

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY GREAT LAKES NATIONAL PROGRAM OFFICE 77 WEST JACKSON BOULEVARD CHICAGO, IL 60604-3590

Ms. Rebecca Fedak, Acting Director Office of Great Waters - Great Lakes and Mississippi River Wisconsin Department of Natural Resources

Dear Ms. Fedak:

Thank you for your letter dated January 24, 2023, requesting approval of the final management action list for the Degradation of Fish and Wildlife Populations Beneficial Use Impairment (BUI) in the Milwaukee Estuary Area of Concern (AOC).

We acknowledge and appreciate the work and the concerted efforts of the Milwaukee Estuary AOC Fish and Wildlife Technical Advisory Committee; the implementing entities including the Wisconsin Department of Natural Resources (DNR), Milwaukee County Parks, and the Milwaukee Metropolitan Sewerage District; and the Community Advisory Committee and other stakeholders.

EPA has reviewed your request and agrees that the proposed management action list reflects the complete list of projects needed to remove this BUI.

Thank you very much for the dedication and hard work that the Wisconsin DNR, in conjunction with its partner agencies and organizations, have invested in this AOC. We are eager to continue working with the Wisconsin DNR and all the Milwaukee Estuary AOC partners to achieve our mutual goal of completing these final agreed-upon and approved management actions, pending the availability of funds.

Should you have any questions feel free to contact Megan O'Brien, (312) 353-3167 or obrien.megan@epa.gov; or Kate Stephens, (312) 353-0201 or stephens.kathereine@epa.gov.

Sincerely,

KORLESKI

Digitally signed by CHRISTOPHER CHRISTOPHER KORLESKI Date: 2023.03.22 12:01:07 -05'00'

Chris Korleski, Director Great Lakes National Program Office

Kendra Axness, WDNR cc: Brennan Dow, WDNR

Rebecca Fedak, WDNR Rae-Ann Eifert, WDNR Madeline MaGee, WDNR Lainet Garcia-Rivera, USFWS

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January 24, 2023

Mr. Chris Korleski, Director Great Lakes National Program Office U.S. Environmental Protection Agency, Region 5 77 West Jackson Boulevard Chicago IL 60604

Subject: Management Action List for the Degradation of Fish and Wildlife Populations Beneficial Use Impairment in the Milwaukee Estuary Area of Concern

Dear Mr. Korleski:

This letter serves to document the Milwaukee Estuary Area of Concern (AOC) management action list for the Degradation of Fish and Wildlife Populations beneficial use impairment (BUI).

This Wisconsin Department of Natural Resources (DNR) convenes the Milwaukee Estuary AOC Fish and Wildlife Technical Advisory Committee (Tech Team) for addressing fish and wildlife impairments in the AOC. Each of the-management actions were evaluated by the Tech Team in a collaborative four-year long process starting in 2018. The Tech Team is comprised of roughly 30 professionals with fish and wildlife expertise that represent more than 20 state, federal, regional, local, private, and non-governmental organizations. The DNR and U.S. Environmental Protection Agency Great Lakes National Program Office (GLNPO) worked with the Tech Team to identify a final set of actions that would address the removal target and populations metrics. As a result, the Tech Team recommended target and metric revisions, adopted in 2020 and 2022 respectively, to ensure they are measurable and feasible within the AOC Program framework. The Tech Team also completed a detailed status check of this BUI in 2022 and identified how these metrics would be measured as part of a future verification effort post-implementation. With the successful implementation of the following projects and when post-implementation monitoring has confirmed that BUI removal criteria have been met, the State of Wisconsin determines that all known management actions will be completed for the Degradation of Fish and Wildlife Populations BUI:

- Project 1A: City of Mequon Enhancements
- Project 1B: Ozaukee Washington Land Trust Ville du Parc Property Enhancements
- Project 2: Milwaukee River Greenway Parks Enhancements
- Project 3: Estabrook Falls Fish Passage
- Project 4: North Avenue Fish Passage
- Project 5: Havenwoods State Forest Rehabilitation
- Project 6A: Milwaukee County Grounds, Menomonee River Parkway Section 9, and Hoyt Park Wildlife Enhancements
- Project 6B: MMSD Basins Wildlife Enhancements
- Project 7: Kletzsch Park Wildlife Enhancements
- Project 8: Schlitz Audubon Cleaver Property Enhancements
- Project 9: Menomonee River Parkway Sections 5 and 6 Enhancements
- Project 10: Currie Park Fish Passage Improvements
- Project 11: Menomonee River N 16th to N 25th Street Fisheries Improvements



- Project 12: Little Menomonee River Parkway Section 1 Fish and Wildlife Enhancements
- Project 13: Kohl Park Wildlife Enhancements
- Project 14: Lincoln Park Oxbow Fisheries Improvements
- Project 15: Outer Harbor (Summerfest Lagoon) Aquatic Enhancements

Project 16: Milwaukee River Downtown – E Cherry Street to N Humboldt Avenue Fisheries Improvements

