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REMEDIAL ACTION PLAN UPDATE
for the
MILWAUKEE ESTUARY AREA OF CONCERN
December 2013



Wisconsin Department of Natural Resources
Office of the Great Lakes

**2013 Remedial Action Plan Update
for the
Milwaukee Estuary Area of Concern**

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Disclaimer: The Great Lakes Water Quality Agreement is a non-regulatory agreement between the U.S. and Canada, and criteria developed under its auspices are non-regulatory in nature. Any actions identified in this document as needed to remove the impaired beneficial uses are not subject to enforcement or regulatory actions.

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List of Acronyms

AIW	Art Institute of Wisconsin
AOC	Area of Concern
BCOC	Bioaccumulative chemicals of concern
BUI	Beneficial Use Impairment
CDF	Confined disposal facility
CSO	Combined sewer overflow
GLRI	Great Lakes Restoration Initiative
KK	Kinnickinnic
LAMP	Lakewide Action and Management Plan
LOEL	Lowest observable effect level
mg/L	Milligrams per liter
MMSD	Milwaukee Metropolitan Sewerage District
NOAA	National Oceanic and Atmospheric Administration
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
RAP	Remedial Action Plan
SEWRPC	Southeastern Wisconsin Regional Planning Commission
SSO	Sanitary Sewer Overflow
TMDL	Total Maximum Daily Load
TP	Total phosphorus
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UW-Extension	University of Wisconsin - Extension
UWM	University of Wisconsin-Milwaukee
WDNR	Wisconsin Department of Natural Resources
WisCALM	Wisconsin Consolidated Assessment and Listing Methodology

EXECUTIVE SUMMARY

The Milwaukee Estuary Area of Concern (AOC) is very large and many partners are working to improve AOC conditions. In 2013, the priority was finding funding to implement necessary assessments and projects in the AOC. Priority activities for the AOC emerged from many individual conversations and several stakeholder meetings. Over the last couple of years, the Wisconsin Department of Natural Resources (WDNR) with its partners made substantial progress on many of the impaired beneficial uses for the Milwaukee Estuary AOC.

Changes from the 2012 Remedial Action Plan (RAP) Update to this document are summarized below, to highlight activities that occurred between 2012 and 2013:

Summary of Changes for Restrictions on Fish and Wildlife Consumption

- WDNR successfully obtained Great Lakes Restoration Initiative (GLRI) funding to obtain current data to update the waterfowl consumption advisory that has existed for the AOC since 1987, but not been reassessed since that time. Sampling commenced in spring of 2013.
- The second phase of the Lincoln Park and Milwaukee River Channels is being planned and designed in 2013. The cleanup of polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) from Lincoln Park Phase 1 area concluded in 2012. Pending funding, clean up of the Phase 2 area is tentatively planned for 2014.
- A feasibility study is underway for cleanup of the Cedar Creek Superfund site.

Summary of Changes for Degradation of Fish and Wildlife Populations

- Work related to target refinement for both fish and wildlife populations began in 2013.
- The Milwaukee Estuary's separate fish and wildlife population assessment proposals were funded in 2013 and field work is expected to begin in 2014.

Summary of Changes for Fish Tumors or Other Deformities (potentially impaired)

- Sampling began in 2013 to sample fish for contaminant-related tumors for the AOC. Results of that sampling should be available in 2014.
- Reference site selection and sampling may occur in 2014.

Summary of Changes for Bird or Animal Deformities or Reproduction Problems (potentially impaired)

- No change reported for 2013.
- Tree swallow data collected from USGS examining hatching effects was collected from many sites across the Great Lakes, including two sites in the AOC (Lakeshore State Park and Lincoln Park).

Summary of Changes for Degradation of Benthos

- As of Oct. 1, 2013, results from the 2012 benthos data that USGS collected from the AOC and several other Lake Michigan sites (including other AOC sites and non-AOC sites) were not available.
- USGS will do additional sampling in 2014 for benthos and plankton.

Summary of Changes for Restrictions on Dredging

- The second phase of the Lincoln Park and Milwaukee River Channels is being planned and designed in 2013. Pending funding, clean up of the Phase 2 area is tentatively planned for 2014.
- Other cleanups and assessments are still necessary to continue making progress on this impairment. See Figure 1.

Summary of Changes for Eutrophication or Undesirable Algae

- No change reported for 2013.

- Results for the Milwaukee Basin Total Maximum Daily Load (TMDL) study for phosphorus have been delayed, and are expected in fall of 2013. A TMDL implementation plan was originally expected in September 2013, but has been delayed until 2014.

Summary of Changes for Beach Closings/Recreational Restrictions

- In 2012, Milwaukee County hired a contractor to conduct a feasibility study of moving South Shore Beach to improve water quality. The feasibility study was completed in 2013.
- In 2013, a two-year project that will identify and quantify unrecognized sanitary sewage contamination to the AOC was funded and is expected to begin in 2014.

Summary of Changes for Degraded Aesthetics

- In 2013, WDNR contractors continued the citizen aesthetics monitoring program.

Summary of Changes for Degraded Phytoplankton and Zooplankton Populations

- As of Oct. 1, 2013, results from the 2012 plankton data that USGS collected from the AOC and several other Lake Michigan sites (including other AOC sites and non-AOC sites) were not available.
- USGS will do additional sampling in 2014 for benthos and plankton.

Summary of Changes for Loss of Fish and Wildlife Habitat

- The technical team developed a 2014 list of funding priorities based on the interim habitat goals and preliminary prioritization framework for habitat projects in the AOC (see p. 20 in Appendix A for a list of this year's priorities).
- In 2013 significant progress on this impairment was made, as several of the habitat projects on the 2012 list were funded through various grants.
- A draft fish and wildlife plan was developed for the AOC, as specified by the delisting targets.

Next Steps

Sediment cleanups are critically important for removing nearly all impairments. While several sediment cleanups have been completed and others are currently underway, additional assessment and cleanup work is needed. Figure 1 shows the status of contaminated sediment projects in the AOC.

Note that the following actions are still necessary to address aspects of the impairments that are associated with contaminated sediment:

- Remove/manage PCB-contaminated sediments from the Cedar Creek Superfund Site.
- Assess the Milwaukee River downstream of its confluence with Cedar Creek to the Milwaukee River Channels/Lincoln Park Great Lakes Legacy Act projects.
- Complete Phase 2 of the Milwaukee River Channels/Lincoln Park Great Lakes Legacy Act project.
- Assess the Menomonee River downstream of its confluence with the Little Menomonee River to the estuary.
- Complete the evaluation/cleanup of PAHs and metals at the Burnham Canal Superfund Alternative Site.
- Complete the evaluation/cleanup of PAHs and metals at the Solvay Coke Superfund Alternative Site.
- Complete other evaluations/cleanups of contaminated sediment as identified and needed.

For 2014, the Milwaukee AOC Coordinator will be focused on continuing to help partners seek funding for priority habitat projects in the AOC, and engaging the fish and wildlife technical team to begin working on a final list of fish and wildlife projects that will be necessary to remove the loss of fish and wildlife habitat impairment. Other priorities will include reviewing monitoring data as it becomes available and working with partners to develop next actions based on the information, and developing an approach for assessing the Bird and Animal Deformities or Reproduction Problems beneficial use impairment.

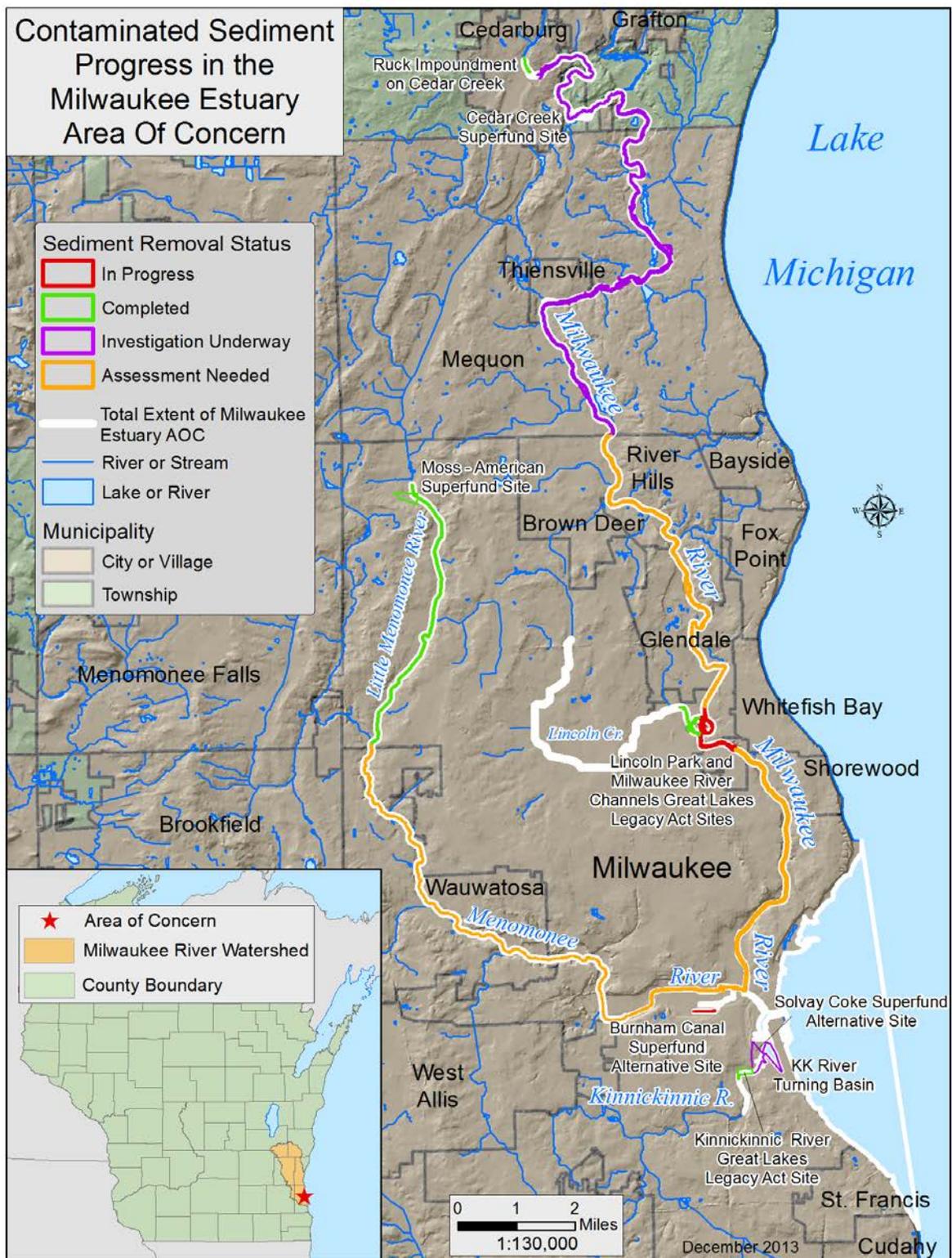


Figure 1. Sediment progress and sites needing action in the Milwaukee Estuary AOC. Note that several reaches still need to be characterized before WDNR will be able to identify all areas that will need to be addressed as part of the AOC program.

DEFINITIONS

Area of Concern (AOC)

Defined by Annex 2 of the 1987 Protocol to the U.S.-Canada Great Lakes Water Quality Agreement 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 of the area’s ability to support aquatic life.” These areas are the “most contaminated” areas of the Great Lakes, and the goal 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 in the Annex, or “delisted.”

Beneficial Use Impairment (BUI)

A "beneficial use" is any way that a water body can improve the quality of life for humans or for fish and wildlife (for example, providing fish that are safe to eat). If the beneficial use is unavailable due to environmental problems (for example if it is unsafe to eat the fish because of contamination) then that use is impaired. The International Joint Commission provided a list of 14 possible beneficial use impairments in the 1987 Great Lakes Water Quality Agreement amendment.

Delisting Target

Specific goals and objectives established for beneficial use impairments, with measurable indicators to track progress and determine when delisting can occur. Targets should be locally derived.

Goal

Goals are broad 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.*” The delisting targets for the impairments may also be considered the goal statements (in some cases they may be objectives).

Hotspot

An area where additional characterization is needed to determine if further remedial actions are necessary. Typically, potential hotspots are identified by information related to historic or adjacent land use.

Objective

Objectives are the detailed activities that are needed in order to meet goals. Objectives are normally accomplished in less time than goals. They are important because they provide a means of measuring progress toward plan implementation. Objectives should be SMART: Specific, Measurable, Achievable, Realistic, Time-Constrained.

Project

As defined for this document, a project is a specific activity that has been defined with enough detail to understand who will do the work, how it will be done, and where it will be done. The end result of the activity should be visible and concrete. One or more projects may be defined to meet the goals and objectives for the impairments, if the AOC is not yet eligible for delisting. With this definition, “Coordinating with partners to make sure data is consistently collected and used” would not be a project. However, “XY Agency will host a symposium and write a set of standards for data collection and analysis for the Example AOC,” would be a project.

Remedial Action Plan (RAP)

According to the 1987 Protocol to the U.S.-Canada Great Lakes Water Quality Agreement, a RAP is a document that provides “a systematic and comprehensive ecosystem approach to restoring and protecting beneficial uses in Areas of Concern...” RAPs are required to be submitted to the International Joint Commission at three stages:

- Stage 1: Problem definition
- Stage 2: When remedial and regulatory measures are selected
- Stage 3: When monitoring indicates that identified beneficial uses have been restored

Note that a renegotiated Great Lakes Water Quality Agreement was signed in 2012 by the U.S. and Canada which removed the “stage” terminology from the AOC Annex, and simply requires Remedial Action Plans to be “developed, periodically updated, and implemented for each AOC.”

Total Maximum Daily Load (TMDL)

A TMDL is the amount of a pollutant a waterbody can receive and still meet water quality standards. It can be thought of as a pollution "budget" for a water body or watershed that establishes the pollutant reduction needed from each pollutant source to meet water quality goals.

PURPOSE STATEMENT

The purpose of this document is to serve as a Remedial Action Plan (RAP) update. Remedial Action Plans are required by Annex 1 of the Great Lakes Water Quality Protocol of 2012 (which replaced the 1987 Protocol amending the Revised Great Lakes Water Quality Agreement of 1978). The 2012 Protocol indicates that Remedial Action Plans must include the following elements:

1. Identification of BUIs and causes;
2. Criteria for the restoration of beneficial uses that take into account local conditions and established in consultation with the local community;
3. Remedial measures to be taken, including identification of entities responsible for implementing these measures;
4. A summary of the implementation of remedial measures taken and the status of the beneficial use; and
5. A description of surveillance and monitoring processes to track the effectiveness of remedial measures and confirm restoration of beneficial uses.

This RAP, which updates the 2012 document, is intended to be a concise summary of beneficial use impairment status and specific actions that will be important for reaching the delisting targets. “Actions” may include on-the-ground restoration projects, monitoring and assessment projects, and stakeholder engagement processes. It is also a tool for documenting and communicating progress to agency partners and technical stakeholders. Subsequent updates will be completed as needed to incorporate new information that may become available.

INTRODUCTION

Areas of Concern (AOCs) are severely degraded geographic areas within the Great Lakes. The areas – 43 within the Great Lakes region – were designated as AOCs primarily due to contamination of river and harbor sediments by toxic pollutants. Cleaning up these severely degraded areas is a first step toward restoring the chemical, physical, and biological integrity of the lakes as required by the Great Lakes Water Quality Agreement. When the areas have been cleaned up to the point where they are not more degraded than other, comparable non-AOC areas, they are “delisted” as AOCs; they are then managed in accordance with the Lakewide Action and Management Plan (LAMP) program, a “whole lake” program that is also set forth in the Agreement. The Agreement is the means for the U.S. and Canada to work together to jointly manage the lakes.

The Milwaukee Estuary AOC is one of five Areas of Concern in Wisconsin (Figure 1). It was designated an AOC in 1987 for several reasons. Sediments contaminated with toxic pollutants such as polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and heavy metals contributed to nearly all of the eleven beneficial use impairments (BUIs) within the original boundaries of the AOC. While loading of toxic substances was one of the primary drivers behind the AOC program, impacts from urbanization and terrestrial and aquatic habitat fragmentation also contribute to the impairments. The waterways within the AOC were also historically modified (straightened and dredged) to accommodate large vessel commercial shipping. Combined sewer overflows from wastewater treatment plants and soil erosion and nutrient enrichment from throughout the estuary’s watershed contributed to degraded water quality.

These sources of impairment led to designation of eleven of the possible fourteen BUIs as applicable to the Milwaukee Estuary AOC (two of the eleven were identified as “suspected”). In 2008, the AOC boundary was expanded to account for the discovery of additional contaminated sediment sites (Figure 2). In the expanded AOC boundary, the BUIs that are most closely tied to sediment contamination (e.g., fish and wildlife consumption, restrictions on dredging, degradation of benthos, degraded fish and wildlife populations¹) are identified as impaired (USEPA, 2009, pp. 1-3). Milwaukee Estuary AOC beneficial use impairments and sources are summarized in Table 1. Impairment status is summarized in Table 2. Note that some impairments must be addressed broadly for the whole AOC, while others must be addressed on a geographic basis (i.e., tributaries are different from each other and are different than the estuary). While significant progress has been made since the first Remedial Action Plan (RAP) document in 1991, no impairments have been removed for this AOC to date.

For a description of the geographic boundaries of the AOC, please see p. 2 and Appendix C of the 2011 RAP Update. Figure 2 on p. 4 depicts the original and expanded boundaries of the AOC.

The Wisconsin Department of Natural Resources (WDNR) worked with community stakeholders to develop a RAP in 1991, with updates in 1994 and 1999. In 2011, WDNR began working again with stakeholders to identify goals and actions necessary to address the impairments of the AOC. To do this, WDNR develops annual Remedial Action Plan Updates to summarize completed work progress toward improving conditions in the AOC.

¹ Note that the Lincoln Park/Milwaukee River Channels Sediment project is a prime example of why the AOC boundaries were expanded. That particular site contributes the greatest mass loading of PCBs to the Milwaukee River and Harbor, and remediation of contaminated sediment within this area is expected to result in a long-term reduction in PCB mass transport in the Milwaukee River of up to 70 percent. The impairments listed above are specifically associated with this site, and are likely the impairments that also apply to the expanded portions of the Milwaukee River portion of the AOC.

The main priorities for the Milwaukee Estuary AOC include remediation of contaminated sediments in tributaries and nearshore waters of Lake Michigan, nonpoint source pollution control, improvement of water quality for recreational purposes, enhancement of fish and wildlife populations, and habitat rehabilitation.

Many projects have occurred in the AOC that have helped to address the impairments. Several formerly contaminated sites have been assessed and remediated through the Great Lakes Legacy Act, the Superfund program, or other efforts. Moreover, a total maximum daily load study for the Menomonee, Kinnickinnic, and Milwaukee Rivers and the Milwaukee Estuary will be completed in 2013 for phosphorus, fecal coliform bacteria, and sediment loading. The Total Maximum Daily Load (TMDL) implementation plan, expected in 2013, will identify the next steps needed to reduce pollution and meet water quality criteria in the AOC.

This RAP Update concisely lists the current status of each BUI, the next actions needed, and potential issues. The AOC is dynamic, and this document captures progress made from the last update completed in December of 2012 through October 2013. An updated version will be submitted again at the end of 2014. Citizen engagement has been an integral component of the AOC program since the beginning and continues to be a priority as additional actions are identified and implemented.

Stakeholder Engagement

The original RAP and RAP Update were the result of significant public consultation and involvement and included multiple technical advisory committees and a citizen advisory committee. Since 2012, WDNR established a Fish and Wildlife technical team and a re-established a citizen advisory committee in the form of the “Stakeholder Delegation,” a subset of the larger groups of interested stakeholders. The purpose of the delegation is to advise and support an education, information, and outreach strategy through direct involvement, consultation, and review of outputs.

This past year’s public involvement continued efforts from 2012, and included the Citizen Aesthetics Monitoring Program (CAMP) and Explore & Restore Expeditions. The following projects, identified and endorsed by the Delegation as meeting a priority stakeholder and engagement/community education need in the Milwaukee Estuary Area of Concern, received WDNR capacity grant program funding:

(Grant Recipients: UEC – Urban Ecology Center; AGL – Alliance for the Great Lakes; GWM – Groundwork Milwaukee, and John Gurda.)

- River Citizen Aesthetic Monitoring to assess BUI status (UEC)
- Beach Citizen Aesthetic Monitoring to assess BUI status (AGL)
- River Ambassadors (GWM)
- “Built on Water: Milwaukee’s Vital Resource” Lecture Tour (John Gurda)
- Explore & Restore Expeditions (UEC)
- Flora and Fauna Field Guide of the AOC (GWM)

In addition, UW-Extension worked closely with the Art Institute of Wisconsin (AIW) to spearhead collaboration between the two entities in which students support AOC education efforts while learning on the job. AIW students videotaped a wetland baseline assessment training and developed a trailer and video lecture of the “Built on Water” lecture tour. The videos will be available in 2014 from the Wisconsin Great Lakes Areas of Concern outreach website (<http://fyi.uwex.edu/aocs/>).

There are multiple other efforts to involve the public and gain their support for actions to improve environmental conditions in the Milwaukee Estuary Area of Concern. The UW-Extension Natural

Resources Educator and WDNR will work with community partners to identify collaboration opportunities when their goals overlap with the AOC program goals. Existing venues for communicating with the public will be utilized, for example incorporating AOC updates into quarterly RiversReport newsletters (distributed by the Southeastern Wisconsin Watersheds Trust); using social media; and partner outreach programs, events, and publications.

This year, DNR and Extension worked closely to produce Restoration Reports for each of the Wisconsin AOCs. These are the first annual reports produced that illustrate the status of each AOC's progress toward removing the beneficial use impairments and the next steps for the coming year. The DNR Office of the Great Lakes will work with UW-Extension to update these annually. In addition, two videos were completed to illustrate progress in the Milwaukee Estuary AOC (with the Office of the Great Lakes) and the benefits of dredging (with University of Illinois, Sea Grant).

For a complete list of areas the Stakeholder Delegation identified for outreach and communication for 2013, see Appendix C.

