of vegetation to reduce the risk of erosion and re-establishment of invasive species.

VII. NEXT STEPS

Now that the habitat restoration projects are in place, verification monitoring is in progress to confirm that the riparian and aquatic habitat restoration and improvement projects are functioning as expected as well as to document biological improvements in the AOC that have resulted from restoration and remediation projects (WDNR, 2013). The overarching goal of these verification surveys is to confirm that the broad habitat conservation goals established by the TAC have been met and that fish and wildlife populations are not degraded by sources of impairment within the AOC. Given expected inherent temporal variability and recovery times for various populations of interest, several years of monitoring are needed before determining if fish and wildlife habitat and associated populations meet AOC targets and goals and whether the “degradation of fish and wildlife populations” and “loss of fish and wildlife habitat” BUIs can be removed. All habitat and populations assessments and repeat verification monitoring surveys will be completed by 2017. Data will then be analyzed to observe if delisting targets are being met. If analysis determines the requirements in this Fish and Wildlife Restoration Plan have been met for the populations and habitat BUIs, BUI removal documents will be prepared.

VIII. PROJECTS NOT REQUIRED FOR BUI REMOVAL (TIER 2)

During development of this Plan the WDNR and TAC discussed and evaluated a list of many potential AOC habitat restoration projects that were ultimately determined not to be required for BUI removal. These projects were either considered to be in excess of what was needed to restore beneficial uses, determined not to be feasible in a reasonable timeframe due to cost or land ownership, or more effective or efficient alternatives were pursued instead. A list of these projects that were considered is included in Appendix D.

Although these projects were dropped from consideration for AOC BUI removal, they may have merit and further benefit to the local ecosystem. Other funding sources and restoration planning efforts may lead to implementation of projects like these, which could go above and beyond what was necessary for the AOC program goal.

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APPENDICES

Appendix A Definitions

Appendix B Rapid Ecological Assessment

Appendix C Sediment remediation efforts

Appendix D Tier 2 habitat restoration projects

Appendix E Habitat restoration projects – before, during and after

APPENDIX A

DEFINITIONS

Activity: A specific action or project that, once completed, will contribute towards the achievement of one or more objectives. Details regarding who will do the work, how it will be done, costs, location, and timeframe should also be included. Activities are listed in Table 2.

Area of Concern (AOC): Defined by Annex 2 of the 1987 Protocol to the U.S.-Canada Great Lakes Water Quality Agreement (GLWQA) as “geographic areas that fail to meet the general or specific objectives of the Agreement where such failure has caused or is likely to cause impairment of beneficial use or of the area’s ability to support aquatic life.” These areas are, or were, the “most contaminated” areas of the Great Lakes, and the purpose of the AOC program is to bring these areas to a point at which they are not environmentally degraded more than other comparable areas of the Great Lakes. When that point has been reached, the AOC can be removed from the list of AOCs, or “delisted.” The GLWQA can be found at: <http://www.ijc.org/rel/agree/quality.html>

Beneficial Use Impairment (BUI): Defined by the Great Lakes Water Quality Agreement (GLWQA) as a reduction in the chemical, physical, or biological integrity of the waters of the Great Lakes sufficient to cause impairment to designated use (GLWQA, 2012). The Sheboygan River AOC was assigned nine BUIs including: restrictions on fish and wildlife consumption; restrictions on dredging activities; degradation of benthos; degradation of fish and wildlife populations; loss of fish and wildlife habitat; bird or animal deformities or reproduction problems; fish tumors or other deformities; degradation of phytoplankton and zooplankton populations; and eutrophication or undesirable algae.

Beneficial use(s): Ways that a water body can improve the quality of life for people or for fish and wildlife. For example, providing habitat for fish and wildlife is a beneficial use of a water body. If a beneficial use is suppressed or unavailable due to environmental problems, like loss of habitat, then that beneficial use is considered impaired. The Great Lakes Water Quality Agreement provided a list of 14 possible beneficial use impairments in the 1987 amendments to the GLWQA.

Consumption Advisory: A health warning issued by WDNR and WDHSS (Wisconsin Department of Health and Social Services) that recommends that people limit the fish and waterfowl they eat from specified rivers and lakes based on the levels of toxic contaminants found in the fish and waterfowl.

Great Lakes Restoration Initiative (GLRI): A federal program that provides unprecedented funding for protection and restoration efforts on the five Great Lakes. State and local governments and non-profit organizations are eligible to receive grants from the U.S. Environmental Protection Agency (U.S. EPA) for projects addressing toxic substances, invasive species, non-point source pollution, habitat protection and restoration or accountability, monitoring, evaluation, communication and partnership building.