This management action list represents projects for which planning and design activities have started and are currently expected to be complete within the goal for all management actions to be completed by 2030. The scope of management actions on this list may be modified or reduced if feasibility concerns are identified through additional phases of each project. Additional details about these projects are provided as a management action list attachment to this letter. The attachment includes the following information:

- Map Showing Project Locations
- Project Titles and Descriptions
- Lead Implementing Agency/Organizations
- Estimated Costs
- Estimated Status and Timeline for Implementation
- Individual Project Maps
- Project Elements/Contribution to Removal Criteria
- Finalized April 2020 Target
- Milwaukee Populations Pre-Project Implementation Status According to the Metrics

We look forward to your continued support and collaboration in carrying out the identified management actions. If you have any questions about the management actions, verification monitoring, or BUI removal target, please contact Brennan Dow, Milwaukee Estuary AOC Coordinator, at (920) 366-1371; Rae-Ann Eifert, Lake Michigan Sediment and Monitoring Coordinator, at (414) 531-0129; or you may contact me.

Sincerely,

Rebecca Fedak, Lake Michigan Basin Supervisor Acting Director Office of Great Waters – *Great Lakes and Mississippi River* Wisconsin Department of Natural Resources

Cc: Kendra Axness, WDNR Brennan Dow, WDNR Rebecca Fedak, WDNR Rae-Ann Eifert, WDNR Madeline Magee, WDNR Todd Nettesheim, USEPA Megan O'Brien, USEPA Amy Pelka, USEPA Lainet Garcia-Rivera, USFWS

ATTACHMENT A: Milwaukee Estuary Area of Concern Management Action List for the Degradation of Fish and Wildlife Populations

Milwaukee Estuary Area of Concern Management Action List

Degradation of Fish and Wildlife Populations



January 2023

Written and compiled by:

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Input and contributions from:

Rae-Ann Eifert, DNR

Lake Michigan Sediment and Monitoring Coordinator Milwaukee Estuary AOC Fish and Wildlife Technical Advisory Committee



Photo Credit UW-Milwaukee

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Milwaukee Estuary Area of Concern – Final Management Actions for the Degradation of Fish and Wildlife Populations BUI

1. Introduction

This document provides details of the management actions designed to address the Degradation of Fish and Wildlife Populations Beneficial Use Impairment (BUI) in the Milwaukee Estuary Area of Concern (AOC). The information in this document demonstrates that the identified management actions are feasible, realistic, and will directly support achievement of the criteria set forth in the BUI removal target (Section 2) and metrics (Section 4). More information regarding the wildlife populations' metrics before remediation and project implementation can be found in the report *Milwaukee Populations Pre-Project Implementation Status According to the Metrics*, Appendix A (Eifert, 2022).

The information provided herein demonstrates that the identified management actions will be directly in support of achieving the BUI removal target and affirms that these actions represent the body of work that is necessary to achieve the target. This action list serves as the "roadmap" for federal, state, and local partners to follow from implementation through BUI removal, and supports planning and monitoring during post-implementation verification.



Figure 1. Milwaukee Estuary Area of Concern Population Projects.

Table 1. Estimated Project Costs for the Degradation of Fish and Wildlife Population BUI Management Action List

Project Lead Organization Approximate Total Cos							
Рорі	Population Projects						
1A	City of Mequon Parks Enhancements	City of Mequon	\$1,825,000				
1B	Ozaukee Washington Land Trust (OWLT) Ville du Parc Property Enhancements	Ozaukee Washington Land Trust	\$400,000				
2	Milwaukee River Greenway Parks Enhancements st	Milwaukee County Parks	\$2,300,000				
3	Estabrook Falls Fish Passage ST	MMSD	\$1,790,000				
4	North Avenue Fish Passage st	MMSD	\$6,500,000				
5	Havenwoods State Forest Rehabilitation st	Wisconsin DNR	\$2,380,000				
6A	Milwaukee County Grounds, Menomonee River Parkway Section 9, and Hoyt Park Wildlife Enhancements	Milwaukee County Parks	\$1,050,000				
6B	MMSD Basins Wildlife Enhancements	MMSD	\$1,950,000				
7	Kletzsch Park Wildlife Enhancements	Milwaukee County Parks	\$1,100,000				
8	Schlitz Audubon Cleaver Property Enhancements	Schlitz Audubon	\$1,000,000				
9	Menomonee River Parkway – Sections 5 and 6 Enhancements	Milwaukee County Parks	\$3,250,000				
10	Currie Park Fish Passage Improvements	Wisconsin DNR	\$80,000				
11	Menomonee River – N 16 th to N 25 th Street Fisheries Improvements	MMSD	\$4,550,000				
12	Little Menomonee River Parkway – Section 1 - Fish and Wildlife Enhancements st	Milwaukee County Parks	\$6,240,000				
13	Kohl Park Wildlife Enhancements	Milwaukee County Parks	\$2,400,000				
14	Lincoln Park Oxbow Fisheries Improvements ST	MMSD	\$6,000,000				
		Sub-Total	\$42,815,000				
Pop	Population Projects Under Great Lakes Legacy Act PA550892 Habitat Components						
2	Milwaukee River Greenway Parks Enhancements (Floodplains)* ST	U.S. EPA GLNPO	\$600,000				
15	Outer Harbor (Summerfest Lagoon) Aquatic Enhancements* ST	U.S. EPA GLNPO	\$1,600,000				
16	Milwaukee River Downtown – E Cherry Street to N Humboldt Avenue Fisheries Improvements ^{*ST}	U.S. EPA GLNPO	\$4,500,000				
		Sub-Total	\$6,700,000				
	Total \$49,515,000						

*Project cost shared as part of the GLLA Amendment No. 1 to PA550892. These estimates are conceptual.