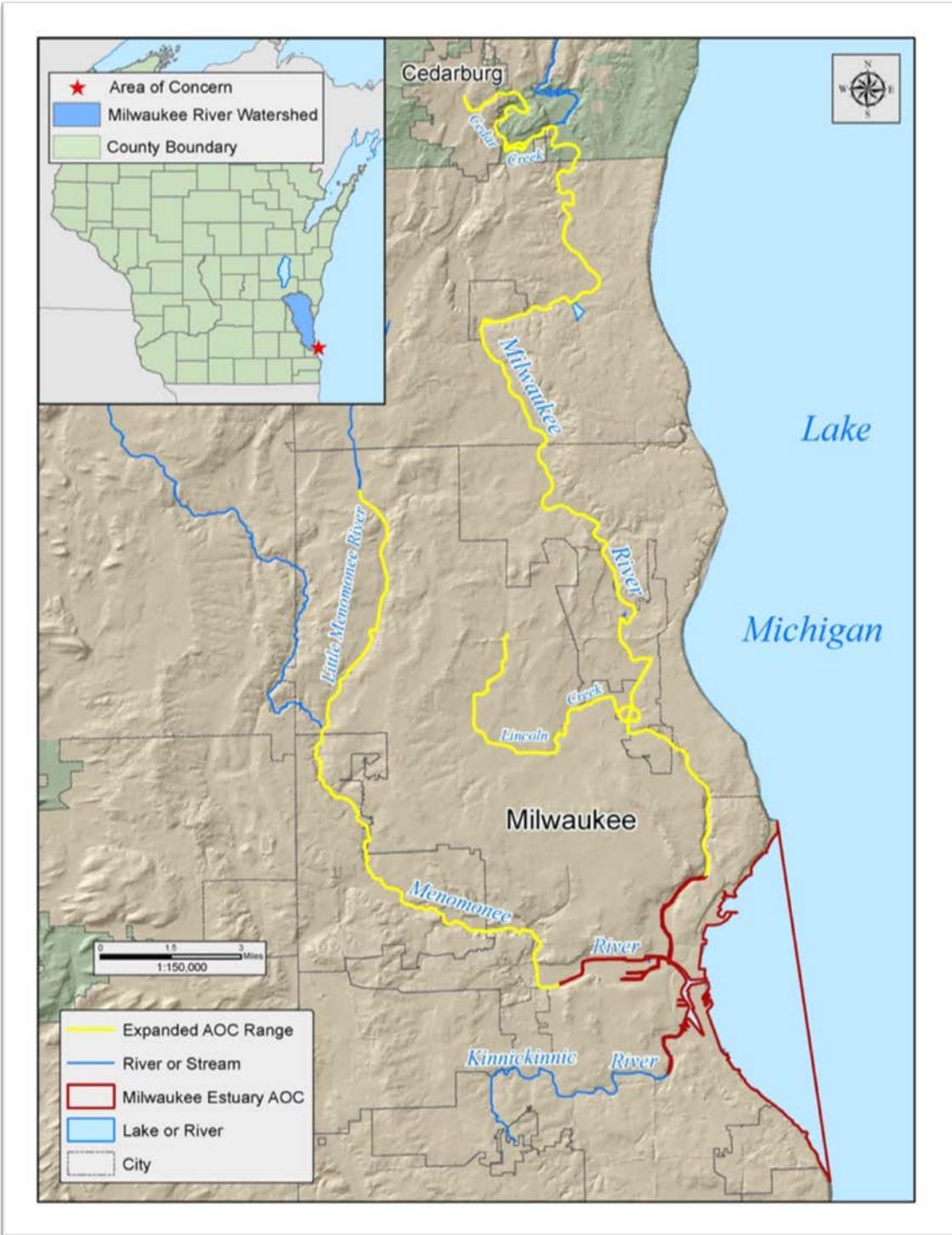


Figure 2. The Milwaukee Estuary AOC. The original boundaries are shown in red and the expanded boundaries that were added because of additional contributions of contaminated sediment in the upper watersheds are shown in yellow.

Table 1. Causes of Beneficial Use Impairments in the Milwaukee Estuary Area of Concern.

Impaired Beneficial Use (Original AOC boundaries)	Sources of Pollution or Problem			
	Toxic Substances	Point Source and Runoff Pollution	Physical Habitat Alteration	Other
Degradation of fish and wildlife populations	X	X	X	X
Loss of fish and wildlife habitat	X	X	X	X
Degradation of benthos	x	X	x	X
Restrictions on dredging	X	X		
Restrictions on fish and wildlife consumption	X	X		
<i>Bird/animal deformities or reproduction problems (suspected)</i>	x	x		
<i>Fish tumors or other deformities (suspected)</i>	x	x		
Beach closings/recreational restrictions	X	X		
Degraded phytoplankton and zooplankton populations	X	X	X	
Eutrophication or undesirable algae		X	X	X
Degradation of aesthetics	x	X	x	X

Note: A lower case x indicates that at the time of the original RAP, these sources were not understood to be part of the source contributing to a particular impaired beneficial use, but are now considered to be a component of the impairment.

Pollution Source Explanations

Toxic Substances

Loading of toxic substances into AOCs was one of the primary drivers behind the AOC program. Sources of toxic substances include contaminated sediments, spills of such chemicals within the watershed, and atmospheric deposition.

Point Source and Runoff Pollution

This category includes loading of sediment, nutrient, and/or bacteria as a result of nonpoint, or diffuse, sources of pollution and includes urban stormwater runoff. Point sources, such as sewer overflows, are also a source of sediment, nutrients, and bacteria into the AOC and are included in this category. Additionally, noncontact cooling water is a significant source of phosphorus, a nutrient, into the waters of the AOC.

Physical Habitat Alteration

Dams, drop structures, concrete-lined channels, and poorly-sized culverts and stream crossings degrade aquatic habitat by impeding the fishes' ability to get to suitable spawning habitat further upstream. This category also includes shoreline alteration, such as sheet piling, that doesn't provide high-quality habitat the same way that more naturalized, meandering streambanks would. Alterations in riparian habitats ecologically connected to the stream have the ability to impair the life cycles of wildlife, such as the ability of fish to spawn in floodplain wetlands, and ducks to nest in riparian grasslands.

Other

In the time since the original RAP documents were written, there has been recognition of the importance of thermal discharges in affecting water quality, specifically dissolved oxygen levels. As water temperature increases, its ability to carry oxygen decreases. Therefore, discharges of water with elevated temperatures can have a significant negative impact on aquatic communities. "Other" for the Degradation of Aesthetics impairment is listed because litter was a primary source of pollution for that impairment.

Table 2. Milwaukee Estuary Beneficial Use Impairment Status Summary (refer to Appendix D for more detail).

Beneficial Use Impairment	Beneficial Use Remains Impaired	Summary Status
Restrictions on dredging	Yes	Several sediment cleanup projects have been completed; additional sediment assessments and cleanups are needed. Known or suspected contaminated areas are in line for Great Lakes Legacy Act funding or are being addressed by Superfund or other remediation programs.
Restrictions on fish and wildlife consumption	Yes	Waterfowl consumption assessments have been funded by GLRI and are in progress. Fish consumption is impaired so long as contaminated sediments are present and is reassessed on a 5-year monitoring cycle.
Degradation of benthos	Yes	USGS benthos study from 2012 still under review; study will provide information for refining the target and determining if additional information is needed (there are different benthic communities in tributaries than in the estuary; may need separate targets).
Degradation of fish and wildlife populations	Yes	The fish and wildlife technical team developed assessments for fish and wildlife populations. Those assessments have been funded in 2013 and will start in 2014.
Loss of fish and wildlife habitat	Yes	The fish and wildlife technical team is developing a list of all projects necessary for BUI removal. Several necessary projects were funded or began in 2013.
Bird/animal deformities or reproduction problems (potentially impaired)	Suspected	The AOC Coordinator plans to develop an assessment strategy for this impairment in 2014.
Fish tumors or other deformities (potentially impaired)	Suspected	Fish tumor study began in 2013 and will help in determining if this use is impaired (200 white suckers sampled). Sampling at reference sites may be warranted, pending the results of this year's sampling in the AOC.
Beach closings/recreational restrictions	Yes	Target may need to be refined to be tributary- and estuary-specific. Bacterial contamination source identification is needed to address recreational restrictions. Support efforts to address bacterial contamination at South Shore Beach, as appropriate.
Degraded phytoplankton and zooplankton populations	Yes	USGS phyto- and zooplankton study from 2012 under review. Study will provide information for refining the target and determining if additional information is needed.
Eutrophication or undesirable algae	Yes	Target may need to be refined to be tributary- and estuary-specific. TMDLs will inform sources and phosphorus loading reductions needed; TMDLs and a TMDL implementation plan has been delayed; expected to be completed in 2014.
Degraded aesthetics	Yes	A citizen-based monitoring project is on-going to help characterize the impairment and determine what or how it would need to be addressed.

BENEFICIAL USE IMPAIRMENT UPDATES

The following pages summarize the current status of each Beneficial Use Impairment using the format below. An explanation of each section is provided after the heading. Note that the order in which the impairments are listed below is different than on pages 6 and 7; Impairments are addressed by the order in which the International Joint Commission lists them.

Target and Status

Updated Targets	Status
The updated target based on the 2011 Draft Stage 2 modifications to the 2008 targets for the Milwaukee Estuary AOC are listed here as separate components on each row to clearly show the status of each part of the target.	May be: <ul style="list-style-type: none">- "Complete"- "In progress"- "Addressed by current projects"- "Action needed"- "Unknown"- "Assessment in progress" (data collection occurring in years listed in parentheses)- "TBD" (to be determined)

Target Rationale

May list one or more of the following:

- Relevant background and explanation related to the target and any applicable modifications.
- If applicable, an explanation of why the updates or clarifications were necessary for the 2008 target updates.

Please note that the information referring to the 2008 delisting targets can be found in the document *Delisting Targets for the Milwaukee Estuary Area of Concern: Final Report*.

Rationale for Listing

The section briefly summarizes the reason the BUI was known or suspected at the time of listing. If sources contributing to the impairment have been identified since listing, those are included in this section as well. Typically, the information from this section is drawn from the existing RAPs for the Milwaukee Estuary that were developed in 1991 and 1994.

Summary of Key Remedial Actions since the 2012 RAP Update and Current Status

"Key remedial actions" are those that directly contribute to the current status of the BUI. Note that any items listed here are not an exhaustive list of all the remedial actions completed that may have helped make progress toward removing the BUI. The items listed here are any key actions that were completed since the draft 2011 RAP. The narrative here explains and leads to the "Next action needed."

Next action(s) needed

This section is a narrative listing of assessments and on-the-ground projects that are clearly delineated and directly address the specific BUI. This is also not an exhaustive list of all actions needed to address the impairment, but rather a list of actions that we know must be implemented to make progress toward removing the impairment. Plans for verifying achievement of delisting targets are listed here, if known. Please also note that because of the urban nature of the AOC, contaminated sediment projects listed in

this section are not necessarily the only cleanups that would need to occur before removal of a particular impairment. Rather, the projects listed reflect the current knowledge of what must be addressed so that progress on an impairment can continue.

It is important to keep in mind that the primary goal of the AOC program is to address legacy contamination and issues related to severe water quality degradation. While there are some other important and necessary considerations for making progress toward removing impairments, areas with high concentrations of contaminated sediment that contribute to loading of toxic substances into the AOC may need to be addressed before additional work can occur, especially in the case of any physical habitat improvements. That said, it should be noted that more than contaminated sediment remediation will be required to remove all BUIs.

Issues (challenges, risks) affecting progress on this BUI

This section lists project contingency (i.e., one thing has to happen before another can occur), funding obstacles, and any other considerations that could affect the timeline for BUI removal.

RESTRICTIONS ON FISH AND WILDLIFE CONSUMPTION

Target and Status

Updated Target	Status
<p>Fish Approach to be used with current level of monitoring for fish consumption advisories within the AOC (every five years):</p> <ul style="list-style-type: none"> • All known man-made sources of BCOCs (including PCBs, mercury, dioxins, and furans) within the AOC and tributary watershed have been controlled or eliminated; and • State fish tissue monitoring confirms that waterbody-specific fish consumption advisories are no longer needed for PCBs for waters in the AOC. • Waters within the Milwaukee Estuary AOC are not listed as impaired due to fish consumption advisories in the most recent Clean Water Act 303(d) and 305(b) Wisconsin Water Quality Report to Congress (submitted to USEPA every two years). <p>Approach to be used with funding to support additional monitoring:</p> <ul style="list-style-type: none"> • All known man-made sources BCOCs (including PCBs, mercury, dioxins, and furans) within the AOC and tributary watershed have been controlled or eliminated; and • A multi-year comparison study of fish tissue contaminant levels demonstrates that there is no statistically significant difference (with a 95% confidence interval) in fish tissue BCOC concentrations in the AOC compared to fish tissue BCOC concentrations in a representative non-impacted control site within the Lake Michigan Basin. <p>Wildlife There are no waterfowl consumption advisories for resident waterfowl due to contamination originating within the AOC.</p>	<p>In progress, <i>and</i> Action needed</p> <p>TBD</p> <p>Assessment in progress (ongoing)</p> <p>TBD</p> <p>TBD</p> <p>Assessment in progress (2013-2016)</p>

Target Rationale

Contaminated sediments are the primary contributor of PCBs to fish and wildlife within the AOC. An effective source control and remediation program is therefore necessary in order to meet delisting goals. Post-remedial actions and taking appropriate source control measures and evaluation monitoring must be conducted to determine the state of recovery for this impairment. Please note that for this impairment, PCBs are the contaminant of concern; there are no additional fish consumption advisories pertaining to mercury in the AOC (i.e., beyond the state-wide fish consumption advice that applies for mercury). Please refer to WDNR's *Fish Consumption Advice for the Milwaukee Estuary Area of Concern* (WDNR, 2013a) and *Choose wisely: A health guide for eating fish in Wisconsin* (WDNR, 2013b) documents for more information about fish consumption advisories.

It should be noted that unrestricted consumption, as proposed in the 2008 targets, is not a goal that can be supported by the AOC program. For this reason, the target was updated to reflect that waters in the

AOC should be no worse than other unimpaired waters of the state. There is, however, statewide fish consumption advice because of other, more widespread sources of contamination.

Fish

According to Candy Schrank, WDNR fish toxicologist, WDNR monitors fish for contaminant burdens from rivers within the Milwaukee River basin (including the AOC) on a five-year schedule and from the open waters of Lake Michigan every other year. New data are reviewed in the context of the existing advisories and previous data. Fish consumption advisories are updated by the WDNR and Department of Health and Family Services as needed based on WDNR sampling results. The most current fish consumption advisories for the AOC are available at <http://dnr.wi.gov/fish/pages/consumption/>. Because the state regularly monitors fish tissue concentrations for the waters of the state, a new monitoring program is not necessary to assess this impairment. Additionally, the state Impaired Waters List is updated every two years, which means that the state evaluates new data and analyzes trends over time. If tissue concentrations consistently improve to the point where fish consumption advisories can be lifted so that there are no waterbody-specific advisories, then the desired outcome has been met and there is no need to wait to remove the impairment (if the other parts of the target have been met, i.e., “All known man-made sources of BCOCs...within the AOC and tributary watershed have been controlled or eliminated”).

Listing guidelines for the state Impaired Waters Program considers a waterbody impaired for fish consumption if a water body has special PCB-based fish consumption advice of one meal per month or less frequent for resident fish species (like walleye, carp, smallmouth bass and others) or one meal per week or less frequent for resident panfish (like yellow perch or bluegill). Special advice for PCBs currently applies to several of these more resident fish species. There are no special fish consumption advisories due to mercury for the Milwaukee AOC.

The fish consumption advice that applies to fish from the Milwaukee Estuary AOC depends on the type of fish. Fish consumption advice is also provided for the Milwaukee River from Estabrook Falls downstream to the estuary and includes the Menomonee and Kinnickinnic Rivers and Lincoln Creek. This advice is for species primarily resident within these rivers and the inner harbor. These advisories will be used to determine when the Restrictions on Fish and Wildlife Consumption BUI in the Milwaukee AOC can be considered for removal.

Fish species like trout and salmon are migratory and may at times be found or caught in the river. However, these species spend most of their time in Lake Michigan; therefore, removal of the fish consumption BUI will not be dependent on these migratory species or on the Lake Michigan fish consumption advisory.

The Milwaukee River downstream from Estabrook Falls, the Menomonee, and Kinnickinnic Rivers (which include the river portions of the AOC) contain special advice for PCBs for several species. Since these species tend to be resident within the AOC and have no barriers to migration, it is appropriate to base delisting targets on resident species. The resident species that exceed the AOC delisting targets include:

- Yellow perch—1 meal/week
- Rock bass, smallmouth bass, walleye less than 18”—1 meal/month
- Black crappie, northern pike, walleye greater than 18”, redhorse, white suckers—6 meals/year
- Carp—do not eat

Additionally, fish caught in Cedar Creek and Zeunert Pond should not be eaten (Candy Schrank, *personal communication*, 2011; WDNR, 2013a; WDNR, 2013b).

Wildlife

In the 2008 target document, there were no targets proposed for wildlife. Unlike fish consumption advisories, which are assessed for in all waters of the state in Wisconsin, waterfowl advisories are only assessed in areas with suspected contamination issues. Because of its legacy of contamination, the Milwaukee Estuary was assessed in the 1980s to determine if a waterfowl consumption advisory should exist for certain waterbodies or portions of waterbodies. According to the state guidelines for developing waterfowl consumption advice, portions of the Milwaukee Estuary AOC did exceed state waterfowl criteria, and thus, the state issued a waterfowl consumption advisory in 1987 for portions of the AOC. Since the advisory was issued, no additional data had been collected.

In the AOC, the following waterfowl consumption advisories apply (please note that in some cases a relevant structure or landmark may no longer be present. Assessing the waterfowl consumption advisory will be necessary to determine the exact locations of any waterfowl consumption advisory, should such advisories still be necessary after reassessment):

- Milwaukee River from Highway 167 (Thiensville) upstream to Lime Kiln Dam at Grafton and Cedar Creek from the Milwaukee River up to Bridge Road in the Village of Cedarburg—do not eat mallard ducks using this water
- Milwaukee Harbor—do not eat black ducks, mallards, scaup, and ruddy ducks using this water
- Waters in the City of Cedarburg—do not eat Canada geese using these waters

Rationale for Listing

Fish samples taken from the Milwaukee River system (which includes the Menomonee and Kinnickinnic Rivers) exceed standards established by the state of Wisconsin for the consumption of sport fish. The state issues consumption advisories for various population groups based on fish species and size classes. Advisories are collectively issued for the presence of mercury and PCBs. The Milwaukee River system has had waterbody-specific fish consumption advisories listed for PCBs for decades. As there is no waterbody-specific advice for mercury for waters of the AOC, waters within the AOC fall under the statewide consumption advisory for mercury.

Summary of Key Remedial Actions since the 2012 RAP Update and Current Status

Because contaminated sediments are the primary contributor of contaminants to fish within the AOC, contaminated sediment cleanups (especially for PCBs) are necessary in making progress toward addressing this impairment. In 2012, Phase 1 of the Lincoln Park/Milwaukee River Channels Great Lakes Legacy Act project was successfully completed. The project removed 120,000 cubic yards of PCB- and PAH-contaminated sediments from the AOC. The total project cost was approximately \$25 million dollars.

Mercury Marine is working in consultation with EPA and DNR on a feasibility study for the Cedar Creek Superfund Alternative Site. This site is a source of PCBs to the AOC and needs to be remediated for BUI removal to occur.

Ozaukee County and partners are conducting comprehensive monitoring of sediment contamination within the upper portion of the AOC in Ozaukee County, including the Mequon-Thiensville Dam impoundment on the Milwaukee River. Results of this assessment are still pending as of December 2013.

Under a Great Lakes Restoration Initiative (GLRI) grant, the DNR is also collecting new data to re-examine the state of the waterfowl consumption advisories and determine if any of the existing advisories can be removed or if any additional advisories are warranted. Data collection began in 2013, and is proposed to continue for nearly three years, until spring of 2015. The proposal and budget for the project can be found in Appendix D of the 2012 RAP Update.

Next action(s) needed

Work is still needed to assess and remediate areas contaminated with PCBs. The waterfowl consumption advisory that was issued in 1987 also needs to be re-evaluated to determine if the wildlife component of the impairment can be removed.

At this time, the following specific actions are needed:

- Complete the cleanup of PCBs at the Cedar Creek Superfund Alternative Site.
- Complete Phase 2 of the cleanup of PCBs from the Lincoln Park/Milwaukee River Channels Great Lakes Legacy Act project site.
- Assess the sediment in the Menomonee River downstream of its confluence with the Little Menomonee River.
- Ensure on-going funding over the next two fiscal years to re-evaluate the waterfowl consumption advisory.
- Assess areas on the Milwaukee River downstream of confluence with Cedar Creek to the estuary.

Issues (challenges, risks) affecting progress on this BUI

The main barrier to progress is ensuring enough funding through programs or responsible parties to complete all the contaminated sediment projects (both assessment and remediation) in a timely manner.

Lincoln Park, Milwaukee Great Lakes Legacy Act Project



Figure 3. Map of the Lincoln Park/Milwaukee River Channels Great Lakes Legacy Act site. Phase 1 was completed in 2012, and a feasibility study is underway for Phase 2 of the project.

DEGRADATION OF FISH AND WILDLIFE POPULATIONS

Target and Status

Updated Target	Status
<p>Fish This BUI will be considered to be eligible for removal when the following have occurred:</p> <ul style="list-style-type: none"> • All contaminated sediment hotspots within the AOC have been identified, and implementation actions to remediate contaminated sites have been completed. • A local fish and wildlife management and rehabilitation plan has been compiled for the estuary that: <ul style="list-style-type: none"> ○ 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 rehabilitation programs/activities within the AOC and establishes a mechanism to assure coordination among all these programs/activities, including identification of lead and coordinative agencies ○ Establishes a time table, funding mechanism, and lead agency or organization responsibility for all fish and wildlife population activities needed within the AOC. ○ The actions/projects necessary to accomplish the recommendations of the fish and wildlife management and restoration plan are implemented. • Populations for native indicator fish species are statistically similar to populations in reference sites with similar habitat but little to no contamination. <p>Wildlife Assess wildlife populations and the possible extent of any impairment within the AOC before setting specific wildlife population targets.</p>	<p>In progress, <i>and</i> Action needed</p> <p>In progress</p> <p>Unknown</p> <p>In progress, <i>and</i> Action needed</p>

Target Rationale

Many partners in the AOC have developed plans that can be drawn from to determine the actions that are a priority to address this BUI. (Please see the References section for a list of resources related specifically to the fish- and wildlife-related impairments.) In 2012, DNR assembled a team of fish and wildlife experts and began facilitating a process to determine measures of success, develop scopes of work for necessary assessments, and identify interim habitat projects that would help assess and address this impairment. Proposals for separate fish and wildlife assessments, as well as an outline of potential fish and wildlife goals and measures of success, can be found in Appendices A and B. The work of the fish and wildlife technical team will be assembled into a Habitat Plan for the AOC. Being able to define the causes of all population impairments is contingent upon completion of the assessments.