Goal: Goals are qualitative overarching ideas that may take a long time to achieve. They usually don’t change significantly over the life of a project. An example goal statement is, “Nesting populations of a diverse array of wetland-dependent and riparian-associated birds are consistently present within the AOC.”

Natural Areas: A "natural area" is an area that currently has value as fish and wildlife habitat or has the potential to be restored so that it has value as fish and wildlife habitat. Natural areas

can be publically or privately held, and can include wetlands or riparian lands within the AOC. Natural areas are not necessarily formally designated State Natural Areas.

Polybrominated Diphenyl Ethers (PBDE): PBDEs are used as flame retardants in a wide variety of products, including plastics, furniture, upholstery, electrical equipment, electronic devices, textiles and other household products

Polychlorinated Biphenyls (PCBs): A group of more than 200 compounds, PCBs have been manufactured since 1929 for uses including electrical insulation, hydraulics, fluorescent lights, and carbonless paper to name a few. In 1979, PCBs were banned because of their persistence in the environment and tendency to magnify up the food chain. They have been linked to reproductive problems in wildlife and are suspected of causing developmental problems in human infants.

Polycyclic Aromatic Hydrocarbons (PAH): Chemicals commonly associated with oils, greases, and other components derived from petroleum, and are often associated with former coal gasification plants. Some PAH compounds have been identified as cancer or mutation causing.

Remedial Action Plan (RAP): A RAP is developed for each AOC to: identify the status of BUIs and their sources, document restoration targets, and list actions needed to reach those targets. RAPs are updated periodically to report progress towards achieving the restoration targets. This Plan along with the most current RAP Update for the Sheboygan River AOC constitutes a complete strategy for removing all BUIs in the Sheboygan River AOC.

Restoration Target: Specific goals and objectives established to track restoration progress of beneficial use impairments. Once targets have been met, the beneficial use is no longer considered impaired. Targets should be locally derived. Restoration targets for the Sheboygan River AOC were initially developed in 2008 by WDNR in partnership with a local project team.

Technical Advisory Committee (TAC): The Sheboygan AOC formed a technical advisory committee made up of fish and wildlife experts from agencies and local partners for the purpose of determining information needs, to set goals, to identify measures and projects that could address potential habitat or population impairments, and to evaluate success. This group has been meeting on a regular basis for more than 4 years.

APPENDIX B

Rapid Ecological Assessment

This document was not included for the public comment period due to the document size. If you wish to read the 2011 *Rapid Ecological Assessment for the Sheboygan River Area of Concern* contact Eric Evensen, Sheboygan River AOC Coordinator (Eric.Evensen@wisconsin.gov).

APPENDIX C

Sediment Remediation Efforts

Summary of Sediment Removal Projects and description from 2014 Remedial Action Plan Update for the Sheboygan River AOC.

Project Name	Year	Funding Source(s)	Approximate Cost of Planning and Dredging	Approximate # of Cubic Yards removed
Sheboygan River and Harbor Superfund Site: Upper River Dredging	2006-2007	Tecumseh Corporation and Pollution Risk Services (PRS)	\$9,000,000	20,728
Sheboygan River and Harbor Superfund Site: Lower River Dredging	2011-2012	Tecumseh Corporation and Pollution Risk Services (PRS)	\$13,500,000	63,744
Camp Marina Former MGP Site	2011	Wisconsin Public Service	\$10,000,000	23,240
Great Lakes Legacy Act Project	2012-2013	GLRI/USEPA-GLNPO, State of Wisconsin, Sheboygan County, City of Sheboygan	\$32,776,000	147,822
Sheboygan Harbor Navigational Dredging	2012-2013	GLRI/USEPA, State of Wisconsin, Sheboygan County, City of Sheboygan	\$20,797,000	154,273
TOTAL	-	-	\$86,073,000	409,807

Sheboygan River and Harbor Superfund Site

In 2000, a Record of Decision (ROD) was completed for the Sheboygan River & Harbor Superfund project. In 2006, contaminated sediment cleanup work began in the upper river segment of the site (Figure 2), which was completed in 2007. No sediment cleanup was necessary under the ROD for the middle river segment of the site. In spring 2011, dredging

began in the lower river and inner harbor sections of the site and was completed in October 2012. Floodplain soils were also removed from the Upper River segment in 2012.

Camp Marina Former MGP Site

The Camp Marina former MGP site remediation has been split into two separate actions, the upland portion and river portion. The site is located near “Boat Island” in the City of Sheboygan (Figure 2). The upland portion of the site was cleaned up in 2002. The river section was dredged in 2011 as a Superfund Alternative or emergency action. This is due to the other Superfund clean-up that was also taking place in 2011 which would have exposed PAH contamination during operations to clean up PCB contamination. The PAH and PCB contaminated sediment removal projects were coordinated in order to address these areas at the same time. Work at the Camp Marina site was completed by the end of 2011.