Rationale for Listing

The Stage 1 RAP (WDNR, 1991) and 1994 RAP update (WDNR, 1994) indicated that fish populations in the AOC were severely degraded and that the fish species resident in the AOC were mostly pollution tolerant species due to poor water quality. The lack of natural shoreline and channel features throughout the AOC, urban runoff, point sources, and sediment accumulation were the major factors noted for this impairment (WDNR, 1994, p. 2-17). In terms of the wildlife component of this goal, at the time that the RAP documents were written, there was essentially no data about wildlife populations. In the first RAP document written in 1991, the wildlife component was not considered to be part of the impairment for the Milwaukee Estuary AOC (WDNR, 1991, p. V-3). The RAP revision in 1994 stated that declines in wildlife populations were likely attributable to degraded water quality and loss of habitat, especially the loss of wetlands (WDNR, 1994, p. 2-17). The 1994 RAP also said that contaminants present in the AOC are known to affect wildlife reproduction and growth, and so the use should be considered impaired (WDNR, 1994, p. 2-18).

According to Waller and Rooney, studies published in 2008 assessed ecological change in Milwaukee County and concluded there have been substantial losses of species richness with declines of 20-70% for bird, amphibian, and reptile groups, resulting mainly from habitat loss (2010).

Historically, there is a component of these impairments that has been viewed as being tied to contamination. While it is unclear from the scientific literature the degree to which contamination contributes to the decline of fish and wildlife populations, cleanup of contaminated sites in the AOC remains a key management action for this impairment. The lack of suitable physical habitat in order to support populations of desired fish and wildlife species is also a key feature that will need to be addressed to make progress on this impairment.

Summary of Key Remedial Actions since the 2012 RAP Update and Current Status

In 2012, the Milwaukee Estuary Fish and Wildlife Technical Team developed fish and wildlife population assessment proposals in order to determine the extent of this impairment. The two proposals have been submitted to U.S. EPA and the first year of the assessments was funded. Doing this work will help us fill in some necessary information, and identify further management actions that are necessary for removing the degraded fish and wildlife populations BUI.

Next action(s) needed

We will continue working with stakeholders to determine which benchmarks are desirable and achievable for this impairment. There are a few projects in the AOC that will help in making progress toward removing this impairment in the meantime. They are:

- Assess and remediate sites or areas with known or suspected contaminated sediment.
- Complete the fish and wildlife populations assessments, as per the fish and wildlife technical team project proposals that were submitted to EPA (Appendix A in the 2012 RAP Update).

Once the assessments have been completed, we will identify any additional projects that will be needed to remove the populations impairments. These will be included in future versions of the fish and wildlife plan.

Issues (challenges, risks) affecting progress on this BUI

Answering the question of when do we know we have created/enhanced enough habitat will be challenging to determine, although the assessments' results will help make the determination. We are aware of the difficulties with establishing population-related objectives for this BUI since attracting desired species can be more complicated than just providing them with suitable habitat. Just because habitat is

created does not necessarily mean that the desired species can colonize those areas and persist as viable populations. Making progress on this impairment is contingent on continued funding for the assessment proposals so that we can determine what other management actions are necessary. These assessments will determine what species can still be viably sustained within the AOC, given the constraints imposed by the limited amount of habitat extent and diversity that can be restored in an urban environment.

FISH TUMORS OR OTHER DEFORMITIES (POTENTIALLY IMPAIRED)

Target and Status

Updated Target	Status
<p>Removal may occur if:</p> <ul style="list-style-type: none"> • All known major sources of PAHs and chlorinated organic compounds within the AOC and tributary watershed have been controlled or eliminated • A fish health survey of resident benthic fish species, such as white suckers, finds incidences of tumors or other deformities at a statistically similar incidence rate of minimally impacted reference sites. <p>OR, in cases where tumors have been reported:</p> <ul style="list-style-type: none"> • A comparison study of resident benthic fish such as white suckers of comparable age and maturity, or of fish species found with tumors in previous fish health surveys in the AOC, with fish at minimally impacted reference sites indicate that there is no statistically significant difference (with 95% confidence) in the incidence of liver tumors or deformities. 	<p>In progress <i>and</i> Action needed</p> <p>Assessment in progress (2012-2013)</p> <p>TBD</p>

Target Rationale

The 2008 document stated that the first step toward removing this impairment would be to determine if the use was impaired by sampling 50 fish to determine whether the tumor incidence rate was greater than 5%. WDNR’s Office of the Great Lakes has used documented incidence rates and performed rigorous statistical analyses to help guide its approach to assessing the fish tumor impairment. The sampling design suggests a relatively large data collection effort in an attempt to achieve an acceptably high and known degree of confidence in the study results. For more detailed information about WDNR’s sampling strategy for the 2012-2013 evaluation of this BUI, please see Appendix E in the 2012 RAP Update.

The updated target stipulates that the appropriate reference sites would be minimally impacted, as opposed to non-impacted, and that the tumors and deformities need to be contaminant-related since there can be other causes, like pathogens, of tumors and deformities in fish. A zero-percent incidence rate is not achievable, since tumors occur naturally in fish even in the absence of contaminants. How the term “minimally impacted reference site” is defined will be discussed and decided upon with local stakeholders, if it is determined that a comparison study is needed. The updated target also removed a previous provision stating that resident non-benthic fish should be sampled for this impairment. Given the nature of this particular impairment, and its close connection to contaminated sediments, there was no justifiable basis for this provision, so it was removed in last year’s RAP update.

Rationale for Listing

The 1994 RAP included this BUI as suspected because the concentrations of certain PAHs and metals in AOC sediments were similar to concentrations in areas with verified fish tumors. As of 2008, no fish health surveys had been conducted within the AOC to determine the extent (or existence) of the impairment. This has since changed (see information in next two sections).

Summary of Key Remedial Actions since the 2012 RAP Update and Current Status

In 2012, a proposal was developed to robustly assess the fish tumors impairment for the Milwaukee Estuary. The proposal was developed by DNR, and received endorsement from the Milwaukee Estuary

Fish and Wildlife Technical Team. As part of this assessment, 200 white suckers were collected in the spring of 2013 and are being analyzed for contaminant-related tumors.

Next action(s) needed

Sites that contain elevated amounts of PAHs, metals, and other substances that cause fish tumors and deformities must be addressed before removal of this impairment can occur. These actions include:

- Completing the assessment and clean up PAHs and metals from the Solvay Coke Superfund Alternative Site.
- Completing the assessment and clean up PAHs and metals from the Burnham Canal Superfund Alternative Site.
- And other necessary projects to clean up PAH-contaminated sediment.

Fish tumor sampling is necessary in order to confirm whether this BUI is impaired for the AOC. For our assessment, the sampling target was 200 fish. If the 200 fish sample yields below 5% within the 95% confidence interval (i.e., 5 or fewer tumors out of 200) we will consider BUI removal. Similarly, if fewer fish are captured, we will consider removing the BUI if the 95% confidence interval of the tumor incidence rate is less than or equal to 5%. Although a background tumor incidence rate of approximately 2% may be more appropriate (Baumann 2010), the most likely point estimate of 5 or fewer fish out of 200 is 2.5%. As such, given our conservative approach, we feel that a point estimate of 2.5% with a 95% confidence interval that does not include 5% is sufficient to consider BUI removal.

If results from the intensive AOC sampling suggest that the upper 95% confidence limit of the tumor incidence rate is not below 5%, we will compare data obtained from the AOC with a suitable reference site that has available data or we will collect data from a suitable reference site again with a sample size of 200 white suckers, or comparable species. Furthermore, if the results from the 2012-2013 sampling show that there are higher than background tumor rates, then sources of contaminants that may be contributing to the problem will have to be re-examined and controlled or eliminated.

Issues (challenges, risks) affecting progress on this BUI

Although sampling is necessary to confirm whether this impairment exists, we also need to continue making progress on cleaning up PAH-contaminated sites in the AOC.

BIRD OR ANIMAL DEFORMITIES OR REPRODUCTION PROBLEMS (POTENTIALLY IMPAIRED)

Target and Status

Updated Target	Status
<p>This BUI can be removed if:</p> <ul style="list-style-type: none"> • Studies conducted in the AOC indicate that the beneficial use should not be considered impaired, or • If studies conducted in the AOC determine that this use is impaired, then two approaches can be considered for delisting: <ul style="list-style-type: none"> ○ Approach 1 – Observational Data and Direct Measurements of Birds and other Wildlife <ul style="list-style-type: none"> ▪ Evaluate observational data of bird or other animal deformities for a minimum of two successive monitoring cycles in indicator species identified in the initial studies as exhibiting deformities or reproductive problems. If deformity or reproductive problem rates are not statistically different than those at minimally impacted reference sites (at a 95% confidence interval), or no reproductive or deformity problems are identified during the two successive monitoring cycles, then the BUI can be removed. If the rates within the AOC are statistically higher than the reference site, it may indicate a source from either within or from outside the AOC. Therefore, if the rates are statistically higher or the data are insufficient for analysis to achieve agreed upon statistical power, then... ▪ Evaluate tissue contaminant levels in egg, young and/or adult wildlife. If contaminant levels are lower than the Lowest Observable Effect Level (LOEL) for that species for a particular contaminant that are not statistically different than those at minimally impacted reference sites (at a 95% confidence interval), then the BUI can be removed. ▪ Where direct observation of wildlife and wildlife tissue data are not available, the following approach should be used: 	<p>Assessment in progress</p> <p>TBD</p>

- Approach 2 – Fish Tissue Contaminant Levels as an Indicator of Deformities or Reproductive Problems
 - If fish tissue concentrations of contaminants known to cause deformities or reproductive suppression identified in the AOC are at or lower than the LOEL known to cause reproductive or developmental problems in fish-eating birds and mammals, the BUI can be delisted, or
 - If fish tissue concentrations of contaminants known to cause deformities or reproductive suppression identified in the AOC are not statistically different than Lake Michigan (at 95% confidence interval with sufficient and agreed upon statistical power), then the BUI can be removed. Fish of a size and species considered prey for the wildlife species under consideration must be used for the tissue data.

Target Rationale

Before targets can be developed with confidence for the AOC, sufficient studies must be conducted to determine if this beneficial use is impaired. The targets identified above should be reviewed following completion of the studies and modified in accordance with the findings of those studies.

Rationale for Listing

Insufficient data are available to show if these problems exist with birds or other animals within the AOC. The 1991 RAP considered this use unimpaired because of lack of information. Because contaminants like PCBs and heavy metals that are found in AOC sediments may have the potential to impair reproduction and development in wildlife, this use was considered impaired in the 1994 RAP.

Summary of Key Remedial Actions since the 2012 RAP Update and Current Status

In 2013, there has been essentially no change in this impairment. The U.S. Geological Survey (USGS) has been using tree swallows as indicators of environmental contamination in areas across the United States, and they have at least one site in the Milwaukee Estuary. At the time of writing, no new data was available. Please see the 2011 update for a further description of the tree swallow study.

Next action(s) needed

In the future, we will have to determine which data are necessary to determine whether this is an impaired use in the AOC. We may be able to draw on some of the already existing data being collected by federal partners, but may need more funding if we need additional monitoring stations in the AOC.

Issues (challenges, risks) affecting progress on this BUI

There has been limited data until recently to aid in the assessment of this impairment, and further data collection will probably be necessary.

DEGRADATION OF BENTHOS

Target and Status

Updated Target	Status
Removal may occur if: <ul style="list-style-type: none">• Known contaminant sources contributing to sediment contamination and degraded benthos have been identified and control measures implemented; and• All remediation actions for contaminated sediments are completed and monitored according to an approved plan; or• The benthic community within the site being evaluated is statistically similar to a reference site with similar habitat and minimal sediment contamination.	In progress In progress, <i>and</i> Action needed Assessment in progress (2012-2013)

Target Rationale

There are several considerations for this impairment. First, the harbor portion of the AOC will support different benthic communities than will the tributaries. Benthic communities in the harbor/estuary are subjected to regularly disturbed and altered physical conditions (like dredging and shoreline hardening from the installation of sheet piling). Second, benthic communities, either in the harbor or in the tributaries, would also be impacted from pollution². The rationale for this target is to clean up contaminants so that they aren't substantially impacting benthic communities, and then determine if the degradation of communities in the harbor is likely being caused by the poor physical conditions for which there is little feasible remedy. If there are degraded benthic communities in the tributaries, the main causes could be the presence of contamination or degraded physical habitat (e.g., substrates that don't provide adequate conditions for higher quality benthic communities). For both the harbor and the tributaries, contaminants and pollution must be assessed. Physical habitat should also be assessed to determine whether this could be contributing to the degraded communities, and, where feasible, habitat improvements should be made.

Measures such as sediment quality guidelines, equilibrium partitioning sediment benchmarks, and other sediment guidelines are part of the WDNR review to arrive at an approved remediation plan.

Rationale for Listing

According to earlier RAP documents, this beneficial use is considered impaired because of degraded physical habitat, low dissolved oxygen concentrations, and constituents in sediment toxic to macroinvertebrates, but the extent of the impairment is not well defined. The 1991 and 1994 RAP documents recognize that monitoring is required to better define this impairment. Furthermore, because physical conditions within the AOC are diverse, different final targets may be required for different habitat types within the AOC.

² The *Consensus-Based Sediment Quality Guidelines* for Wisconsin (see References) were developed through an assimilation of results from multiple published effects-based toxicity testing to freshwater benthos, so there is a clear and documented connection between contamination and deleterious benthic community impacts.

The RAPs also cite results of several benthic surveys in the AOC that showed benthos were lacking in diversity and were dominated by pollution-tolerant species. It was because of the lack of diversity and the prevalence of pollution-tolerant organisms that this impairment was listed.

Summary of Key Remedial Actions since the 2012 RAP Update and Current Status

Cleaning up toxic sites, minimizing sewer overflows, improving physical habitat, and reducing runoff pollution where feasible are the necessary actions to help make progress toward removing this impairment from the Milwaukee Estuary AOC. We assume that cleanups for reducing ecological risk should also result in an improved benthic community.

Results of the 2012 USGS *Benthos and Plankton BUIs Evaluation in Wisconsin's Lake Michigan Areas of Concern* survey are still pending. Because 2012 was an anomalous year for weather conditions, the study will be repeated in 2014 to ensure that data are representative of average conditions.

Next action(s) needed

Contaminated sites within the AOC need to be remediated. We will need to evaluate the findings of the USGS benthos study, assess the need to supplement the study (to adequately characterize the range of benthic conditions in the AOC), and re-examine whether the beneficial use is impaired based on findings.

Issues (challenges, risks) affecting progress on this BUI

Given the urban nature of all of the AOC waterways, it is unlikely that high quality benthic communities can be established at all sites. Reference sites, if used, must be in areas that are urban. Reference sites will likely be degraded and the target will need to take into consideration the achievability of targets for BUI removal.

RESTRICTIONS ON DREDGING ACTIVITIES

Target and Status

Updated Target	Status
Removal of this BUI can occur when: <ul style="list-style-type: none"> • Contaminated sediment hotspots within and upstream from the AOC have been identified. • Implementation actions to remediate contaminated sites have been completed. As a source control measure and for AOC remediation, known contaminated sites must be addressed before BUI removal is possible. • There are no special handling requirements of material from routine navigational dredging due to contamination originating from controllable sources within the AOC. 	In progress and Action needed In progress In progress

Target Rationale

While many of the AOCs have defined this BUI to only federally maintained navigation channels, the Milwaukee Estuary RAP took a broader view of this issue. The Technical Advisory Committee for the 1994 RAP update recognized that contaminated sediments are linked to most of the BUIs in the AOC. Therefore, addressing contaminated sediments is central to removing this impaired beneficial use.

The intent is to eliminate special handling requirements that go beyond the normal handling requirements for dredged sediments. If sediments that are dredged for navigation, either by the U.S. Army Corps of Engineers or by private companies, contain moderate to high levels of contaminants, then there are additional costs incurred from the proper disposal of such sediments. We seek to eliminate those additional burdens imposed by the presence of contaminants so that parties can dredge and dispose of sediment by simply following required standard testing and disposal as mandated by state law.

Rationale for Listing

Contaminated sediments are recognized as one of the primary sources of pollution in the Milwaukee Estuary AOC. Historically, most of the AOC was modified, dredged, and maintained for large vessel navigation, making the estuary a settling basin for sediments. Over time, sections of the rivers that were previously maintained are no longer needed for deep draft navigation, but the sediments and their associated contaminants remain. This impairment was listed due to the presence of a number of contaminated sediment sites. Contaminants that are issues within the AOC include PAHs, heavy metals, and PCBs.

Summary of Key Remedial Actions since the 2012 RAP Update and Current Status

Remediation of contaminated sediment hotspots is necessary before this BUI can be removed. In 2013, a feasibility study was completed for Lincoln Creek Phase 2, setting the stage for implementation of a Great Lakes Legacy Act sediment remediation project in 2014. No additional sites were remediated for contaminated sediment in 2013.

Ozaukee County and partners are conducting comprehensive monitoring of sediment contamination within the upper portion of the AOC in Ozaukee County, including the Mequon-Thiensville Dam impoundment on the Milwaukee River. Results of this assessment are still pending as of December 2013.

Next action(s) needed

Investigate suspected areas of contaminated sediment in areas of the Milwaukee and Menomonee River portions of the AOC to identify the need, if any, for cleanup actions. An investigation of the upper Milwaukee River is currently underway. With regard to contaminated sediment projects, there are still some necessary actions that must be taken before the impairment can be removed. They are:

- Complete the cleanup of PAHs and metals from the Solvay Coke Superfund Alternative Site.
- Complete the cleanup of PAHs and metals from the Burnham Canal Superfund Alternative Site.
- Complete the cleanup of PCBs at the Cedar Creek Superfund Alternative Site.
- Complete the cleanup of PCBs from Phase 2 of the Lincoln Park/Milwaukee River Channels Great Lakes Legacy Act project site.
- Assess the sediment in the Menomonee River downstream of its confluence with the Little Menomonee River.
- Assess areas on the Milwaukee River downstream of confluence with Cedar Creek to the estuary.

For contaminated sediment cleanups, when possible upstream sources/sites should be addressed before addressing sites further downstream; however, anytime opportunities present themselves to address contamination, they should be taken, even if a downstream site is cleaned up ahead of a site further upstream.

Issues (challenges, risks) affecting progress on this BUI

Cleanup timelines are uncertain and this affects the ability to remove this impairment. Any reductions in federal Great Lakes Legacy Act funding could affect progress as well.

EUTROPHICATION OR UNDESIRABLE ALGAE

Target and Status

Updated Target	Status
Removal of this BUI can occur when:	
<ul style="list-style-type: none"> Total phosphorus (TP) concentrations within the AOC rivers, harbors, and nearshore waters meet the criteria recommended for the State of Wisconsin, as established by WDNR. 	In progress <i>and</i> Action needed
<ul style="list-style-type: none"> When the results from the total maximum daily load study for phosphorus, total suspended solids, and bacteria are completed for the Menomonee, Kinnickinnic, and Milwaukee Rivers. 	In progress
<ul style="list-style-type: none"> Measures to meet the Total Maximum Daily Loading Implementation Plan are being completed. 	TBD
<ul style="list-style-type: none"> No water bodies within the AOC are included on the list of impaired waters due to nutrients or excessive algal growths in the most recent WI Impaired Waters list. 	Action needed
<ul style="list-style-type: none"> Chlorophyll-a concentrations within the AOC lake and impoundment areas do not exceed 4.0 µg/L. 	Unknown
<ul style="list-style-type: none"> There are no beach closures in the AOC due to excessive nuisance algae growth. 	Unknown

Target Rationale

The target revision was needed because at the time that the proposed targets were being developed in 2008, Wisconsin did not have any criteria for nutrients, but was in the process of developing them. Phosphorus criteria have since been established, and in the AOC, the Menomonee, Milwaukee, and Kinnickinnic Rivers (as well as many of their tributaries) are listed as impaired because of low dissolved oxygen concentrations caused by excessive phosphorus pollution (WDNR, Impaired Waters Program). The Milwaukee Metropolitan Sewerage District (MMSD) has received funding to determine where the sources of contamination are coming from (i.e., a total maximum daily load study, or TMDL), and the results of the study should inform future actions that will be necessary in order to reduce phosphorus pollution to the AOC.

The estuary rivers currently have variance criteria (see NR 104.06 of the Wisconsin Administrative Code) for dissolved oxygen concentrations (2 mg/L), indicating that the estuary is not capable of supporting full fish and aquatic life use designations that would require dissolved oxygen concentrations of at least 5 mg/L. Stakeholders have indicated that they would like waters of the AOC to meet the full fish and aquatic life standard of 5 mg/L, and significant strides have been made in improving water quality. We'd like to aim for attaining the full fish and aquatic life standard in cases where there are sometimes lower dissolved oxygen concentrations (e.g., on portions of the Kinnickinnic River).

Rationale for Listing

The 1994 RAP considered this use impaired because phosphorus, nitrogen, and chlorophyll a concentrations within the AOC indicated eutrophic conditions (WDNR, 1994, p. 2-19). Low dissolved oxygen concentrations were also common within the AOC rivers. The estuary acts as a settling basin for suspended materials. The organic portion is broken down through chemical and biological processes that demand oxygen from the water column, leading to lower concentrations. The Milwaukee Estuary, including the lower Menomonee, Milwaukee, and Kinnickinnic Rivers are regularly listed as impaired waters (as part of the state's Clean Water Act/303(d) program) for excess phosphorus and low dissolved oxygen concentrations. In the 1994 RAP, total phosphorus levels in the AOC exceeded 0.1 mg/L in 40 to 75 percent of the samples taken from the Inner Harbor, and 10 to 25 percent of the time from the Outer Harbor.

Summary of Key Remedial Actions since the 2012 RAP Update and Current Status

While dissolved oxygen levels used to be low in the rivers because of sewer overflows, overflows have decreased substantially since the Deep Tunnel project went online in 1994. Despite these improvements, the estuary and large portions of the AOC rivers are included on Wisconsin's list of impaired waters as per section 303(d) of the federal Clean Water Act because of insufficient dissolved oxygen concentrations to support the designated fish and aquatic life uses of the rivers. Many waterbodies in the AOC are also listed as impaired under the Clean Water Act because of phosphorous, total suspended solids (TSS), and bacteria pollution that exceed state criteria. Under federal law, TMDL studies are needed in order to determine the amount of a pollutant a waterbody can receive and still meet water quality standards. The TMDL also functions as a planning tool within the process of delisting impaired waters.

MMSD received GLRI grants from the U.S. Environmental Protection Agency (USEPA) to complete third-party TMDL analyses on four water bodies in the Milwaukee River basin. The MMSD projects will focus on the Kinnickinnic, Menomonee, and Milwaukee Rivers and the Milwaukee Estuary. The Milwaukee River TMDL will focus on the reaches of that river that are included in the State's 303(d) Impaired Waters List. The project consultant will complete the final TMDL report by the end of 2013. The implementation plan is scheduled to be completed in 2014.

The following is a list of the waters in the original AOC boundaries that are proposed for listing as impaired for the year 2012. The listing is for low dissolved oxygen attributed to phosphorus pollution:

- Last 2.8 river miles of the Kinnickinnic River
- Last 2.7 river miles of the Menomonee River
- Last 2.9 river miles of the Milwaukee River

The results from the TMDL study should be helpful in determining what progress can be made with regard to the issue of phosphorus loading in the estuary, and improving water quality. Once the TMDL has been completed and the implementation plan has been prepared, we will have a better idea if we will need to do anything further in order to remove this BUI.

Next action(s) needed

Nonpoint source pollution is a challenge to making progress on this impairment. Therefore, addressing nonpoint source pollution throughout the AOC watersheds is a priority issue for continuing to make progress in the estuary itself. Green infrastructure projects and implementation of other stormwater best management practice projects should be a priority to address this impairment.

The TMDL study, which includes an examination of phosphorus loading, is scheduled to be completed in 2013, at which point the following action will be necessary to address this impairment:

- Re-evaluate the chlorophyll-a portion of this target to determine if it is an appropriate measure.

Support for the TMDL implementation will also be critical, and specific actions will be identified in the TMDL implementation plan.

Issues (challenges, risks) affecting progress on this BUI

The physical conditions within the estuary itself have not changed, so despite the substantially decreased contributions of organic material from sewer overflows, meeting the designated fish and aquatic uses may still be difficult. Another challenge for addressing this impairment will be the contribution of orthophosphate to total phosphorus levels in waterbodies in the AOC. Some municipal water supplies in the AOC add orthophosphate as an anticorrosive agent. Under Wisconsin state statute and administrative code (Section 283.35, Wis. Stats. and Section NR 205.08, Wis. Adm. Code), this treated water is used in some non-process waters, (e.g., cooling systems) and directly discharged without having the orthophosphate removed. The orthophosphate increases the total phosphorus concentrations in waterbodies and can contribute to further algal growth. It is currently estimated that this contribution of phosphorus is quite significant in the AOC, but this will be examined in greater detail as part of the TMDL.

BEACH CLOSINGS/RECREATIONAL RESTRICTIONS

Target and Status

Updated Target	Status
<p>This BUI will be considered removed when:</p> <ul style="list-style-type: none"> • All known sources of bacterial contamination to the AOC and tributary watersheds have been identified and, if feasible, have been controlled or treated to reduce possible exposures; and • No unpermitted overflows (either from sanitary sewers or combined sewers) have occurred within the AOC during the previous five year period. • All municipalities within the AOC have adopted and are implementing storm water reduction programs including an illicit discharge elimination program; and • No water bodies within the AOC are included on the list of impaired waters due to contamination with pathogens or chemicals having a public health concern (i.e., carcinogenic, mutagenic) in the most recent Wisconsin Impaired Waters list that is submitted to USEPA every two years; and • No local or state contact advisories related to the presence of a chemical contaminant have been issued within the AOC during the previous five years. • No water bodies (including beaches) within the AOC are included on the list of impaired waters for recreational restrictions in the most recent Wisconsin Impaired Waters list. • Implementation of the Milwaukee River Total Maximum Daily Load Study for bacteria is complete. 	<p>Assessment in progress, <i>and</i> Action needed</p> <p>Unknown</p> <p>Complete</p> <p>In progress <i>and</i> Action needed</p> <p>Unknown</p> <p>In progress, <i>and</i> Action needed</p> <p>In progress, <i>and</i> Action needed</p>

Target Rationale

At the time that the targets were being proposed, there were several beaches listed for pathogens, and there had been problems in the recent past with pathogens at beaches. Bradford Beach was closed 28 days in 2006 and South Shore Beach was closed 43 days in 2006. Bradford, McKinley, and South Shore Beaches were listed on the Wisconsin Impaired Waters list because they were not meeting their full recreational uses due to bacterial contamination.

Since that time, conditions at several of the beaches have substantially improved, and for the 2010 impaired waters list, Wisconsin recommended delisting, or removing, Bradford and McKinley beaches from the impaired waters list for pathogens.

In 2012, DNR modified the targets for this impairment (refer to WDNR, 2012, p. 37-38). The second bullet specifying that there should be no sanitary sewer overflows or unpermitted combined sewer overflows for

a less than 25-year rainfall event was revised, since this language is inconsistent with WDNR's wastewater permitting language. Additionally, two items of the target relating to no water bodies or beaches in the AOC being listed for recreational restrictions were combined into one target item. Additionally, a target item related to implementation of the TMDL for bacteria was necessary, since implementation of the TMDL should lead to removing the AOC waterbodies from the impaired waters list.

Since the Deep Tunnel system came online in 1994, the frequency of sanitary sewer overflows (SSOs) and combined sewer overflows (CSOs) has decreased dramatically. Complicating matters is that water quality models have shown that 60-75% of the fecal coliform loads cannot be explained by nonpoint source runoff from rooftops, parking lots, streets, and other impervious surfaces (SEWRPC, 2008), especially for the Menomonee and Kinnickinnic (KK) Rivers. The Great Lakes Water Institute's preliminary data demonstrates that exfiltration (leaking) from failing sanitary sewer infrastructure is a major source of fecal indicator bacteria and pathogens in urban stormwater that impacts the AOC. This means that stormwater systems are acting as conduits for conveying sewage from failing infrastructure into surface waters used for drinking water and recreation. This sanitary waste poses a more direct threat to human health, since it is more likely to contain pathogens than urban stormwater runoff. This problem is particularly difficult to address because thousands of localized breaches within the sanitary sewage system are much more difficult to address than combined and sanitary sewage overflows, where sources and system capacities are well understood. Pathogen loading from non-point sources is quite high and must be addressed before state water quality standards for recreation can be met. This is why we are proposing that the TMDL be implemented first before BUI removal occurs. In order to implement the TMDL, there is a need to understand where sewage is getting into the AOC waterways. To this end, we have assembled a proposal to both help with TMDL implementation and BUI removal. This proposal can be found in Appendix G of the 2012 RAP Update.

Although the 2008 targets address some aspects of source control, actions that will address the problems caused by bacteria loading need to be considered, e.g., excessive beach closures or recommended limits for body contact on AOC rivers attributed to high pathogen levels. This means that additional reductions through the abatement of non-point source loading of bacteria will be necessary in order to remove this impairment.

According to the current methodology in the Wisconsin Consolidated Assessment and Listing Methodology (WisCALM), waters can be listed as impaired for having contaminated sediments that would pose a risk to public welfare and safety (WDNR, 2013a, p. 51). While contaminated sediments are a problem in the AOC, high counts of pathogens are a more widespread recreational hazard and are more directly associated with this impairment.

Rationale for Listing

The 1991 RAP indicates that although there are no beaches within the river system, there are several public beaches within the Lake Michigan portion of the AOC that consistently do not meet water quality standards for recreation. Data from the lower river system also exceeds the state recreation standards. The 1994 RAP Update indicates that there were essentially no changes in the status of this BUI between the initial RAP document and the update. Beach closings and recreational restrictions was still considered an impaired beneficial use in the AOC. Potential sources of contamination are indicated as CSO events and both urban and rural storm water. In the early 1990s, South Shore beach along Lake Michigan closed periodically, for 48 to 96 hours, when high bacteria counts occur after CSO events (WDNR, 1994, p. 2-19).

In summary, the waters of the AOC have frequently exceeded state water quality standards for recreation.

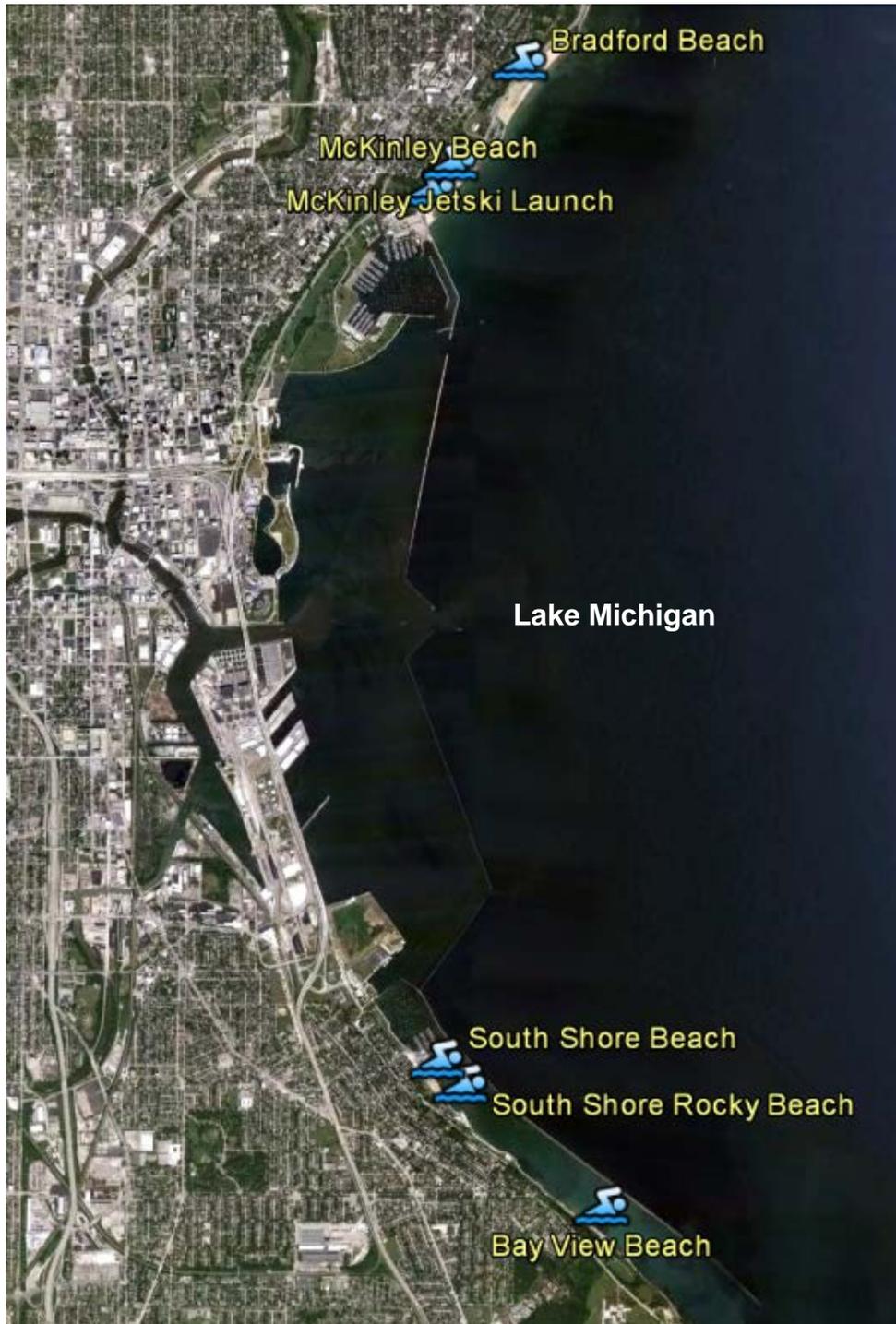


Figure 4. Beaches in the Milwaukee Estuary AOC.

Summary of Key Remedial Actions since the 2012 RAP Update and Current Status

There are six beaches within the AOC: Bradford Beach, McKinley Beach and Jet Ski Launch, South Shore Beach, South Shore Rocky Beach, and Bay View Beach (Figure 7). Conditions have improved greatly at McKinley and Bradford Beaches. Bradford Beach received Blue Wave Certification through the Clean Beach Council in 2009 (see the 2011 Draft Stage 2 RAP for the Milwaukee Estuary for more details).

While there have been successes with regard to beaches, South Shore Beach continues to be on the impaired waters list for high levels of bacteria. In 2013, the Natural Resources Defense Council listed South Shore Beach in its Annual Beach Report as a National “repeat offender” because of persistent contamination problems—water samples violated public health standards more than 25 percent of the time for each year from 2008 to 2012 (NRDC, 2013).

Milwaukee County is weighing options on how to address contamination at the beach. Once a path has been outlined to address the chronic issues at the beach, resources can be allocated to implement the necessary actions.

In addition to addressing beach issues in the AOC, however, the main impediment toward making progress on this impairment is that bacteria levels in the rivers themselves continue to be high and have, in many instances, actually increased (see next section for further details and recommendations).

In 2013, DNR received funds to begin a comprehensive assessment that will identify areas that pose the great risk to human health. DNR has established an agreement with the University of Wisconsin-Milwaukee (UWM) School of Freshwater Sciences to do this work, which will run two years.

Next action(s) needed

Early RAP documents (WDNR 1991, WDNR 1994) stated that the use was impaired because of high bacteria counts and sewer overflows in the AOC that caused beach closings and recreational hazards. While sewer overflows closed beaches in the AOC, high bacteria counts from urban nonpoint pollution throughout the AOC waterways often exceeded water quality standards for recreation. Since the early 1990s, sewer overflows have decreased substantially, largely as a consequence of the MMSD’s Deep Tunnel system. Before the wastewater storage tunnel became available, rain storms caused more than 50 combined sanitary and storm sewer overflows each year to local rivers and Lake Michigan. Construction of the 19.4-mile-long original tunnel was completed in 1993 and its first full year of operation was 1994. Since the Deep Tunnel system came online, there has been an average of 2.5 overflows a year from 1994 through 2011.

Despite this substantial improvement in sewage treatment in the AOC, water quality standards for recreation are still regularly exceeded in the AOC, and pose a significant challenge to removing the beach closings and recreational restrictions impairment. The cause of these exceedances is largely attributed to contamination of urban stormwater. High levels of fecal indicator bacteria have been found in urban stormwater discharges, and are the largest contributor to water quality impairments for bacteria in Milwaukee’s urban rivers (SEWPRC, 2008). Complicating matters is that water quality models have shown that 60-75% of the fecal coliform loads cannot be explained by nonpoint source runoff from rooftops, parking lots, streets, and other impervious surfaces (SEWRPC, 2008), especially for the Menomonee and KK Rivers. The Great Lakes Water Institute’s data demonstrates that exfiltration (leaking) from failing sanitary sewer infrastructure is a major source of fecal indicator bacteria and pathogens in urban stormwater that impacts the AOC. This means that stormwater systems are acting as conduits for conveying sewage from failing infrastructure into surface waters used for drinking water and

recreation. This sanitary waste poses a more direct threat to human health, since it is more likely to contain pathogens than urban stormwater runoff. This problem is particularly difficult to address because thousands of localized breaches within the sanitary sewage system are much more difficult to address than combined and sanitary sewage overflows, where sources and system capacities are well understood.

In 2013, a project that will fill critical data gaps by identifying human versus nonhuman sources of stormwater contamination and estimating loads of sewage-derived pathogens for the two watersheds that contribute high loadings of human waste and pathogens into the AOC was funded (more details can be found in Appendix G of the 2012 RAP Update). Specifically, the project will address significant impediments to TMDL implementation by identifying the most critical infrastructure failures, and assisting decision-makers in determining their policy priorities for stormwater management and infrastructure investment. Based on source testing results, we will map and disseminate the locations of stormwater outfalls that are discharging sewage to the municipalities, so they can effectively direct their limited budgets toward projects that would make the greatest impact on improving water quality in the Milwaukee Estuary AOC, thus helping to bring the AOC into compliance with water quality standards.

Work to address high bacterial levels at South Shore beach should continue. The following actions should be supported, as appropriate, through the AOC program:

- Continue the Identification and Quantification of Sanitary Sewage Contamination in the Milwaukee Estuary Area of Concern project.
- Control stormwater on South Shore Beach; explore other options for improving beach water quality (e.g., moving the beach).

Where feasible, actions should be taken to control sources of bacteria that cause recreational restrictions on AOC waters.

Issues (challenges, risks) affecting progress on this BUI

Bacterial levels will continue to increase as infrastructure ages and lateral sewer lines continue to fail, posing a significant obstacle toward making progress on the recreational restrictions portion of this impairment. Continued funding will be necessary to complete the bacteria source tracking assessment.

DEGRADATION OF AESTHETICS

Target and Status

Updated Target	Status
<p>This delisting target is consistent with Chapter NR 102, Water Quality Standards for Surface Waters. Delisting shall occur when monitoring data within the AOC and/or surveys for any five year period indicates that water bodies in the AOC do not exhibit unacceptable levels of the following properties in quantities which interfere with the Water Quality Standards for Surface Waters:</p> <ul style="list-style-type: none"> a) Substances that will cause objectionable deposits on the shore or in the bed of a body of water shall not be present in such amounts as to interfere with public rights in waters of the state. b) Floating or submerged debris, oil, scum, or other material shall not be present in such amounts as to interfere with public rights in waters of the state. c) Materials producing color, odor, taste, or unsightliness shall not be present in such amounts as to interfere with public rights in waters of the state. <p>The following target will also be met to determine when restoration has occurred: Corrective action plans are in-place and being implemented for all known sources of materials contributing to the degradation of aesthetics within the AOC.</p>	<p>Assessment in progress</p> <p>Assessment in progress</p> <p>Assessment in progress</p> <p>TBD</p>

Target Rationale

The proposed target is consistent with existing state water quality standards, but because of its arbitrariness, we should evaluate with the Stakeholder Delegation whether a five year period is the appropriate amount of time necessary to determine when impairment removal can occur.

Rationale for Listing

This beneficial use is considered impaired because of the poor visual quality of the water resources and adjacent land. The 1994 Milwaukee RAP attributed the likely cause of the impairment to surface water debris, oil and grease, and overdevelopment along the estuary. The likely sources of these causes include point source pollution, nonpoint source pollution, and litter.

After storms, considerable debris can be seen near almost every combined sewer overflow and storm sewer outfall. Floating litter significantly degrades aesthetic value and recreational enjoyment of our urban waterways. Floatable trash likely comes from many sources, including illegal dumping of trash into streams; littering into the drainage area of rivers; ill-maintained dumpsters; improper streambank modifications; sanitary sewer overflows and combined sewer overflows; marine sources and recreational users; and, most importantly, from stormwater runoff.

Summary of Key Remedial Actions since the 2012 RAP Update and Current Status

In 2013, the Volunteer Aesthetics Monitoring program continued in the AOC.

Benefits of this approach include expanding public participation in AOC activities, generating needed data at minimal cost, and incorporating public perceptions in evaluation of this BUI. Contracts with two

organizations, the Urban Ecology Center and Alliance for the Great Lakes, assisted in administering the program. Results from 2013 will be compiled in late 2013/early 2014.

Next action(s) needed

As sustained funding is available, DNR will continue to contract with local organizations to carry out the volunteer aesthetics monitoring program to collect more data and determine what else must be done to address this BUI.

Issues (challenges, risks) affecting progress on this BUI

The impairment was listed primarily for the AOC because of the water’s poor visual appearance and “overdevelopment along the estuary.” At the present time, it is unclear whether some of the potential contributing factors that degrade aesthetics may be able to be addressed through the AOC program.

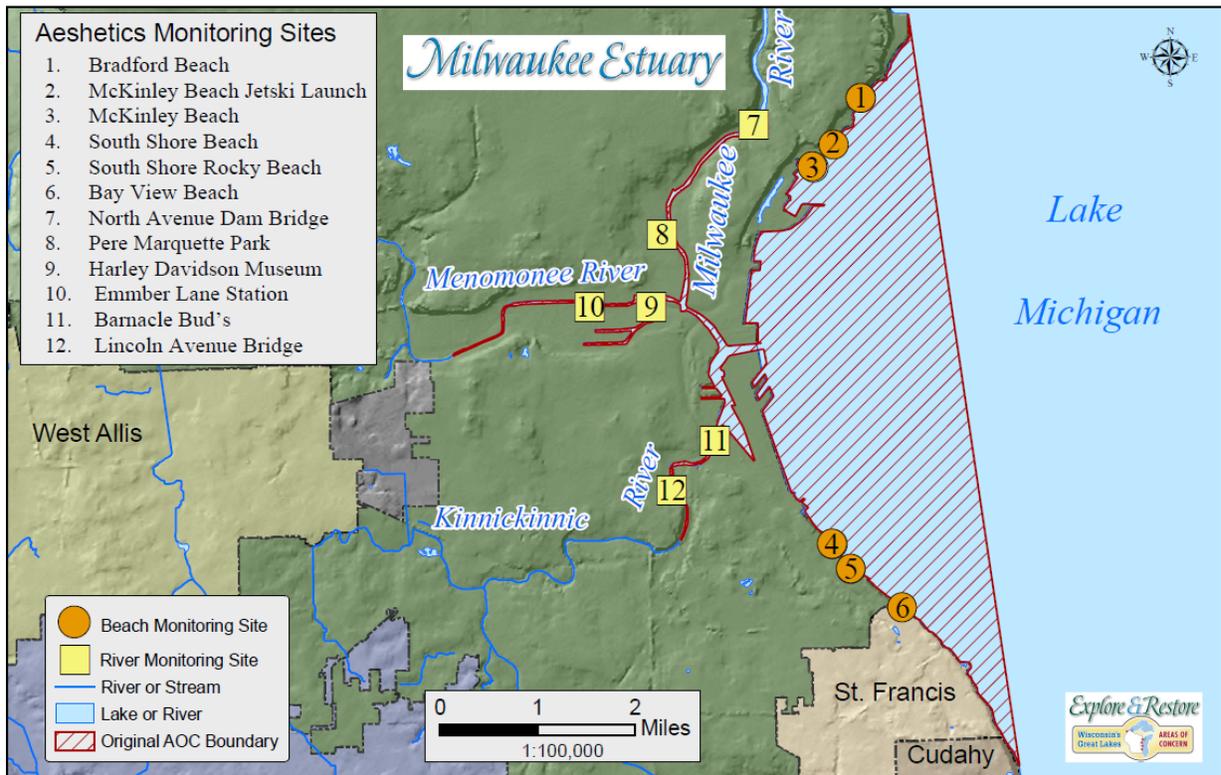


Figure 5. Aesthetics Monitoring Sites for 2013.