Great Lakes Legacy Act Project

River stakeholders pursued a Legacy Act project as a betterment to the two Superfund projects. Community stakeholders desired to remove contaminated sediment left behind after the Superfund actions were complete. The Legacy Act dredging project was implemented in 2012 in the lower river between Kiwanis Park and the 8th Street Bridge and was completed in 2013.

Sheboygan Harbor Navigational Dredging

During the investigation stage of the Legacy Act project, sediments below the 8th Street Bridge were found to have much lower levels of contamination than were previously thought to exist in this area. As a result, USACE was able to design a navigational dredging project, something they were previously unable to do. Sediments in the lower portion of the river between the 8th Street Bridge and the outer harbor were dredged in 2012 and completed in 2013, improving the navigation of this area of the river.

Appendix D

Tier 2 Habitat Restoration Projects

Table 1: Tier 2 habitat restoration projects within the Sheboygan River AOC. List was compiled by the Sheboygan River AOC Technical Advisory Committee.

	Habitat Category	Project
1	Floodplain forest	Restore floodplain forest habitats to improve riparian connectivity, climate change, and wildlife habitat (songbird nesting and stopover) *Work has been done but more opportunities are available
2		Map potential floodplain forest restoration projects within AOC (compare to FF impact areas)
3		Plant non-ash trees in high-ash areas within AOC (~\$1000/acre)
1	Bank stabilization & naturalization	Kiwanis Park opposite shoreline (private ownership) shoreline naturalization
2		Enhance riparian buffers along private residences and Kohler stables
3		Habitat baskets / seawall improvements
1	Aquatic	Remove or construct fish passage at Walderhaus dam (reconnect approx. 6 miles of river) for steelhead, coho, chinook, smallmouth, and northern pike
2		Remove or construct fish passage at River Bend dam (reconnect approx. 6 miles of river) for steelhead, coho, chinook, smallmouth, and northern pike
3		Establish sturgeon stocking program and restore in stream habitat
4		Attach fish cribs to sheet pilings along urban areas
1	Stormwater	Taylor Drive stormwater BMPs *Work has been done but more opportunities are available
2		Blue Harbor rain gardens / infiltration
1	Recreational	Taylor Drive parking improvements and fishing access *Work has been done but more opportunities are available
2		Establish greenway along Sheboygan River and Willow Creek with connection to Plank Road Trail
3		Kiwanis Park boat landing improvements and fishing access *Work has been done but more opportunities are available
1	Invasive Species	Establish invasive species control program (partner with Boy Scouts, Lutheran HS, Sheboygan South HS, Kohler HS, Oostburg HS, UW-Sheboygan, garden clubs, local citizens) *Work has been done but more opportunities are available
2		Focus on newly emerging invasive populations within AOC
1	wildlife	Promote mink population *Work has been done but more opportunities are available
2		Promote wood duck nest success *Work has been done but more opportunities are available
3		Increase king fisher populations *Work has been done but more opportunities are available
4		Increase wetland species diversity through restoration *Work has been done but more opportunities are available

5	Add nesting structures for raptors (e.g. osprey) *Work has been done but more opportunities are available
6	Install purple marten / tree swallow boxes on private lands near AOC waterways *Work has been done but more opportunities are available
7	Increase floodplain forest habitat for red-shouldered hawks *Work has been done but more opportunities are available
8	Reduce goose populations (reduce mowed grass and increase shrub cover in riparian zone) *Work has been done but more opportunities are available

Table 2: Tier 2 habitat restoration projects outside the Sheboygan River AOC boundaries. List was compiled by the Sheboygan River AOC Technical Advisory Committee.

	Habitat Category	Project
1	Bank stabilization & naturalization	Plank Road trailhead bank stabilization project
1	Aquatic	Retrofit Willow Creek/I-43 culvert to improve fish passage and retrofit with daylight windows
2		Retrofit Willow Creek/Glendale Road culvert to improve fish passage
3		Remove Willow Creek/Erie Avenue culvert on Kohler property to improve fish passage and restore channel
4		Remove large debris dams in Willow Creek downstream from Glendale Road
5		Schuchardt Parcel in-stream cold water improvements
6		Weedens Creek - In-stream habitat improvements
1	Stormwater	Plank Road trailhead groundwater infiltration pilot project
2		Install stormwater BMPs within DOT ROW to promote groundwater infiltration and improve Willow Creek water quality

Appendix E

Habitat Restoration Projects – before, during and after photos

Taylor Drive/Indiana Avenue Wetlands Before



Taylor Drive/Indiana Avenue Wetlands During





Taylor Drive/Indiana Avenue Wetlands After



Esslingen Park Before





Esslingen Park During



Esslingen Park After



Roy Sebald Sheboygan River Natural Area Before





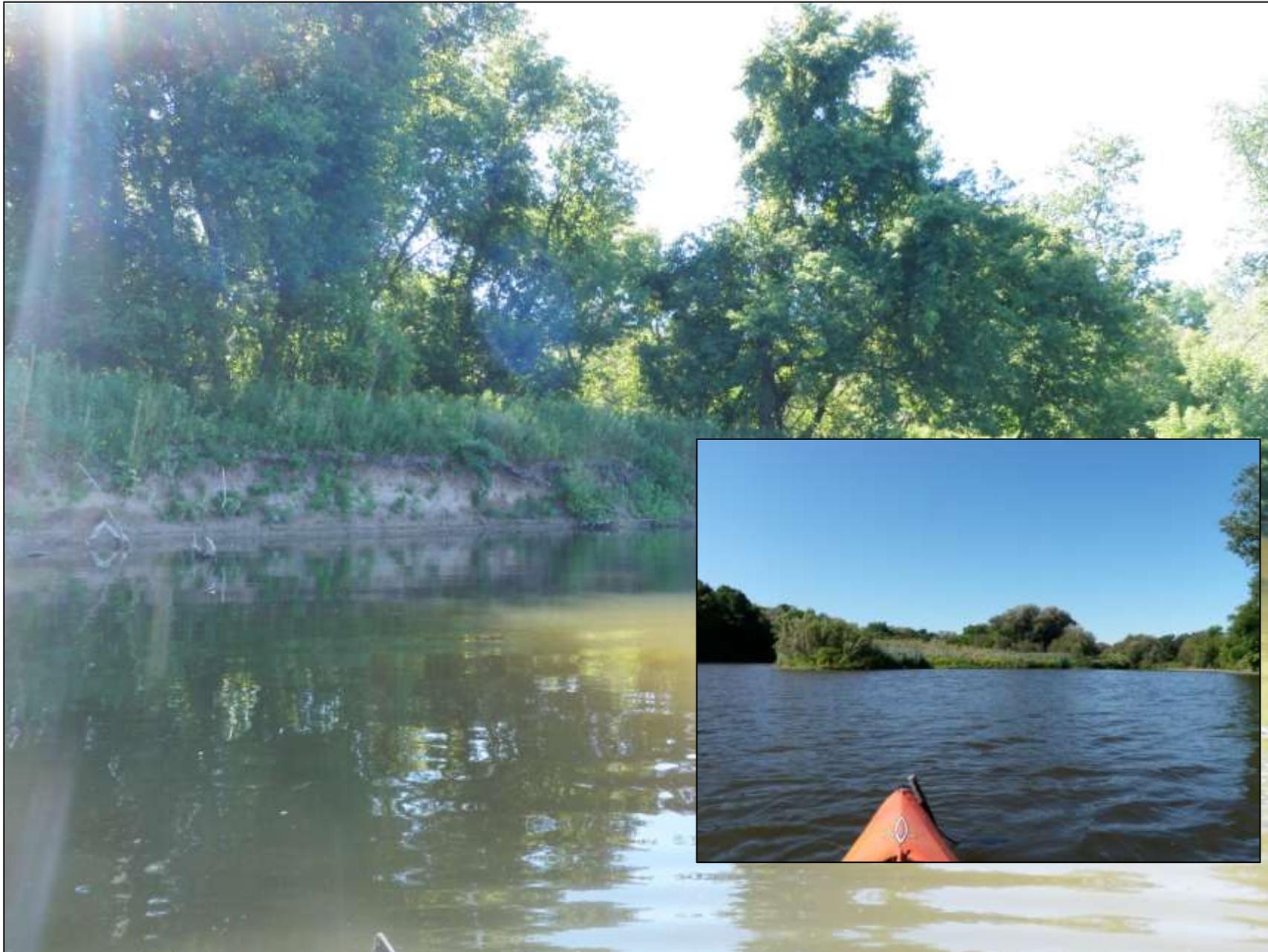
Roy Sebald Sheboygan River Natural Area During



Roy Sebald Sheboygan River Natural Area After



Wildwood Island Before



Wildwood Island During



Wildwood Island After



Kiwanis Park Before





Kiwanis Park During







Kiwanis Park After