DEGRADED PHYTOPLANKTON AND ZOOPLANKTON POPULATIONS

Target and Status

Updated Target	Status
<p>A stepped approach is needed for delisting for this impairment:</p> <ol style="list-style-type: none"> 1. The first step toward delisting will be to establish a baseline condition for the estuary to evaluate the extent of this impairment. Phytoplankton and zooplankton community surveys should be conducted and compared to a non-impacted or minimally impacted reference site to set the baseline condition. If the community structure is statistically different than the reference conditions, this BUI should be considered impaired. 2. Identify the factors leading to this impairment. <ol style="list-style-type: none"> a) Ambient water chemistry sampling should be conducted to determine if nutrient enrichment is the main contributor. If nutrients are the main contributor, sources causing nutrient enrichment to the outer harbor and nearshore waters are identified and controlled. b) If nutrient enrichment is not considered the cause of the impairment, conduct bioassays to determine if ambient water toxicity is causing impairment. 	<p>Assessment in progress (2012-2013 and 2014-2015)</p> <p>TBD</p>

Target Rationale

Basic information regarding this impairment is lacking. Assessment is needed to verify the impairment before factors leading to the impairment can be identified.

The 1994 RAP indicated that this beneficial use was impaired because of the poor diversity of plankton, attributed to the eutrophic conditions and the increased conductivity in the estuary and Outer Harbor (WDNR, 1994, p. 2-20).

DNR removed a third item in the targets last year requiring the AOC not to be listed as impaired due to phytoplankton and/or zooplankton toxicity in the most recent Wisconsin Impaired Waters list. We did this because there are no considerations for listing waterbodies as impaired due to plankton toxicity (WDNR, 2013c). Pending assessment of the plankton communities, we will then try to determine any causes of the impairment. Item two in the targets captures the necessity to look at both water chemistry and possible toxicity effects on plankton communities.

Rationale for Listing

This BUI is relevant to the Outer Harbor and nearshore Lake Michigan portions of the Milwaukee Estuary AOC. The 1994 RAP Update indicated that both phytoplankton and zooplankton populations within the Outer Harbor and near shore Lake Michigan are impaired. Like the eutrophication and undesirable algae BUI, these organisms are most affected by nutrient loading and dynamics in the estuary and lake.

According to the 1994 RAP, phytoplankton population data collected by MMSD in the Outer Harbor were representative of nutrient enriched (eutrophic) conditions. Nearshore phytoplankton assemblages had some tolerant organisms, but were more indicative of mesotrophic conditions. The data indicated that the three rivers draining to the Estuary have a significant influence on the phytoplankton community in the

Outer Harbor. The nearshore waters in the AOC are also affected by the rivers, but to a lesser extent. Phytoplankton populations were noted to be affected by high nutrient loads to the rivers and harbor. An increase in species tolerant of eutrophic conditions indicated degraded water quality conditions.

Zooplankton populations were also affected. Studies in the 1980s done by MMSD found declining species richness, and dominance of pollution tolerant species in the outer harbor compared with the community structure of the open lake. Species abundance was greater in the Outer Harbor compared to the lake, which indicates nutrient enrichment (WDNR, 1994).

Summary of Key Remedial Actions since the 2012 RAP Update and Current Status

The results of the 2012 USGS assessment, which included plankton populations in the AOC and reference sites, are still pending. This assessment was intended to provide necessary data so that we can decide how to move forward on this impairment. Locations were sampled throughout the state to see how the AOC sites compared to other similar areas that do not have the designation. Because 2012 was an anomalous year for weather conditions, the study will be repeated in 2014 to ensure that data are representative of average conditions.

Next action(s) needed

To be further determined based upon results of the 2012 and 2014 studies.

Issues (challenges, risks) affecting progress on this BUI

There is a lot of uncertainty about this impairment since we do not know much about the plankton communities in the AOC. It is likely that plankton communities have been affected by ecological changes in Lake Michigan, and actions carried out through the LAMP for Lake Michigan will be important for addressing the root causes of degraded plankton communities.

LOSS OF FISH AND WILDLIFE HABITAT

Target and Status

Updated Target	Status
<p>This BUI will be considered to be eligible for removal when the following have occurred:</p> <ul style="list-style-type: none"> • All contaminated sediment hotspots within the AOC have been identified, and implementation actions to remediate contaminated sites have been completed. • A local fish and wildlife management and rehabilitation plan has been compiled for the estuary that: <ul style="list-style-type: none"> ○ Defines the causes of all habitat impairments within the AOC ○ Establishes site-specific habitat and population targets for native indicator fish and wildlife species within the AOC ○ Identifies all fish and wildlife habitat rehabilitation programs/activities within the AOC and establishes a mechanism to assure coordination among all these programs/activities, including identification of lead agencies ○ Establishes a time table, funding mechanism, and lead agency or organization responsibility for all fish and wildlife habitat rehabilitation activities needed within the AOC. • The programs and actions necessary to accomplish the recommendations of the fish and wildlife habitat plan are implemented, and modified as need to ensure continual improvement. 	<p>In progress</p> <p>In progress</p> <p>In progress</p>

Target Rationale

Contaminated sediments in the AOC must be addressed in order for this impairment to be removed. A plan also needs to be developed that will list measures of success, and focal species, and projects that will help address the physical habitat issues in the AOC.

Rationale for Listing

This beneficial use is considered impaired by the 1994 Milwaukee AOC RAP. The 1994 RAP cites urban development in areas adjacent to the estuary as having greatly diminished aquatic and wildlife habitat. Natural stream banks did not, and still do not, exist below the former North Avenue Dam on the Milwaukee River. Almost no natural areas exist on adjacent streambanks in the harbor or along the rivers. The rivers within the estuary have been heavily engineered for shipping and commerce, producing unnatural shorelines and a virtual "ecological desert" for many aquatic and semi-aquatic wildlife species. The habitat in the lower reaches of each of the watersheds draining into the Milwaukee Harbor estuary is typical of that found in a highly urbanized environment, with extensive channelization and placement of sheet piling for bank stabilization. From a water quality perspective, fish and aquatic habitat is impaired by excessive sedimentation (including contaminated sediments) and poor ambient water quality. Nutrient loading and low dissolved oxygen concentrations further degrade habitat available for fish forage and spawning. There is little cover for resident fish species, and few trees, shrubs and other vegetation to provide shade that could temper high water temperatures in summer months. More natural habitat can be generally found in upstream areas of each of the major rivers and their tributaries.

Loss of wildlife habitat was not considered impaired in the 1991 RAP because it was not considered to be caused by contamination, but by lack of physical habitat (WDNR, 1991, p. V-12). The 1994 RAP expanded the scope to include lack of physical habitat as an impairment. There is very little loafing and resting habitat for migratory waterfowl—it is not uncommon to see mallards and other ducks resting on submerged logs, and other floating debris as well as boats due to general lack of natural resting areas in the AOC's urban waterways (WDNR, 1994, p. 2-21).

The 1994 RAP added that the confined disposal facility (CDF) near Jones Island may be a source of contaminants for waterfowl. The CDF within the outer harbor provides sheltered water habitat and is used for loafing and forage by many migratory and resident duck species and geese. A sentinel duck study was conducted in the summer of 1990 to determine if waterfowl were accumulating contaminants from the Milwaukee CDF. The study concluded that ducks released into the CDF did not accumulate significant concentrations of contaminants compared to field and background levels (WDNR, 1994, p. 2-16). This may be due to the fact that the most contaminated sediments within the CDF were originally deposited in the 1970s and are buried to the extent that they are no longer available to wildlife.

More recent studies documented substantial losses of species richness in Milwaukee County in other wildlife, with declines of 20-70% for bird, amphibian and reptile groups, resulting mainly from habitat loss (Waller and T. Rooney, 2010). Habitat restorations within the AOC will be key to addressing these more regional losses.

Summary of Key Remedial Actions since the 2012 RAP Update and Current Status

In 2013, DNR continued the work that began in 2012 with the fish and wildlife technical team, and assembled a draft fish and wildlife plan for the AOC (see Appendix A).

Appendix B summarizes the status of several projects identified in the 2012 habitat project list; several of which were funded in 2013. In 2013, the team also determined priority habitat projects for 2014.

Next action(s) needed

While not all habitat projects have been identified at this time, the fish and wildlife technical team has identified interim habitat goals. Each of these goals addresses a critical aspect of physical or biological habitat in the AOC. We will continue working with stakeholders to determine which additional goals and measures of success are desirable and achievable for this impairment. In 2014, the team will continue its efforts to develop a final list of habitat projects necessary to remove this impairment.

Issues (challenges, risks) affecting progress on this BUI

Projects in and connected to the AOC can be expensive to complete; however, in order for aquatic projects to have an impact in the estuary, they need to be connected to it (i.e., there need to be no downstream passage barriers to proposed projects).

CONCLUSION

Working with the stakeholders and project partners will be critical to securing support for projects and making overall progress in the AOC. Several key partnerships have been developed through the program, and with the GLRI, a lot of data have been collected around the Great Lakes that pertain to different BUIs. These partnerships help ensure efficiency in the AOC program, both in the state of Wisconsin and throughout the Great Lakes.

Although progress has been made in the AOC, there are still several key actions that need to continue or occur in order to address the impairments. First, the assessment and remediation of contaminated sites is necessary in order to address many of the impairments. Several sites to date have been addressed, but other parts of the AOC need to be characterized and addressed before contamination-related issues in the AOC no longer pose a substantial threat to fish and aquatic life in the AOC.

Second, the TMDL must be completed and implemented so that issues related to eutrophication, body contact, beach closings, and habitat (as a result of high sediment loads) are no longer impacting the AOC. Source identification of bacteria will also be necessary to fully implement the TMDL for bacteria so that projects related to bacteria loading in the AOC are done in an efficient manner that will truly reduce human health risks related to recreation in the AOC.

Additionally, we need to continue monitoring aesthetics in the AOC. The project data, monitoring forms, and sites will be re-evaluated to see if there are any necessary improvements for moving into 2014.

The fish and wildlife technical team will continue to meet and make progress on identifying necessary actions for the fish and wildlife impairments, and will continue to provide input for any fish and wildlife assessments.

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APPENDICES

Appendix A	Draft Fish and Wildlife Plan for the Milwaukee Estuary Area of Concern
Appendix B	Status Updates on Habitat Projects Listed in Table 3 of the 2012 RAP Update
Appendix C	Education, Information, and Outreach Campaign Tracking
Appendix D	AOC Tracking Matrix

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Appendix A

Draft Fish and Wildlife Plan for the Milwaukee Estuary Area of Concern

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Fish and Wildlife Plan
for the
MILWAUKEE ESTUARY AREA OF CONCERN

December 2013



Wisconsin Department of Natural Resources
Office of the Great Lakes

**Draft Fish and Wildlife Plan
for the
Milwaukee Estuary Area of Concern**

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Disclaimer: The Great Lakes Water Quality Agreement is a non-regulatory agreement between the U.S. and Canada, and criteria developed under its auspices are non-regulatory in nature. Any actions identified in this document as needed to remove the impaired beneficial uses are not subject to enforcement or regulatory actions.

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List of Acronyms

AOC	Area of Concern
BCOC	Bioaccumulative chemicals of concern
BUI	Beneficial Use Impairment
CDF	Confined disposal facility
CSO	Combined sewer overflow
GLRI	Great Lakes Restoration Initiative
GLWI	Great Lakes Water Institute
km	Kilometers
LOEL	Lowest observable effect level
mg/L	Milligrams per liter
MMSD	Milwaukee Metropolitan Sewerage District
NOAA	National Oceanic and Atmospheric Administration
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
RAP	Remedial Action Plan
SEWRPC	Southeastern Wisconsin Regional Planning Commission
SIG	Stakeholder Input Group
SWWT	Southeastern Wisconsin Watersheds Trust (also known as Sweet Water)
TMDL	Total Maximum Daily Load
TP	Total phosphorus
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWM	University of Wisconsin-Milwaukee
WDNR	Wisconsin Department of Natural Resources
WisCALM	Wisconsin Consolidated Assessment and Listing Methodology

EXECUTIVE SUMMARY

The purpose of this Fish and Wildlife Population and Habitat Plan (Plan) is to outline a path to removing the “**degradation of fish and wildlife populations**” and the “**loss of fish and wildlife habitat**” beneficial use impairments (BUIs) from the Milwaukee Estuary Area of Concern (AOC). The need for this plan was established in the March 2008 *Delisting Targets for the Milwaukee Estuary Area of Concern*. This plan and its components will eventually meet all requirements of those targets by:

- Defining the causes of all population impairments within the AOC
- Establishing site-specific local population targets for native indicator fish and wildlife species within the AOC
- Establishing a list of projects that must be implemented to address the loss of fish and wildlife habitat impairment
- Identifying all fish and wildlife population/habitat restoration programs/activities within the AOC and establishing a mechanism to assure coordination among all these programs/activities, including identification of lead and coordinative agencies
- Establishing a time table, funding mechanism, and lead agency responsibility for all fish and wildlife population/habitat restoration activities needed within the AOC

We expect to meet all the requirements of the targets for this plan once the fish and wildlife populations assessments are completed. The assessments are expected to be completed by 2017. Targeted fish species for management in the AOC include lake sturgeon, walleye, greater redhorse, and northern pike. Target species for wildlife are being developed and will be included in the subsequent annual updates to this plan once they are available.

INTRODUCTION AND PURPOSE STATEMENT

One of the fundamental challenges of the Great Lakes Remedial Action Program is being able to determine when an Area of Concern (AOC) has recovered such that the AOC designation can be lifted (a process known as AOC Delisting). In 2008, DNR and its partners took the first step toward developing goals and targets for each of the beneficial use impairments (BUIs) in the Milwaukee Estuary AOC. Due to the complexity of the AOC, some targets, specifically those for Degraded Fish and Wildlife Populations and Loss of Fish and Wildlife Habitat, were left more general, until additional assessments were underway or completed. The purpose of this plan is to address the targets for these two impairments by identifying which assessments and actions are necessary in order for impairment removal to occur.

In 2012, DNR assembled a fish and wildlife technical team to assist in the identification of necessary habitat and population assessments, goals, and actions for the AOC so that BUI removal may eventually occur (Appendix A). This Draft Fish and Wildlife Plan, therefore, draws on the work of the technical team by beginning to fill in some of those gaps. The overarching aim of this planning effort, in concert with the annual Remedial Action Plan Update for the Milwaukee Estuary, is quantifiable and authentic ecosystem improvement, so that (contingent on available funding) these impairments can be ultimately removed from the AOC in a timely and scientifically defensible manner. Completing the assessments in an expedient manner is a first and important step in making necessary progress toward addressing and removing these impairments.

With regard to the RAP or AOC program, this document is essentially an addendum to the Remedial Action Plan (RAP) Update for the Milwaukee Estuary AOC. RAPs are described in the 1987 Protocol amending the *Revised Great Lakes Water Quality Agreement of 1978* as plans that evaluate and describe remedial measures needed to restore the beneficial uses. The Protocol indicates that the RAP should also contain a schedule and identify the organization responsible for implementation. To the extent possible, this plan will show this information for assessments, goals, and actions identified, but will be updated annually as needed to reflect technical team progress. This plan should be treated as a work-in-progress until the assessments are completed and until all remedial actions have been identified.

This fish and wildlife 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 remove beneficial use impairments, not to create a pristine habitat reflective of pre-European settlement conditions. However, the implementation of this plan, and subsequent removal of the fish and wildlife BUIs, can be an important initial milestone toward a broader and more ambitious restoration effort, should the community choose to strive for improvements beyond delisting.

A Word about Citizens' Advisory & Technical Advisory Committees

Citizens' and technical advisory committees are ubiquitous in the RAP program. In the Milwaukee Estuary AOC, we have a wide variety of expertise and stakeholders whose advice may be sought, depending on the particular geographic area of interest and the topic. Because of the focus of this plan, we assembled an ad hoc fish and wildlife technical team to assist in the development of this plan. In essence, they are the technical advisory committee for fish- and wildlife-related issues in the AOC.

On behalf of the more than 250 self-identified stakeholders, a 12-person Stakeholder Delegation was assembled to serve as an outreach advisory panel. The Stakeholder Delegation functions as the

Citizens' Advisory Committee for the AOC; however, broader or targeted participation from the stakeholders may also be desirable or necessary in certain circumstances.

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CAUSES OF FISH & WILDLIFE HABITAT AND POPULATION IMPAIRMENTS

According to documents cited in SEWRPC's Memorandum Report Number 194, early records reveal that the Milwaukee Estuary area, including the Milwaukee, Menomonee, and Kinnickinnic Rivers, has been substantially channelized, relocated, dredged, filled, and dammed to convert the significant wetland complex into the highly constructed navigable port that currently exists. This conversion allowed for the development and growth of the greater Milwaukee metropolitan area that currently exists, but this conversion has led to significant environmental degradation in water quality, fisheries, and wildlife habitat. Further comparison of the earliest known survey of the entire Menomonee River and Kinnickinnic River systems completed in 1836 to the present channel conditions in 2005 also shows evidence of significant channelization and diversion of stream channels over this time period (SEWRPC, 2010a, p. 17).

The 1994 RAP recognized these as being a primary reason for listing the Degraded Fish and Wildlife Populations and Loss of Fish and Wildlife Habitat as impaired for the AOC. This section summarizes relevant portions of the 1994 RAP document to provide historical context (WDNR, 1994). Where this information is still relevant, it will be used to help inform the strategy for addressing the impairment.

Degraded Fish and Wildlife Populations

The 1994 RAP states that overall fish species diversity in the AOC was low, with many pollution tolerant species. The lack of natural features in the AOC along with the installation of steel sheet piling, channelization and concrete lining, urban and rural runoff, and high sediment load led to poor quality habitat for fish foraging and spawning. The 1994 RAP also mentions the barrier to fish passage that the former North Avenue Dam provided.

The RAP also specifies that declines in wildlife populations and decreases in species diversity could be partially attributed to urban development in the AOC. Nearly all the wetlands that existed prior to European settlement were filled as development occurred. The RAP cited that the wildlife habitat that remained was concentrated in and around existing parkland and other open areas. It also stated that further investigations were needed to determine whether problems related to poor water quality or toxic contamination impair wildlife populations, since those were suspected as having some kind of an effect (WDNR, 1994, p. 2-17 to p. 2-18).

Loss of Fish and Wildlife Habitat

Urban development is cited as having diminished aquatic and wildlife habitat. The lack of natural areas in the harbor and along the rivers (in the original AOC boundaries) is also identified as part of the impairment, especially for wildlife. The RAP also mentions poor water quality from excessive nutrients and contaminated sediments as degrading habitat for fish. The document states further that although water quality concerns were an issue, this impairment was listed for wildlife because of the lack of physical habitat in the AOC (WDNR, 1994, p. 2-12).

Summary

Overall, the Loss of Fish and Wildlife Habitat and Degraded Fish and Wildlife Populations were listed for the AOC primarily because of

- Poor water quality as a result of changes in land use and increased urbanization,
- Concerns about toxicity from contaminated sediment, and
- The loss of physical and biological habitat from habitat fragmentation and alteration (as a result of urbanization and barriers to fish and wildlife passage), and the lack of natural areas in the AOC.

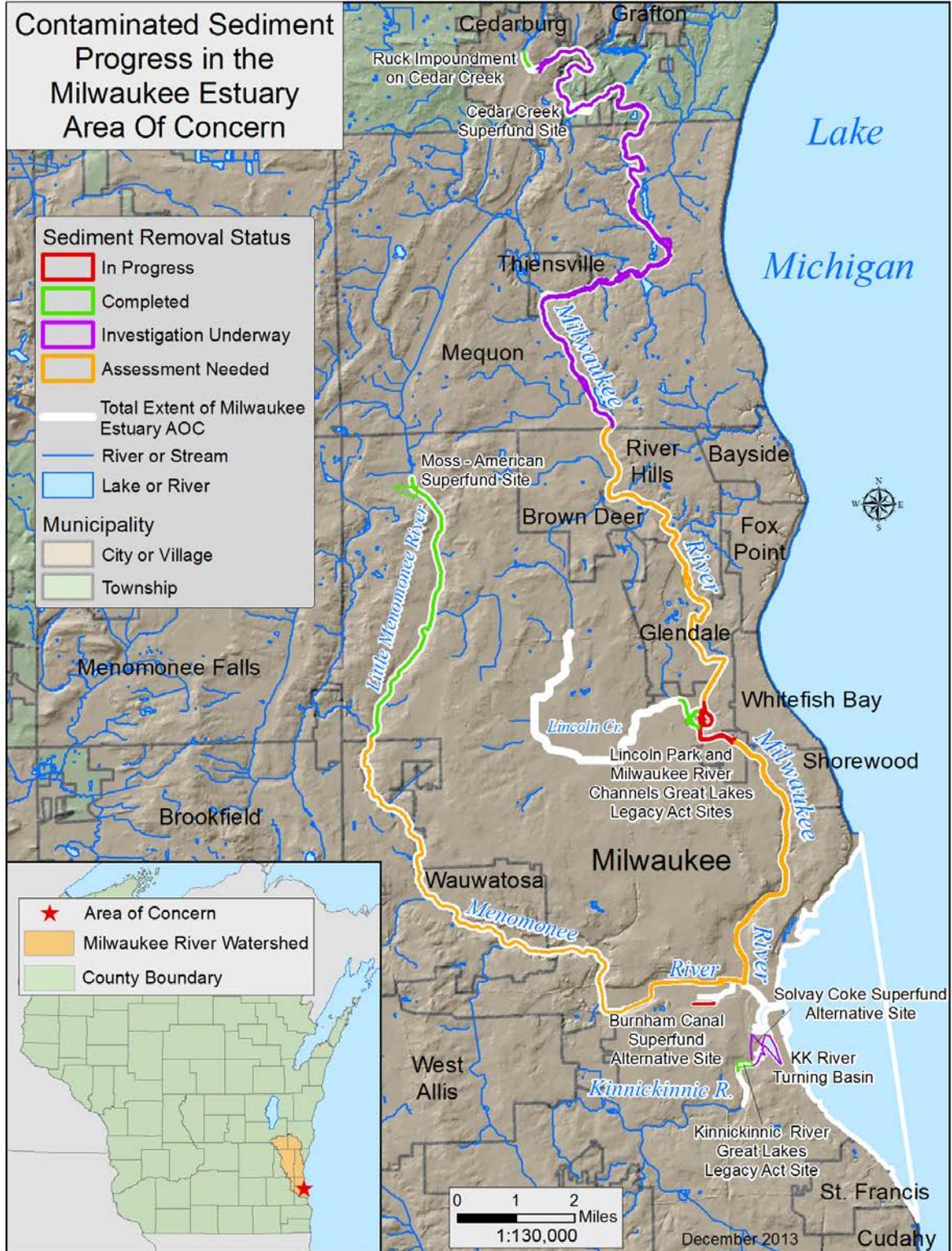


Figure 1. Sediment progress and sites needing action in the Milwaukee Estuary AOC.

STRATEGIES FOR ADDRESSING THE FISH AND WILDLIFE HABITAT AND POPULATION IMPAIRMENTS

Degraded Fish and Wildlife Populations

One of the main aspects that still needs to be addressed for this impairment is making progress on contaminated sediments (see Figure 1). This must occur before the impairments can be removed, however, aspects related to contaminants will be addressed primarily through the Restrictions on Dredging and Degradation of Benthos impairments. Additionally, improving water quality is required for this impairment; aspects related to water quality will be addressed primarily through the Eutrophication and Undesirable Algae impairment.

For this impairment, in particular, the Milwaukee Estuary Fish and Wildlife Technical Team has identified necessary assessments to determine the current status of the impairment. These assessments will also assist with target refinement, which is included in both proposals (although the degree of target refinement differs between the two). They will be used to determine, if population targets have not been met, whether additional species-specific management actions are needed so that impairment removal can occur.

Due to the differences in the amount of information that is available for fish and wildlife in the AOC, there are two approaches for assessing fish and wildlife in the AOC. Those approaches are outlined in the assessment proposals that can be found in Appendix A of the 2012 RAP Update for the Milwaukee Estuary. It is worth noting that at the time of AOC designation, there was a poor understanding of the condition of wildlife populations in the AOC. As a result, part of the assessment includes sifting through historical information in order to determine appropriate wildlife population targets and focal species¹. DNR completed an assessment for fish in the estuary in 1983. Based on this data and improvements since that time, targets for fish species are included in the assessment proposal, and require:

- A 100% increase of relative density for four native indicator species (lake sturgeon, northern pike, walleye, and greater redhorse), and
- An increase in relative density of 95% of the other native species captured in the original 1983 study, regardless of magnitude, and
- An overall mean value from all IBI sampling efforts of “fair” or better (i.e., IBI scores of 40-69).

The assessments for both fish and wildlife are planned to take three years, and call for \$565,000 total over the three years. At this point, we are planning to do this work through contracting with outside firms or agencies, although it would also be acceptable to collect the data for the assessments internally, if that capacity exists.

Loss of Fish and Wildlife Habitat

Like the Degraded Fish and Wildlife Populations impairment, making progress on contaminated sediments must occur before the impairment can be removed. However, aspects related to contaminants will be addressed primarily through the Restrictions on Dredging and Degradation of Benthos impairments. Additionally, improving water quality is required for this impairment; aspects related to water quality will be addressed primarily through the Eutrophication and Undesirable Algae impairment.

¹ Focal species can be defined as those whose habitat requirements represent those of a larger species suite. These habitat requirements are then utilized in developing restoration projects which can support these species. Focal species must have habitats that can be realistically restored or enhanced in the project area (i.e., the AOC), and may include keystone, umbrella, or flagship species.

The way this impairment will be specifically addressed is by implementing habitat projects that the fish and wildlife technical team identifies. While not all habitat projects have been identified at this time, the fish and wildlife technical team was able to identify a list of interim habitat projects. These habitat projects are derived from the interim habitat goals, each of which addresses several critical aspects of physical or biological habitat in the AOC. We will continue working with stakeholders to finalize goals and measures of success that are desirable and achievable for this impairment. For a complete listing of the goals and potential measures of success used to develop the interim habitat goals and help the group focus on priority habitat projects, see Appendix B.

Habitat Project Criteria

Each of the interim habitat projects addresses at least one of the habitat goals, and also meets the key practical criteria listed below. Additionally, for each goal, appropriate measures of success are also listed for each project to help measure progress toward removing the impairment. Besides addressing necessary technical criteria for habitat projects, there were also some practical features that were necessary in order for a potential project to be included. Candidates for interim physical habitat projects are listed here because they generally met several key practical criteria:

- They have a discrete area/geographic location associated with them,
- They have a cooperative landowner (typically public ownership),
- And they have a willing and interested implementer to spearhead the work,
- By helping to accomplish at least one of the physical/biological habitat goals, they would substantively help improve physical/biological habitat in the AOC. The interim habitat goals are listed and explained in further detail below.

Physical/biological habitat primary goals:

1. Enhance/improve aquatic habitat by...
 - A. Identifying and enhancing fish spawning sites from Lake Michigan to the tributaries and headwaters where opportunities exist (e.g., inner and outer harbors, Milwaukee River downstream of the North Ave. Dam pedestrian bridge), and/or
 - B. Improving lateral connectivity by connecting aquatic habitat to floodplain wetland with suitable hydroperiod from Lake Michigan to the tributaries and headwaters where opportunities exist.
2. Improve aquatic habitat connectivity by...
 - A. Improving linear connectivity by restoring or enhancing fish and aquatic organism passage from Lake Michigan to the tributaries and headwaters, and/or
 - B. Reconnecting high quality habitat downstream of the Bridge Street Dam and Lepper Dam to the main stem rivers of the AOC in cases where that habitat is directly connected to the estuary (i.e., there are no downstream barriers from the proposed project site).
3. Enhance/improve terrestrial, semi-aquatic, and/or riparian habitat by...
 - A. Expanding habitat buffer width to a minimum of 75 feet, and/or
 - B. Where possible, expanding shoreline buffers up to 1,000 feet to meet core habitat area needs for semi-aquatic species, and/or
4. Improve terrestrial riparian habitat connectivity by expanding riparian buffer habitat quality and continuity.
5. Protecting high-quality areas or environmentally sensitive lands, especially those supporting rare and protected species.

Physical/biological habitat secondary goals:

1. Moderate flow regimes to decrease flashiness.
2. Provide and preserve sufficient baseflow.

Primary habitat goal explanations

In order to provide some context for why each of the habitat goals, and meeting those goals, is critical, an explanation is provided for each of the goals and, where applicable, related objectives. Many of the goals and explanations are taken directly from SEWRPC's Biological Assessment for the Menomonee and Kinnickinnic Rivers that was completed in 2010, and are relevant to other impacted waters in the Milwaukee Estuary AOC.

In-stream goal: **Enhance/improve aquatic habitat.**

Why is enhancing/improving aquatic habitat necessary to delist the AOC?

Stream channels in the AOC have been highly altered in many locations, whether through installation of sheet piling, channelization/concrete lining, dredging, damming, or other in-stream changes that have occurred as a result of urban-influenced hydrology (changes in sediment loads, substrate type, channel incision, etc.). Prior to all these alterations, fish and other aquatic life had access to deep near-shore habitat, thousands of acres of shallower wetland habitat with abundant and diverse submergent and emergent aquatic plant communities, and hundreds of miles of riverine habitat. These varied and connected habitat types provided fish and other aquatic organisms (e.g., mussels, turtles, etc.) with their critical reproductive, protective, and growth (feeding) life requisites. At the time of AOC designation, nearly all of these critical habitat types had been obliterated from the estuary. Deep water and near-shore Lake Michigan habitats (currently comprised of the Inner and Outer Harbors) and nearly all associated wetlands were degraded or destroyed. As a consequence, fish and other aquatic organisms' populations have dwindled as a direct result of alterations within the AOC. Therefore, to improve their populations, it is critical to try to address these alterations as opportunities present themselves. Several projects of varying scales have already occurred within the AOC and further upstream in its tributaries, including the removal of multiple dams (the Menomonee River Falk Dam, the Milwaukee River North Avenue, Lime Kiln and Chair Factory Dams, the Pigeon Creek Wisconsin Lutheran Seminary Dam), the construction of an engineered fish passage facility (Milwaukee River Thiensville Dam fishway), the removal of several miles of concrete lined stream channels (Kinnickinnic River, Menomonee River, Lincoln and Indian Creeks), the removal or replacement of over 40 barrier culverts, and rehabilitating wetlands (Trinity Creek). Despite these improvements, there is additional work to be done in the AOC that would improve aquatic habitat and aid in providing aquatic life with habitat types that would meet their critical needs.

What opportunities exist to accomplish this goal?

There are several types of activities that can be done to help alleviate the impacts of these hydrological alterations that have also affected habitat in the AOC.

- *Improving opportunities for fish spawning habitat in the inner and outer harbor.* Because of their close connection to Lake Michigan, increasing the extent of wetland habitats for phytophilic spawning fishes (such as northern pike), and increasing the diversity and extent of native aquatic plants in deep water habitats for protection and growth (feeding) of native adult and juvenile fish, and enhancing spawning habitat for lithophilic spawning fishes (such as walleye and sturgeon) is a priority. Due to social, economic, and technical constraints within most of the estuary, however, efforts to enhance near-shore Lake Michigan and estuary AOC fish populations, in particular migratory potamodromous and fluvial species, must include the removal of significant barriers to riverine and wetland spawning habitats, as well as creating or enhancing the biological functions of riverine and wetland habitats where they are found to be technically, socially, and economically feasible.

- *Reconnecting high quality habitat downstream of the Bridge Street Dam (Milwaukee River) and Lepper Dam (Menomonee River) to the main stem rivers of the AOC in cases where that habitat is directly connected to the estuary.*

We realize the necessity of creating a certain amount of high quality habitat that is connected to the AOC (i.e, there are no downstream barriers from the proposed project site), if fish populations are going to be able to address their critical reproductive, protective, and growth (feeding) life needs. Due to the urban nature of the AOC and its surrounding areas, there are limitations on what can be done to improve conditions for fish and wildlife within the AOC. While we are striving to improve aquatic habitat connectivity overall (see next goal explanation), we also recognize that the high quality habitat that is necessary for certain species may not be able to successfully created within the original boundaries of the AOC. In support of this goal, efforts to remove fish movement barriers (see below), and create or enhance critical habitats may extend to the designated complete aquatic invasive species barriers at the Menomonee River Lepper Dam located 17-river miles (RM 17) at Menomonee Falls and select tributaries; and the Milwaukee River Bridge Street Dam located 32-river miles (RM 32) at Grafton, and select tributaries. For the purposes of the AOC program, however, such sites must be accessible to native fish migrating into the estuary from Lake Michigan and into the mainstem rivers.

In summary, projects that help mitigate the extensive alterations that occurred in the AOC can have a real and measurable positive impact in the AOC. Such was the case with the removal of the North Avenue Dam and the in-stream habitat enhancements that were also installed around the time of the dam removal. Furthermore, this goal is tightly linked with the next goal, since opportunities in the AOC will be limited for improvement, but ensuring that fish can access other connected high quality habitats will help bolster overall populations.

In-stream goal: Improve aquatic habitat connectivity.

Why is improving aquatic habitat connectivity necessary to delist the AOC?

Removing barriers to fish and aquatic organism movement cannot be overstated. This is especially true in the AOC, where the shoreline has been highly altered in most locations, and while some improvements can and should be made that would improve in-stream aquatic habitat, providing passage to upstream areas with higher quality habitat is essential. The Southeastern Wisconsin Regional Planning Commission (SEWRPC) has recommended using a three-tiered approach for prioritizing in-stream management actions for linear connectivity (Memorandum Report No. 194, pp. 38-41). This framework is focused on the reconnection of waterways that have been historically isolated from the Lake Michigan stream system through construction of dams, roadways, and flow control structures, or modified through construction of single-purpose systems, such as stormwater conveyances.

The three components of this strategy are:

- Tier 1—Restoring connectivity and habitat quality between the mainstem waterways and the Lake Michigan endpoint,
- Tier 2—Restoring connectivity and habitat quality between the tributary streams and the mainstems of the Milwaukee, Menomonee, and Kinnickinnic Rivers, and
- Tier 3—Expanding connection of highest-quality fish, invertebrate, and habitat sites within each of the watersheds.

The third tier is a “catch-all” that enables stakeholders to link the goals of habitat restoration and improvement of recreational options with ongoing activities throughout each watershed. This strategic element provides the flexibility for communities and stakeholders to take advantage of opportunities throughout each watershed that may arise independently of the primary strategy of restoring linkages with Lake Michigan and tributary streams. An example of this latter strategic approach would be using the opportunity provided by scheduled reconstruction of area roadways to remove obstructions or

modify channelized stream segments that might not fully conform to the first two strategic priorities. To this end, it is further noted that provision of fish passage will provide passage for other aquatic organisms such as invertebrates.

It is fully recognized that within this framework opportunities will arise that should be acted upon. For example, even though it is a general principle of this strategy that activities progress from downstream to upstream, the completion of an action in headwaters areas or on a tributary stream should not be passed up or ignored simply because it does not conform to the downstream to upstream strategy. Rather, all opportunities should be seized as they become available. However, where multiple opportunities exist, and where limited funds are available, this strategic framework is intended to assist decision-makers in allocating resources where they would be most appropriate and effective in achieving the goals of the regional water quality management plan update. Figure 2 on the following page shows an example of how this prioritization strategy works.

For improving lateral connectivity, enhancing connections of floodplains to their respective channels would also provide additional habitat enhancements, especially for species like northern pike, which prefer shallow, grassy areas for spawning.

What opportunities exist to accomplish this goal?

Removal of barriers on the AOC tributaries, starting with the downstream/mainstem barriers whenever possible, is necessary, and we know of several opportunities (see project list). Additionally, we will also look into a strategy to prioritize which potential fish passage projects in the higher quality portions of the AOC would yield the best results for fish populations.

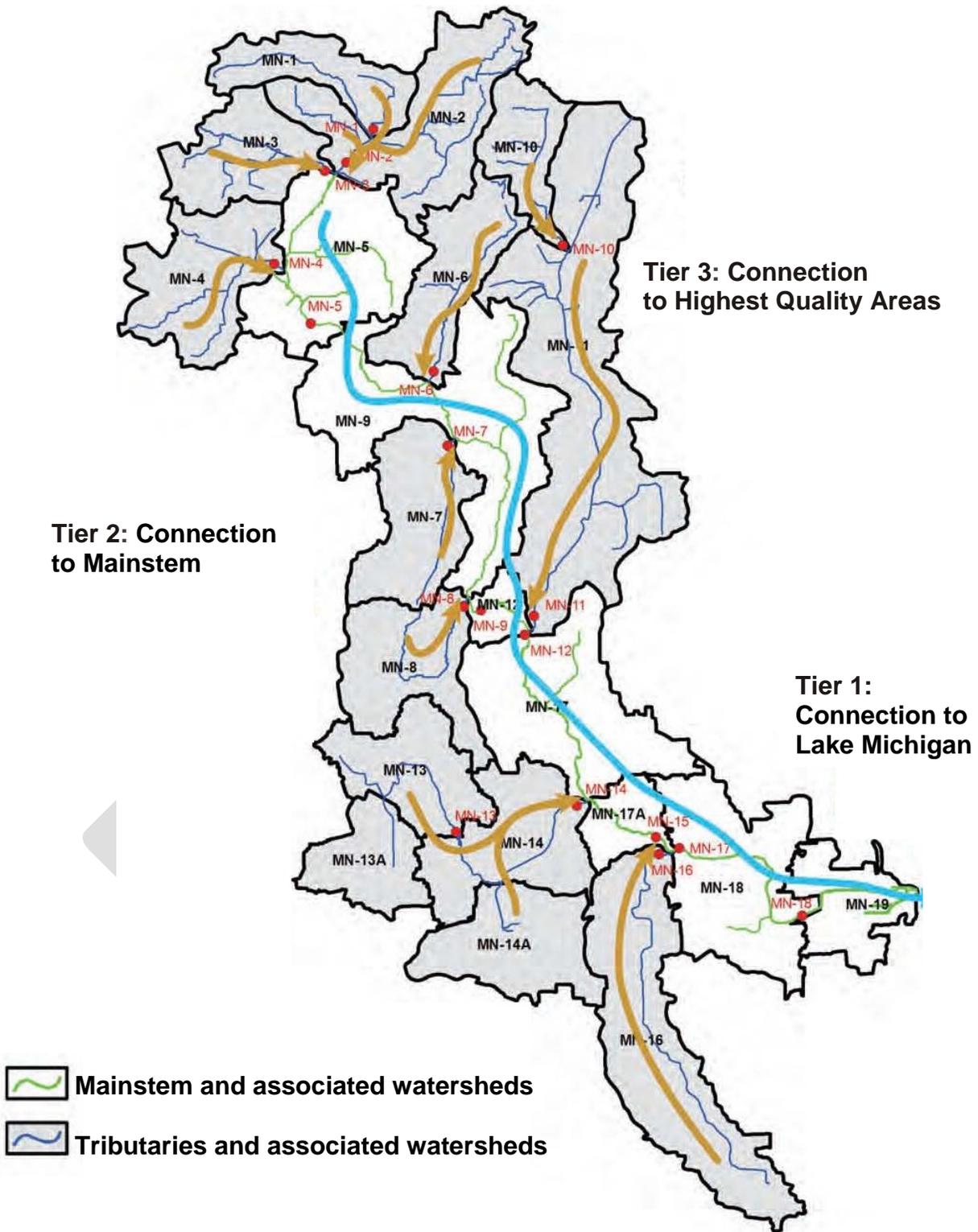


Figure 2. An example of the in-stream three-tier prioritization strategy within the Menomonee River Watershed. (Figure adapted from SEWRPC, 2010a.)

Riparian goal: **Enhance/improve terrestrial, semi-aquatic, and/or riparian habitat.**

Why is improving terrestrial, semi-aquatic, and/or riparian habitat necessary to delist the AOC?

Wildlife habitat in the AOC has been highly altered through a variety of impacts. Urban development has greatly reduced the acreage available for wildlife habitat. Remaining habitat patches are often small and isolated, reducing their suitability for wildlife species that require large habitat patches. Connectivity of habitats has been fragmented by roads and developments. Habitat quality and its suitability for supporting viable wildlife populations has been degraded through the spread of non-native invasive plant species, a super abundance of human-subsidized predators (i.e., raccoons, opossums), and contaminants from a variety of sources (e.g., airborne, industrial waste, urban runoff). Excessive noise levels and urban lighting can also alter wildlife behaviors, reduce reproductive success, increase exposure to predation, and elevate stress levels with subsequent reductions in fitness (Andrews et al., 2006).

Prior to all these alterations, wildlife had access to thousands of acres of diverse, quality habitats directly connected to the AOC, including aquatic, wetland, riparian and terrestrial habitats. Habitats such as mature forest, bluffs, vernal ponds, tamarack swamps, and emergent marsh supported wildlife species that had very specialized habitat requirements. These connected habitat types provided the critical reproductive, protective, and growth (feeding) life requisites. At the time of AOC designation, most of these critical habitat types had been substantially lost or degraded, and could no longer support many wildlife species. For example, estimates of species richness losses for the county are 37% for breeding birds, 47% for reptiles, and 44% for amphibians, along with a 37% loss of the native flora in the habitats of these species (Casper. 2008; Leitner *et al.*, 2008). Losses within the more limited AOC area are undoubtedly higher. For example, a review of mussels in the Greenway section of the AOC (the Milwaukee River from the Milwaukee/Ozaukee County line downstream to Humboldt Ave.) suggests that somewhere between 27% and 57% of species have been lost (Casper and Dare, 2013). Lichens, an important component of wildlife habitat, are especially sensitive to air pollution (Brodo *et al.*, 2001) and a trend towards higher species richness with distance from roads was suggested in a recent study within the AOC (Rutherford, 2012). This loss of species richness, and reduction of wildlife abundance, is a direct result of habitat alterations within the AOC.

To improve wildlife habitat and populations, it is critical to address existing habitat alterations as opportunities present themselves. A first step is underway, an assessment of current conditions and evaluation of which species can be reasonably targeted for restoration. Since it will be impossible and undesirable to restore wildlife resembling pre-settlement conditions in an area dominated by economic development priorities, the assessment will identify a suite of native wildlife species that can be restored to sustainable populations within these social constraints. For example, some simple habitat restorations such as restoring vernal pools within managed terrestrial or riparian habitat matrices can significantly increase the number of species supported, restoring those that require vernal pools as a critical breeding habitat (such as many salamanders and frogs, aquatic insects, fairy shrimp and dabbling ducks). Similarly, connecting and expanding existing forest stands can result in increased richness and abundance of forest interior species such as woodpeckers, tree squirrels, owls, and songbirds. Several projects of varying scales have already occurred within the AOC and further upstream in its tributaries, such as the restoration of vernal ponds at the Mequon Nature Center, and planning for others has begun through organizations such as the Milwaukee River Greenway Coalition, and Milwaukee County Parks. Riparian buffer recommendations have been advanced by SEWRPC that enhance habitat along streams. Despite these efforts, no comprehensive AOC-wide plan has been completed, identifying the species of local conservation interest and targeting specific on-the-ground habitat improvements to address the BUIs. Completing the AOC-wide wildlife assessments and project recommendations will address the need for providing wildlife with habitat improvements that meet their critical reproductive, protective, and growth (feeding) life requisites.

To summarize, buffers and connectivity are an important starting point for restoring wildlife habitat (and eventually wildlife populations), but more work through the wildlife assessment will also be necessary to help better define how to have riparian, terrestrial, and semi-aquatic habitat that not only affords water quality benefits, but is also truly functional as habitat for select focal species in the AOC.

What opportunities exist to accomplish this goal?

Many opportunities exist within public and private lands to improve and restore wildlife habitats. Many of these goals overlap with water quality goals, and achieving partnerships that accomplish multiple goals is a high priority in the AOC, where social constraints and competing land use interests somewhat limit opportunities for habitat restorations. Specific examples include:

- *Expanding habitat buffer width to a minimum of 75 feet.*
The SEWRPC has identified the Rule of 75: 75% is the proposed minimum of total stream length that should be naturally vegetated to protect the functional integrity of the water resources, and 75 feet is the proposed minimum riparian buffers width from the top edge of each stream bank should be naturally vegetated to protect water quality and wildlife (SEWRPC, 2007). For the purposes of the AOC, 75 feet has been recommended as the objective for riparian restoration projects in the AOC, in order to provide water quality benefits and also for its potential to provide wildlife habitat.
- *Where possible, expanding shoreline buffers up to 1,000 feet to meet core habitat area needs for semi-aquatic species.*
There are many riparian buffer functions and the ability to effectively fulfill those functions is largely dependent on width. Determining what buffer widths are needed should be based on what functions are desired as well as site conditions. For example, water temperature protection generally does not require as wide a buffer as provision of habitat for wildlife. Based on the needs of wildlife species found in Wisconsin, the minimum core habitat buffer width is about 400 feet and the optimal width for sustaining the majority of wildlife species is about 900 feet. This recommendation from SEWRPC is data reported in the scientific literature and the quality of available habitats within the context of those studies. Additionally, buffer size drives important natural functions like food availability and quality, access to water, habitat variety, protection from predators, reproductive or resting areas, corridors to safely move when necessary, and help in maintaining the health of species' gene pools to prevent isolation and perhaps extinction (SEWRPC, 2010, p. 10).
- *Expanding and improving habitat for species identified as of local conservation interest (typically rare, keystone, or other focal species).*
Many taxonomic groups have already demonstrated lost species richness in the area, which offers excellent restoration opportunities. The species of local conservation interest approach provides a method to identify what is actually important and feasible, and then is used to help recommend more species-specific goals, given that there are potentially thousands of "native" or "exotic invasive" species in the AOC. This approach also addresses species' critical habitat needs. For example, while improving buffers and connections is an important first step, amphibians species that have largely been extirpated from the area, will need additional and specific types of habitat, like breeding sites, if their populations are to be successfully re-established. Like fish, wildlife will need to have their critical habitat parameters met if restoration plans are to be truly successful and sustainable in the longer-term.
- *Constructing ephemeral wetlands where feasible and where optimally beneficial.*
Based on work already done in the area, we know that doing this will address some of the target species' critical habitat needs (TBD through wildlife assessment). Relevant biological and human constraints will be addressed in any proposals for ephemeral wetland construction along with metrics for monitoring success (i.e., increases in species richness on a landscape) (See Appendix C).
- *Identifying and enhancing existing and potentially restorable habitat areas through fish and wildlife assessments, whenever possible.*

For portions of the Little Menomonee and Milwaukee Rivers, this process is already underway from a 2011 LMR wildlife habitat assessment and an ongoing MR Greenway assessment.

Terrestrial goal: Improve terrestrial riparian habitat connectivity.

Why is improving terrestrial riparian habitat connectivity necessary to delist the AOC?

In the AOC, urban and suburban land uses fragment the landscape by creating islands or isolated pockets of wetland, woodland, and other natural lands available for wildlife preservation and recreation. One major factor responsible for this decline in diversity is that routes for native plants and wildlife to re-colonize isolated habitat islands are largely cut-off within the fragmented landscapes. Fragmentation of the landscape has resulted in decreased biological diversity, but can be mitigated.

The ability of in-stream and riparian habitat to support wildlife is directly limited by adjacent terrestrial and semi-terrestrial habitat quality, through a variety of connections. These connections include water quality issues (the ability of watershed habitats to filter, absorb, and release rain water and runoff), and wildlife habitat issues related to the biological constraints each species is bound by that cannot be altered. Biological constraints are not "negotiable," being set by evolution and the physical limits of the species (Dodd and Seigel, 1991; Seigel and Dodd, 2000; Dodd, 2001). They include parameters such as the presence of critical habitats like denning sites or nesting areas; the quality of habitats including aquatic, wetland, and terrestrial habitat needs of the species; and minimum viable habitat patch size. Habitats adjacent and/or connected to aquatic or riparian areas are part of the biological constraint of patch size which limits the species supported in the entire habitat area, and restoring losses of wildlife habitat and populations cannot be achieved unless all available connected habitat is considered. According to SEWRPC (2010):

Emerging research has increasingly shown that, in addition to water, more and more species such as amphibians and reptiles cannot persist without landscape connectivity between quality wetland and upland habitats. Good connectivity to upland terrestrial habitats is essential for the persistence of healthy sustainable populations, because these areas provide vital feeding, overwintering, and nesting habitats found nowhere else. Therefore, both aquatic and terrestrial habitats are essential for the preservation of biodiversity and they should ideally be managed together as a unit (p.12).

Habitat patch size and connectivity are important biological constraints on wildlife presence and abundance. Increasing connectivity among quality natural landscapes (wetlands, woodlands, prairies) can benefit biodiversity by providing access to other areas of habitat, increasing gene flow and population viability, enabling recolonization of patches, and providing habitat (Bentrup, 2008 in SEWRPC, 2010, p.12).

In short, larger and more diverse habitats support more species and greater wildlife abundance. The wildlife assessment will determine a balance between available area for habitat restoration and enhancement, and the number of species and species abundance that can be expected to result. A feasible target for species richness and abundance can then be set as a delisting goal, which is acceptable within the social and biological constraints of the system. For example, a 50% increase in amphibian species may be set as a goal, based on an assessment that concludes that creating 20 new vernal ponds and enhancing the habitat around them should achieve this result. Similar goals for increasing mammal, bird and invertebrate populations can be set, with metrics and methods for monitoring to demonstrate success.

What opportunities exist to accomplish this goal?

- *Expand riparian buffer habitat quality and continuity.*

Several partners have lands or other interests that are directly aligned with this goal, where such projects could be potential implemented, including the Milwaukee River Greenway Coalition/River Revitalization Foundation, Urban Ecology Center, Milwaukee County Parks, and MMSD through its Greenseams program.

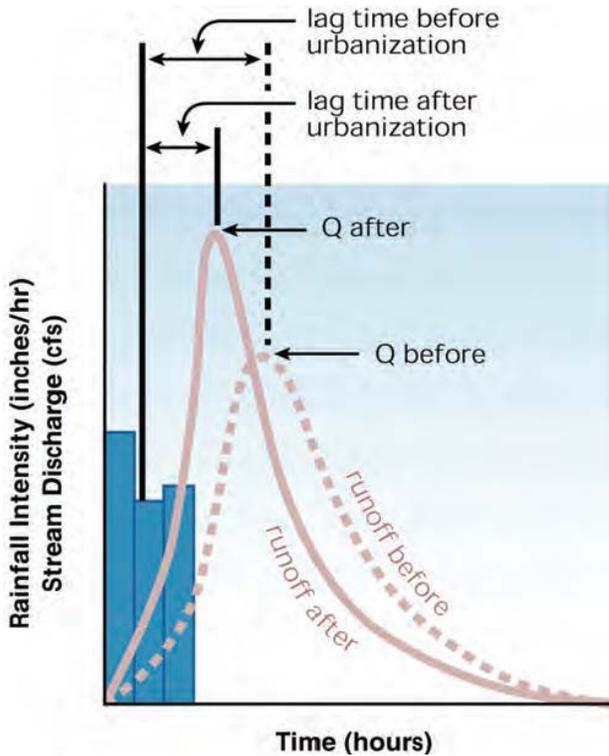


Figure 3. Urbanization and interconnected impervious surfaces result in “flashy” streams, where stream discharge surges relatively quickly after a precipitation event.

Terrestrial goal: Protect high-quality areas or environmentally sensitive lands, especially those supporting rare and protected species.

Why is protecting high-quality areas or environmentally sensitive lands, especially those supporting rare and protected species, necessary to delist the AOC?

High-quality and sensitive lands provide specialized wildlife habitats that support vastly greater species richness. The loss of these specialists was the first extinction cascade in the AOC (Leitner *et al.*, 2008), so that we now see an excess of generalist species. Protecting, restoring and enhancing these habitats is the most productive and efficient way to restore species richness in the AOC. Identifying existing populations of rare and protected species is important and necessary to preventing further losses of species. These species are by definition rare and need to be preserved and enhanced. It is also important to identify their habitats to follow a “first do no harm” paradigm, such that related projects do not further degrade or eliminate these rare populations without appropriate mitigation to prevent losses.

What opportunities exist to accomplish this goal?

Several partners have lands, or other interests, that are directly aligned with this goal, where such projects could be potential implemented, including the Milwaukee River Greenway Coalition, Milwaukee County Parks, and MMSD through its Greenseams program.

Secondary habitat goal explanations

Goal: Moderate flow regimes to decrease flashiness.

Why is moderating flow regimes necessary to delist the AOC?

According to the SEWRPC Memorandum Report No. 194, urbanization itself is not the main factor driving the degradation of the local waterbodies. Streams can survive and flourish in urban settings. The main factors leading to the degradation of urban waterbodies are the creation of large areas of connected impervious surfaces, the lack of adequate stormwater management facilities to control the quantity and quality of runoff, proximity of development to waterbodies, loss of natural areas, and inadequate construction erosion controls. These factors increase the potential for the occurrence of the negative water quality/quantity effects associated with urbanization.

In the absence of mitigating measures, urbanization impacts the watershed, not only by altering the ratio between stormwater runoff and groundwater recharge, but also through the changing of stream hydrology (i.e., increasing stormwater runoff volumes and peak flows and altering the baseflow regime) and through divergence of the seasonal thermal regimes away from their historical patterns (see Figure 3). These changes further influence other characteristics of the stream, such as channel morphology, water quality/quantity, and biological diversity. More specifically, recent research has shown that average flow magnitude, high flow magnitude, high flow event frequency, high flow duration, and rate of change of stream cross-sectional area were the hydrological variables most consistently associated with changes in algal, invertebrate, and fish communities (pp. 9-10).

Location of impervious surfaces also determines the degree of direct impact they will have upon a stream. There is a greater impact from impervious surfaces located closer to a stream, due to the fact that there is less time and distance for the polluted runoff to be naturally treated before entering the stream. A study of 47 watersheds in southeastern Wisconsin found that one acre of impervious surface located near a stream could have the same negative effect on aquatic communities as 10 acres of impervious surface located further away from the stream (p. 15).

Urbanization increases impervious surface, which can lead to an increase in “flashiness” (or the rate at which flow responds to a precipitation event). Such increases in streamflow subsequently affect streambank stability, streambed stability, pollutant loading, and sediment dynamics, which, in turn, affect habitat availability and quality (p. 17).

Goal: Provide and preserve sufficient baseflow.

Why is providing and preserving sufficient baseflow necessary to delist the AOC?

As stated in the SEWRPC Memorandum Report No. 194, in the absence of mitigating measures, one of the consequences of urban development is the increase in the amount of stormwater, which runs off the land, instead of infiltrating into the groundwater. A parking lot or driveway produces much more runoff than an undisturbed meadow or agricultural hay field. Depending on the degree of watershed impervious cover, the annual volume of storm water runoff can increase by up to 16 times that for natural areas. In addition, since impervious cover prevents rainfall from infiltrating into the soil, less flow is available to recharge groundwater. Therefore, during extended periods without rainfall, baseflow levels are often reduced in urban streams. This has been observed to occur in both the Menomonee and Kinnickinnic River watersheds. Furthermore, runoff traveling over a parking lot or driveway will pick up more heavy metals, hydrocarbons, chlorides, bacteria, pathogens, and other stream pollutants than runoff traveling over surfaces that allow some of the stormwater to be filtered or to infiltrate. Runoff traveling over impervious surfaces bypasses the filtering action of the soil particles, soil microbes, and vegetation present above (stems and leaves) and below (roots) the soil surface. For example, MMSD staff observed that total phosphorus and total suspended solids concentrations downstream of stormwater outfalls in the greater Milwaukee River watersheds were significantly higher during the initial first flush of a rainfall event compared to later samples (p. 12).

In the Menomonee River watershed, the highest amount of agricultural and open lands are located in the northern portion of the watershed, and these areas are currently providing the greatest amount of groundwater infiltration, helping to sustain stream baseflows. The developed areas within the watershed are associated with the lowest groundwater recharge potential. Therefore, preservation and, where feasible, expansion of the open space lands including agricultural lands would protect, and perhaps enhance, the groundwater recharge potential within the watershed (p. 24).

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HABITAT PROJECT LIST

Listed below are the projects that will address the Loss of Fish and Wildlife Habitat impairment for the Milwaukee Estuary. As stated earlier, this impairment cannot be removed without addressing contaminated sediments. Additionally, we reserve the right to require additional habitat enhancement/creation actions, pending the results of the fish and wildlife population assessments. Those actions, however, would be necessary for removal of the Degraded Fish and Wildlife Populations impairment.

The “ready to go” list of projects meet both practical and technical aspects of the habitat goals. The technical team identified some other projects that would also address the fish and wildlife habitat impairment, but some of these projects, at this time, have no project implementer, and/or need further design or engineering work so that cost estimates are available. We hope that further funding opportunities are available to help assist in project development.

In 2013, several projects were funded that had to be implemented for BUI removal, including:

- ✧ Wheelhouse Gateway Riparian Restoration- ~\$500,000
- ✧ Removal of Five Low-Flow Barriers on the Menomonee River- ~\$973,527
- ✧ Little Menomonee River Parkway Grassland Restoration (Phases 1 and 2)-\$37,000
- ✧ Menomonee River Concrete Removal (from Wisconsin Ave. to I-94)-\$3,000,000 (project total \$4,900,000)
- ✧ Milwaukee River Fish Habitat Enhancement and Expansion-\$80,000
- ➔ **Total funded for 2013 = \$4,520,000**

A list of habitat projects that are “shovel ready” and should be implemented in 2014, as WDNR and the tech team identified them as being necessary for BUI removal, will be available in early 2014 from Megan O’Shea, Milwaukee Estuary Coordinator.

Known additional projects that are needed to address the BUI regardless of time horizons include:

- ✧ Estabrook Dam Fish Passage-TBD
- ✧ Kletzsch Dam Fish Passage-TBD
- ✧ Burnham Canal Wetland Creation-\$4,500,000
- ✧ Menomonee River Concrete Removal (Phase 2)-\$7,000,000
- ➔ **At this time, total additional funds necessary for these projects are yet to be determined**

Proposed habitat projects that need further discussion by the tech team to determine if they are necessary for BUI removal include:

- ✧ Ulao Creek Fish Passage Restoration
- ✧ Lake Sturgeon Habitat Assessment and/or Enhancement Project
- ✧ Trinity Creek Land Acquisition/Lateral Connectivity/Habitat Improvement (N. Branch)
- ✧ Little Menomonee Creek Lateral Connectivity/Habitat Improvement
- ✧ Grand Trunk Wetland Restoration
- ✧ Little Menomonee River, Little Menomonee Creek, and/or Menomonee River Floodplain Reconnection
- ✧ Soil Remediation/Floodplain Lowering at Former North Ave Dam Impoundment
- ✧ Fish Passage and Habitat Enhancement (aka “Rock Ramps”) at the Former North Avenue Dam Impoundment
- ✧ Removing Fish Passage Barriers in the Menomonee River Watershed
- ✧ Little Menomonee River Linear Connectivity
- ✧ Tributary Stream Linear Connectivity
- ✧ Trinity Creek Lateral Connectivity/Habitat Improvement (S. Branch)

Proposed habitat projects that are beneficial for addressing habitat, but not necessary for removal include:

- ✧ Contaminant studies for Bridge St. and Mequon-Thiensville Dam Impoundments (Assessment Project)
- ✧ Bridge St. Dam Removal/Fish Passage
- ✧ Kinnickinnic River Concrete Removal (Upstream of 6th St.)
- ✧ Concrete Removal on Underwood Creek (Reach 2 Phase 1)
- ✧ Concrete Removal on Underwood Creek (Reach 1, Phase 2)
- ✧ Honey Creek Concrete Removal (Reach 1)
- ✧ Schoonmaker Creek Daylighting

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CONCLUSION

Work is underway in the AOC to help constrain final targets (i.e., project specific targets and target species to rehabilitate) for the fish and wildlife impairments. It should be noted that the causes attributed to the loss of habitat may not be able to be sufficiently addressed by implementing projects only within the original boundaries of the AOC. This is especially true in the case of wildlife, but can also be applied to the availability of aquatic passage to high-quality habitat areas for aquatic and semi-aquatic species. As a rule of thumb, our aquatic habitat goals are consistent with the Southeastern Wisconsin Regional Planning Commission's recommendations to prioritize projects.

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APPENDICES

Appendix A Fish and Wildlife Technical Team Roadmap

Appendix B Goals and Measures of Success for Fish and Wildlife for the Milwaukee Estuary AOC

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Appendix A

Fish and Wildlife Technical Team Roadmap

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Road Map for Developing a Draft Fish and Wildlife Habitat Plan by December 2012

Membership

Members were invited based on their technical expertise on matters related to fish and wildlife issues. Members typically also represent an agency, organization, or program. Others may attend the technical team meetings if they contact the AOC coordinator before a scheduled meeting. The members for the Milwaukee Estuary Fish and Wildlife Technical Team are listed below along with their areas of expertise and/or agency represented.

Brian Russart (Milwaukee County Parks)
Theresa Morgan (River Revitalization Foundation)
Marty Johnson (DNR-Wildlife)
Cheryl Nenn (SWWT Science Committee/Milwaukee Riverkeeper)
Steve Choy (U.S. Fish and Wildlife Service)
Noel Cutright (Birds)
Joanne Kline (DNR-Environmental Analysis/wetlands)
Josh Kapfer (Herptiles)
Dan Sullivan (U.S. Geological Survey/fisheries)
Andrew Struck (Ozaukee County/birds)
Will Wawrzyn (DNR-Fisheries)
John Janssen (UW-M Great Lakes WATER Institute/fisheries)
Chris Magruder (Milwaukee Metropolitan Sewerage District)
Tom Slawski (Southeastern Wisconsin Regional Planning Commission)
Marsha Burzynski (DNR-Water Resources)
John Masterson (DNR-Water Resources)
Andy Fayram (DNR-Office of the Great Lakes)
Ann Brummitt/Gary Casper (Milwaukee Greenway Coalition)

It was originally envisioned that the group would meet approximately quarterly, but the group may decide that they would like to meet more frequently, or more frequently over a certain period of time. Members are charged with reviewing the AOC coordinator's work, and giving input and feedback to help shape a draft plan.

If work is still necessary moving into 2013, members will each have the opportunity to determine whether they wish to continue working on the technical team.

Work Group Charge

Form an ad hoc work group that will assist in the development of a draft fish and wildlife habitat plan that addresses the Milwaukee Estuary AOC delisting targets to have a fish and wildlife plan for the AOC.

What are we trying to accomplish? (Goal)

A strategy that outlines if and what further assessment actions are necessary to define the fish and wildlife impairments, and that outlines the priority actions (i.e., projects) necessary to address the impairments. The group should also decide the appropriate metrics that should be used in order to determine the success of the projects.

Why is it needed? (Objectives)

- To identify which assessments are necessary in order to determine the extent that fish and wildlife populations in the AOC are impaired.
- To provide clarity on the relative priority of potential projects that would be implemented in the AOC.

What should the Fish and Wildlife Plan entail to be effective? (Outcomes)

- Summary of existing biological and habitat data within the AOC and identify what additional monitoring is needed to assess the current conditions.
- Should specify for each potential project who would be responsible for implementing the project.
- Set a clear priority level of which projects must occur for BUI removal (“Tier 1 Projects”), versus projects that are of benefit, but not necessary, for the purposes of BUI removal in the AOC (“Tier 2 Projects”).
- Should assess the potential in and merits of habitat improvement the estuary portion of the AOC compared to the expanded boundaries.
- Should address opportunities for collaboration with partners and citizens to fulfill BUI removal.

What specific elements should the Fish and Wildlife Plan include? (Outputs)

- Inventory of existing monitoring needs, and available resources (staffing, funds, etc). May include a list of past projects and reports.
- Direction for technical teams and clarification of roles and responsibilities of AOC staff.
- A process for setting and ranking project priorities, especially priorities for WDNR staff versus other partners.
- Benchmarks and a process for evaluating success at regular intervals.

Timeline:

The goal is to have developed a draft fish and wildlife plan by the end of 2012.

- Initial contact with potential members to occur in Feb. and March.
- Initial meeting planned for May 2012, with tentative additional meetings held quarterly thereafter.
- Draft fish and wildlife plan completed by Dec. 2012.
- In order to achieve the desired outcomes and goals, we will need to answer the following questions at our meetings:
 - What is the exact boundary of the area that we should focus on?
 - Which assessments are still needed to determine the extent of the impairment?
 - How do we determine our list of projects that must occur?
 - What is the list of projects that must occur in order to remove the fish and wildlife habitat and population impairments?
 - Others?

Appendix B

Goals and Measures of Success for Fish and Wildlife for the Milwaukee Estuary AOC

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Goals and Measures of Success for Fish and Wildlife Habitat for the Milwaukee Estuary AOC

Physical/biological habitat primary goals:

1. Enhance/improve aquatic habitat by...
 - A. Identifying and enhancing fish spawning sites from Lake Michigan to the tributaries and headwaters where opportunities exist (e.g., inner and outer harbors, Milwaukee River downstream of the North Ave. Dam pedestrian bridge), and/or
 - B. Improving lateral connectivity by connecting aquatic habitat to floodplain wetland with suitable hydroperiod from Lake Michigan to the tributaries and headwaters where opportunities exist.

Potential measures of success:

- Amount (length) of habitat protected and/or created
 - Amount (length) connected and functional as fish and aquatic organism habitat
 - Area of adjacent floodplain reconnected for the 2-yr and 5-yr events
 - Area of adjacent wetlands reconnected and/or restored/created
 - Area of adjacent potentially restorable wetlands reconnected, as applicable
 - Number of existing critical habitat areas identified and protected, enhanced, reconnected, or re-created
2. Improve aquatic habitat connectivity by...
 - A. Improving linear connectivity by restoring or enhancing fish and aquatic organism passage from Lake Michigan to the tributaries and headwaters, and/or
 - B. Reconnecting high quality habitat downstream of the Bridge Street Dam and Lepper Dam to the main stem rivers of the AOC in cases where that habitat is directly connected to the estuary (i.e., there are no downstream barriers from the proposed project site).

Potential measures of success:

- Amount (length) of concrete removed
 - Number of impediments removed and/or retrofitted (e.g., bridge crossings or drop structures)
 - Amount of enclosed channel daylighted or retrofitted, number of tributary miles connected to mainstem, or length of stream channel restored
3. Enhance/improve terrestrial, semi-aquatic, and/or riparian habitat by...
 - A. Expanding habitat buffer width to a minimum of 75 feet, and/or
 - B. Where possible, expanding shoreline buffers up to 1,000 feet to meet core habitat area needs for semi-aquatic species

Potential measures of success:

- Length of streams inventoried and area of potential suitable buffer habitat identified
 - Length of streams with suitable buffer habitat width of 75 feet or greater preserved or established
 - Volume of historic fill and/or tons of trash removed from riparian areas
 - Area of native wetland or upland suitable habitat reconstructed
 - Area of Advanced Identification of Wetland Disposal Areas (ADID wetlands), upland within PEC, and/or 100-yr floodplain limits protected
 - Area of exotic invasive species removed
4. Improve terrestrial riparian habitat connectivity by expanding riparian buffer habitat quality and continuity.

Potential measures of success:

- Length of streams of continuous suitable buffer habitat widths of 75 feet or greater preserved or established
 - Number of riparian area crossings and/or impediments removed and/or retrofitted to improve or restore continuity of riparian buffers, including improvements to decrease resistance to animal movements
 - Increase in suitable habitat patch size resulting from new connectivity
5. Protecting high-quality areas or environmentally sensitive lands, especially those supporting rare and protected species.

Potential measures of success:

- Length of streams inventoried and area of potential buffer identified
- Length of streams or area of land protected

Physical/biological habitat secondary goals:

1. Moderate flow regimes to decrease flashiness
2. Provide and preserve sufficient baseflow

Potential measures of success:

- Area of groundwater recharge protected
- Improvement in flashiness index
- Number of flow deflectors installed, pipes cut back from streambank, or land area treated by infiltration practices

Appendix B
Status Updates on Habitat Projects Listed in Table 3 of the 2012 RAP Update

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Status of Projects Listed in the Milwaukee Estuary Remedial Action Plan Update for 2012

FY seeking funds/ funding status	Project name	Landowner/s	Potential implementer/project overseer	Estimated cost	Interim habitat goals project addresses	Potential measure of success
'13 Funding secured	Milwaukee Estuary AOC Wildlife Population Assessment	Milwaukee Co.	TBD	\$305,000	NA (part of populations impairment)	Helps set and assess targets for wildlife populations and ID additional on-the-ground projects necessary to reaching populations targets.
'13 Funding secured	Milwaukee Estuary AOC Fish Population Assessment	N/A	TBD	\$260,000	NA (part of populations impairment)	Helps set and assess targets for fish populations and ID additional on-the-ground projects necessary to reaching populations targets.
'13 Funding secured	Removal of Five Low-Flow Barriers on the Menomonee River	MMSD and Milwaukee Co.	MMSD	\$900,000 (originally listed as \$450,000)	2A	Length of river/stream connected and functional as fish and aquatic organism habitat; number of structures removed/retrofitted
'13 Funding secured	*Little Menomonee Parkway Grassland Restoration (Phase 1)	Milwaukee Co.	Milwaukee Co. Parks	\$37,000	5	Area of native wetland or upland constructed/rehabilitated; stream length of buffer width 75 feet or greater preserved or established
'13 Funding secured	*Wheelhouse Gateway Riparian Restoration	RRF	RRF	\$971,000 (originally listed as \$268,000)	3A, 4	Stream length of continuous buffer widths of 75' or greater preserved or established; area of land protected
'13 Funding secured	Identification and quantification of sanitary sewage contamination in the Milwaukee Estuary Area of Concern (AOC)	N/A	UWM-Great Lakes Water Institute	\$502,226	NA	See proposal in 2012 RAP Update
'14 Funding secured	*Menomonee River Concrete Removal	Milwaukee Co.	MMSD	\$3,000,000	2A	Length of river/stream connected and functional as fish and aquatic organism habitat; stream length of concrete removed
'14 Funding partially secured	Ulao Creek Fish Passage Restoration	Multiple private, with prior agreement	Ozaukee County	\$1,900,000	1B, 3, 4	Length of river/stream functional as fish and aquatic organism habitat
'14 Funding partially secured	*Burnham Canal Wetland Restoration (Phases 1 and 2)	Miller Compressing & City of Milwaukee	MMSD	\$3,200,000	1, 3	Area of native wetland or upland constructed/rehabilitated

Status of Projects Listed in the Milwaukee Estuary Remedial Action Plan Update for 2012

	Project name	Landowner/s	Potential implementer/project overseer	Estimated cost	Interim habitat goals project addresses	Potential measure of success
'14 Funding partially secured	Estabrook Dam Fish Passage	Milwaukee Co.	Milwaukee Co.	TBD	2A	Length of river/stream connected and functional as fish and aquatic organism habitat; stream length of concrete removed; number of structures removed/retrofitted
'14 Funding partially secured	Grand Trunk Wetland Restoration	City/Port of Milwaukee	City of Milwaukee	\$125,000	1A&B, 2A	Number of structures removed/retrofitted; area of native wetland or upland constructed
'14 Seeking funding	Concrete Removal on the Underwood Creek	Milwaukee Co.	MMSD	\$2,000,000	2A	Length of river/stream connected and functional as fish and aquatic organism habitat; stream length of concrete removed
'14 Seeking funding	*KK River Dredging From Becher St. to Chase Ave.	City of Milwaukee	MMSD	TBD	1A&B, 2A	Length of river/stream connected and functional as fish and aquatic organism habitat

* Project also has potential for water quality/contaminant load reduction benefit.

*Phase 1 of 2 for concrete removal; Phase 2 still seeking funds

Appendix C
Education, Information, and Outreach Campaign Tracking

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Milwaukee Estuary AOC

2013 Education, Information & Outreach Campaign

To raise awareness of the projects, messages and actions/cooperation needed associated with the Milwaukee Area of Concern; provide updates that keep the local community of partners, residents, and businesses informed and supportive of projects.

Campaign components shaded purple below are those in which the Delegation is currently involved.						
Media	Target Audience	Messages	Implementer(s)	Collaborators	Funded by	BUI (see footer)
Gateway to Improved Long-term Spawning (GILS)						2, 3, 4
• HUB 3-D Exhibit	Outreach Venue Audiences of conferences, meetings, festivals	Test if Habitat Underwater Baskets provide food and shelter for migrating fish to and from Lake Michigan and survive urban river conditions	Groundwork Milwaukee (GWM)	Marek Landscaping, WDNR, SEWRPC, UWEX, MMSD	GLRI	2, 3, 4
• Two 80-foot floating islands	Researchers, AOC staff and partners, river users	Pilot to test if the islands can provide food and shelter for migrating fish to and from Lake Michigan and survive urban river conditions	GWM	Marek Landscaping, WDNR, SEWRPC, UWEX, MMSD	GLRI and FFLM,	2, 3, 4
• 8 Bi-lingual Interpretive Signs for Gateway to Improved Long-term Spawning project	Boaters, residents, river walk users, tourists, businesses	Habitat Baskets provide food and shelter for migrating fish to and from Lake Michigan	UWEX – signage creation, Installation throughout 2013- Groundwork Milwaukee	Groundwork Milwaukee, Various Project Partners	GWM – GLRI, FFLM, MMSD	2, 3, 4
• Live View Telescope of Habitat Underwater Baskets	Harley Davidson Museum Visitor, Riverwalk users, community, tourists, etc.	HUB & River Critter viewing	Harley Davidson – installed April 2013	Groundwork Milwaukee, GILS Outreach Advisory Team	GWM-GLRI	3, 4

1- Degradation of Benthos; 2- Degradation of Phytoplankton and Zooplankton Populations; 3-Loss of Fish and Wildlife Habitat; 4- Degradation of Fish and Wildlife Populations; 5- Restrictions on Fish and Wildlife Consumption; 6-Restrictions on Dredging; 7-Fish Tumors or Other Deformities; 8-Beach Closings and Recreational Restrictions; 9-Degradation of Aesthetics; 10- Eutrophication or Undesirable Algae; 11-Bird or Animal Deformities or Reproduction Problems

• 10 GILS Presentations	Various meeting & event participants	Background info and status of evaluation of GILS Project	GWM	UWEX & GILS Outreach Advisory Team	GWM-GLRI	2, 3, 4
Interpretive Expeditions: Milwaukee's Magnificent Waters – 46 attendees	General Public & SIG	Awareness of issues on specific reaches of the rivers in the Area of Concern. Messages vary based on the location of the program. Chronicle the Milwaukee Estuary Area of Concern.	Urban Ecology Center, UWEX	UWEX, WDNR	WDNR CAC Capacity 2012 & 2013	General Awareness, 3, 4, 9
AOC Exhibit at Events (Gathering Waters/Urban Island Beach Party, Sturgeon Fest, UEC Fall Festival, John Gurda Lectures)	Event participants	Overview of the Milwaukee Estuary Sediment Cleanups and post-cleanup rehabilitation projects, How YOU can get involved.	UWEX	WDNR, Stakeholder Delegates	UWEX-WDNR	All
Boat Trips with Interpretation (one with historian John Gurda) – 44 attendees	Stakeholder Delegation	Complexity of the AOC Program, History of the AOC, Current Projects and how they address the issues	Urban Ecology Center	UWEX, WDNR	WDNR CAC Capacity 2012 Grant	All – focus on 3 & 9
Baseline Habitat Assessment Workshop – 10 attendees	Stakeholder Delegation	How to perform a baseline assessment as part of habitat restoration projects.	Urban Ecology Center, Partners	UWEX, WDNR, City of Milwaukee, UWM School of Freshwater Sciences	WDNR CAC Capacity 2012 Grant	3, 4
Stakeholder Delegation Meetings	Key Stakeholders Identified	Review and act as a sounding board for UWEX NRE as key outreach mechanisms & audiences are identified and developed	UWEX	WDNR	UWEX-GLRI	All

1- Degradation of Benthos; 2- Degradation of Phytoplankton and Zooplankton Populations; 3-Loss of Fish and Wildlife Habitat; 4- Degradation of Fish and Wildlife Populations; 5- Restrictions on Fish and Wildlife Consumption; 6-Restrictions on Dredging; 7-Fish Tumors or Other Deformities; 8-Beach Closings and Recreational Restrictions; 9-Degradation of Aesthetics; 10- Eutrophication or Undesirable Algae; 11-Bird or Animal Deformities or Reproduction Problems

Quarterly newsletters (July, Oct, Jan, Apr)	SIG, Tech Team, Sweet Water Partners, general public, residents, river businesses, project partners	1 page (or more) of Project updates and news, Education opportunities	Sweet Water, UWEX	UWEX, WDNR, Sweet Water, Various Partners	UWEX-WDNR	General Updates
Milwaukee Estuary AOC web page & Facebook	SIG, Tech Team general public, residents, river businesses, tourists, project partners	Milwaukee Estuary AOC info, status and events	UWEX	WDNR	UWEX-GLRI	All
Milwaukee River Clean-ups	General Public, residents & SIG	Importance of stakeholders to river health and upkeep; Tie to aesthetics problem/public perceptions	UEC	UWEX	WDNR CAC Capacity 2012 Grant 2013 Grant	9
Stakeholder Delegation Business Cards	General Public, residents & SIG	Contact information for learning more or getting involved – for Delegates to have when acting as an outreach liaison to the public and other audiences.	UWEX	Stakeholder Delegation	UWEX-GLRI	General Awareness
Restoration Report for the Milwaukee Estuary AOC	EPA, Agencies, AOC staff and stakeholders in Wisconsin and Great Lakes	Basic Information on the AOC and the impact to the community.	UWEX, WDNR	Stakeholder Delegation	UWEX-GLRI	All
Milwaukee Estuary Area of Concern Video	All	Importance of restoration efforts in the Milwaukee Estuary AOC – History, effects of contaminants on recreation, history of recreation on the rivers,	WDNR	UWEX, UEC, Paul Davis Restoration	WDNR-GLRI	1, 3, 4, 5, 8
Data Information System Development	Various: EPA, WDNR, AOC Project Partners,	Tracking & reporting progress of AOC projects and movement towards BUI	UWEX, WDNR- OGL	AOC Coordinators in Milwaukee and	UWEX-GLRI, EPA, WDNR- GLRI	All

1- Degradation of Benthos; 2- Degradation of Phytoplankton and Zooplankton Populations; 3-Loss of Fish and Wildlife Habitat; 4- Degradation of Fish and Wildlife Populations; 5- Restrictions on Fish and Wildlife Consumption; 6-Restrictions on Dredging; 7-Fish Tumors or Other Deformities; 8-Beach Closings and Recreational Restrictions; 9-Degradation of Aesthetics; 10- Eutrophication or Undesirable Algae; 11-Bird or Animal Deformities or Reproduction Problems

	Sweet Water, UWEX, Tech Team, Delegation, SIG, Community Stakeholders	removal and AOC delisting at various levels of detail and complexity		Menominee, EPA, ECT, Inc.		
Paws Pledge Committee Outreach efforts (Dogipots installed in Milwaukee County Parks within the AOC, Logo Creation, Dogbone Bag Holders, Brochure, Milwaukee Journal Sentinel paper bags with message)	Milwaukee County Park Users, Dog Owners in Milwaukee County Parks and other municipalities within the AoC, Pet Fair participants, Sweet Water Partners	Dog waste contributes to harmful bacteria in our rivers and Lake Michigan, Pet Owners have a responsibility to pick up after pets and can make a collective difference in water quality improvements; Municipalities, Parks, and other Partners can collectively assist in addressing bacteria issues in the rivers and the estuary	Sweet Water Paws Pledge Committee – Muni’s, UWEX, SWWT, Veterinarians, Waukesha County Humane Society	UWEX, County Parks, Municipalities in the Area of Concern (expanded area)	Sweet Water, Municipalities, UWEX Publications Unit	8, 9, 10
Miscellaneous Take-Aways (lanyards, magnets)	Event (Festivals, state fair, Pet Fairs, etc.) & Meeting participants, general stakeholders	Contact information about the Great Lakes Explore & Restore Areas of Concern Program	UWEX	WDNR, Tech Team, Delegation, Misc. Partners	UWEX-GLRI	General Awareness
Dredging benefits video	all	Benefits of contaminated sediment removal – quality of life, boost to the economy	II-SG, UW-SG	UWEX, Paul Davis Restoration, Pier Milwaukee, Horny Goat	IISG	1, 5, 9
Lincoln Park Open House/Public Meeting	Boaters, businesses, municipal officials, Park visitors, etc...	Project updates and logistics	EPA Contractor	City, County, WDNR, EPA, UWEX, IISG	Dredging and habitat contractors, GLLA	1, 5, 9
Lincoln Park	General public	Dredging and habitat project	IISG, UWEX	EPA, WDNR,	IISG	1, 5, 9

1- Degradation of Benthos; 2- Degradation of Phytoplankton and Zooplankton Populations; 3-Loss of Fish and Wildlife Habitat; 4- Degradation of Fish and Wildlife Populations; 5- Restrictions on Fish and Wildlife Consumption; 6-Restrictions on Dredging; 7-Fish Tumors or Other Deformities; 8-Beach Closings and Recreational Restrictions; 9-Degradation of Aesthetics; 10- Eutrophication or Undesirable Algae; 11-Bird or Animal Deformities or Reproduction Problems

Frequently Asked Questions brochure		info		UWEX, City, county		
River Ambassador Program – 15 different venues	Varies depending on site location / venue	What YOU can do to protect and keep our waterways clean.	Groundwork Milwaukee	AGL, UWEX, UEC	WDNR CAC Capacity 2013 Grant	
Citizen Aesthetics (River and Beach) Monitoring Program	Citizen Volunteers DNR, Technical Team, Outreach Partners	Aesthetics data collected that will guide remedial actions needed for BUI removal.	River – UEC Beach – AGL	WDNR, UWEX	WDNR CAC Capacity 2013 Grant	9
Built on Water: Milwaukee’s Vital Resource Lecture Series – 1000 attendees	General Public	History of Milwaukee – a city built on water – and how the AOC Program fits into the history.	John Gurda, UWEX	WDNR, Delegation, volunteers and sponsoring venues	WDNR CAC Capacity 2013 Grant	General Awareness
Lecture Promotion: Explore & Restore Brochure	General Public	Get informed, inspired and involved – highlighting various opportunities for the public.	UWEX	Delegation	UWEX-GLRI	General Awareness
Misc Video Projects with Art Institute of Wisconsin (AIW)	Delegation, General Public, Agency supporters	Wetland baseline assessment; John Gurda Lecture	UWEX, AIW	WDNR, UEC, John Gurda	AIW In-kind	3, 8,

1- Degradation of Benthos; 2- Degradation of Phytoplankton and Zooplankton Populations; 3-Loss of Fish and Wildlife Habitat; 4- Degradation of Fish and Wildlife Populations; 5- Restrictions on Fish and Wildlife Consumption; 6-Restrictions on Dredging; 7-Fish Tumors or Other Deformities; 8-Beach Closings and Recreational Restrictions; 9-Degradation of Aesthetics; 10- Eutrophication or Undesirable Algae; 11-Bird or Animal Deformities or Reproduction Problems

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Appendix D

AOC Tracking Matrix

Note that projects listed in the table below are the next clearly delineated action steps that have been identified by WDNR in collaboration with AOC partners and stakeholders to make progress toward delisting the AOC. This list does not necessarily reflect all actions that will ultimately be needed to remove impairments.

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Milwaukee Estuary AOC Tracking Matrix

Project Title/Name	BUI Addressed	Project/Action Type	Project Status	Project Start Date*	Project End Date*	Project Cost	Primary Funding Source	Project Lead Organization
Milwaukee Estuary Wildlife Consumption Advisory Evaluation	Restrictions on Fish and Wildlife Consumption	Assessment	In Progress	June 2013	June 2016	\$185,000	State GLRI non-competitive Grant	WDNR
Wildlife Population Assessment	Degraded Fish and Wildlife Populations	Assessment	In Progress	May 2014 (e)	August 2017 (e)	\$305,000	State GLRI non-competitive Grant	WDNR
Fish Population Assessment	Degraded Fish and Wildlife Populations	Assessment	In Progress	April 2014	August 2016 (e)	\$262,000	State GLRI non-competitive Grant	WDNR
Milwaukee Estuary Fish Tumor Evaluation	Fish Tumors or Other Deformities	Assessment	In Progress	May 2013	April 2015	\$170,400	State GLRI non-competitive Grant	WDNR
Solvay Coke Superfund Alternative Remediation	Restrictions on Dredging Activities	Sediment Remediation	In Development	Unknown	Unknown	Unknown	Responsible Party	USEPA
Sediment cleanup in area across from Solvay Coke site	Restrictions on Dredging Activities	Sediment Remediation	Not Started	Unknown	Unknown	Unknown	Great Lakes Legacy Act	USEPA
Assess Menomonee River downstream of its confluence with the Little Menomonee River	Restrictions on Dredging Activities	Baseline Assessment	Not Started	Unknown	Unknown	Unknown	Great Lakes Legacy Act	USEPA
Cedar Creek Superfund Alternative Remediation	Restrictions on Dredging Activities	Sediment Remediation	In Development	May 2015 (e)	Unknown	Unknown	Superfund	USEPA
Lincoln Park/Milwaukee River Channels Remediation-Phase 1	Restrictions on Dredging Activities	Sediment Remediation	Completed	May 2012	December 2012	Unknown	Great Lakes Legacy Act	USEPA
Lincoln Park/Milwaukee River Channels Remediation-Phase 2	Restrictions on Dredging Activities	Sediment Remediation	In Development	May 2014 (e)	December 2014 (e)	Unknown	Great Lakes Legacy Act	USEPA
Burnham Canal Superfund Alternative Remediation	Restrictions on Dredging Activities	Sediment Remediation	In Development	Unknown	Unknown	Unknown	Responsible Party	USEPA
Assess the Milwaukee River downstream of its confluence with Cedar Creek to the Milwaukee River Channels/Lincoln Park Great Lakes Legacy Act projects	Restrictions on Dredging Activities	Assessment	Not Started	Unknown	Unknown	Unknown	Great Lakes Legacy Act	USEPA

Project Title/Name	BUI Addressed	Project/Action Type	Project Status	Project Start Date*	Project End Date*	Project Cost	Primary Funding Source	Project Lead Organization
Identification and Quantification of Sanitary Sewage Contamination in the Milwaukee Estuary Area of Concern	Beach Closings/Recreational Restrictions	Assessment	In Progress	January 2014	December 2015	\$502,000	State GLRI non-competitive Grant	UW-Milwaukee
Estabrook Dam Fish Passage	Loss of Fish and Wildlife Habitat	Habitat Improvement	Ready for Funding	Unknown	Unknown	Unknown	TBD	Milwaukee County
Menomonee River Concrete Removal 1-94 to Wisconsin Avenue	Loss of Fish and Wildlife Habitat	Habitat Improvement	Ready for Funding	Unknown	Unknown	\$2,500,000	TBD	MMSD
Burnham Canal Wetland Restoration	Loss of Fish and Wildlife Habitat	Habitat Improvement	Ready for Funding	Unknown	Unknown	\$4,500,000	TBD	MMSD
KK River Dredging from Becher St to Chase Ave	Loss of Fish and Wildlife Habitat	Habitat Improvement	Ready for Funding	Unknown	Unknown	Unknown	TBD	MMSD
Wheelhouse Gateway Riparian Restoration	Loss of Fish and Wildlife Habitat	Habitat Improvement	In Progress	October 2013	October 2014	\$971,000	EPA GLRI Competitive Grant	River Revitalization Foundation
Milwaukee River Fish Habitat Enhancement and Expansion	Loss of Fish and Wildlife Habitat	Habitat Improvement	In Progress	Unknown	Unknown	\$80,000	Fund for Lake Michigan	WDNR
Kletsch Dam Fish Passage	Loss of Fish and Wildlife Habitat	Habitat Improvement	Not Started	Unknown	Unknown	Unknown	Unknown	Milwaukee County
Removal of Five Low Flow Barriers on the Menomonee River	Loss of Fish and Wildlife Habitat	Habitat Improvement	In Progress	May 2014 (e)	Unknown	\$973,527	Other GLRI Competitive Grant	MMSD
Volunteer Aesthetics Monitoring Program	Degradation of Aesthetics	Assessment	In Progress	March 2012	Unknown	\$50,000 (e)	State GLRI non-competitive Grant	WDNR

* (e) indicates a start or end date that is estimated based on current information. Other project start and end dates are the actual dates.