STProjects that are underway and have received initial funding. Project phases that are completed or underway are listed in each individual project section.

2. Target

The removal target that was finalized in April 2020 is listed below. A detailed Populationsto-Metrics Management Action Matrix was created to indicate how each of the 16 projects will contribute to BUI removal. The matrix can be found in Section 9 of the document.

Target (Updated 2020); Metrics (Updated 2022)	Status
Removal of the Degradation of Fish and Wildlife Populations BUI can occur when:	
 Contaminated sediment sites within the AOC have been identified, and implementation actions to remediate contaminated sites have been completed. 	In Progress & Action Needed
 All management actions/projects have been identified and implemented. 	Action Needed
 Post-implementation verification monitoring of the AOC shows that, in consultation with the Fish and Wildlife Tech Team, the Wisconsin DNR concurs that the goals for this BUI, as identified in the updated RAP to reflect current conditions, have been met. 	Future Assessment Needed

NOTE: Metrics for BUI removal were most recently updated in 2022. Detailed metrics are reflected in Section 4 and will be placed in future Milwaukee Estuary AOC Remedial Action Plan (RAP) Updates.

3. Project Overviews

This section provides a summary of each management action (project), including estimated project length, lead organization, estimated total cost, and a map of project location. Timeline and costs are subject to change as some management actions have not yet been started. This section also indicates how each management action relates to the fish and wildlife populations metrics.

Each project was evaluated by the Milwaukee Fish and Wildlife Technical Advisory Committee (Tech Team) in a collaborative four-year long process starting in 2018. The Milwaukee Tech Team is comprised of roughly 30 professionals with fish and wildlife expertise that are familiar with the Milwaukee Estuary AOC and its surroundings. See Section 6 for the complete list of organizations.

Four assessments were funded and completed between 2014 and 2018 to determine the status of the Degradation of Fish and Wildlife Populations BUI.

- U.S. Geological Survey (USGS) and Wisconsin Department of Natural Resources (DNR) completed a fish population assessment summary of historic densities and life history for the AOC in 2014 (Sullivan and Fayram, 2014). Based on this summary, USGS conducted a non-wadeable fisheries population assessment (replicate of Holey 1984) from 2014-2016 (Sullivan, 2018).
- University of Wisconsin (UWM) Field Station completed a wildlife population assessment summary of historic densities and life history for the AOC. Based on this summary, UWM Field Station and Milwaukee County Parks (MCP) conducted a comprehensive wildlife survey throughout the AOC from 2014-2017 (Casper and Robson, 2018).
- Ozaukee County Planning and Parks (OCPP) conducted a fisheries and aquatic habitat study in the wadeable portions of the AOC from 2016-2018 (Struck *et al.*, 2018).
- UWM School of Freshwater Sciences (SFS) assessed fish habitat in the Lower Milwaukee Estuary from 2015-2018 (Dow, 2018).

Results from the assessments provided information for determining the status of this BUI. Starting in 2018, the Tech Team went through a process for revising the many metrics that were generated from the four AOC-wide assessments. Through a collaborative process, the Tech Team refined the fish and wildlife populations metrics multiple times over the course of four years and reduced the number of metrics needed for BUI removal from 93 to 18 (11 wildlife¹ and 7 fish²). These fish and wildlife populations metrics were re-evaluated in 2022 to better document the status of the metrics, and to further define a "site" and what it means to support the various focal species. Details of these metrics are provided in Appendix A: *Milwaukee Populations Pre-Project Implementation Status According to the Metrics* (Eifert, 2022).

To draft a list of management actions, recommendations from assessments and project opportunities provided by Tech Team members were combined to develop a list of projects in the AOC to address this

¹ Eleven primary wildlife population metrics are needed for BUI removal. A few species groups have subset metrics to ensure a diverse population is established within the AOC. See Section 4 and Appendix A for further information. ² Feasibility of fish population metrics were increased. Native species (lake sturgeon and northern pike) are not required to show signs of natural reproduction in the AOC, but rather expressing spawning behavior and using habitats for reproduction. Population abundance criteria for select lower estuary fishes was reduced from a 100%

increase to an increase of any magnitude. See Section 4 and Appendix A for further information.

BUI. A total of 120 project opportunities were identified in five geographical sub-areas of the AOC. These projects were initially given a low, medium, or high priority ranking on overall importance. This narrowed the list down to 34 high priority projects. Projects were then paired with the revised list of 18 metrics, to finalize a list of 16 projects necessary to address the Degradation of Fish and Wildlife Populations BUI.³ More details about the decision process and initial, full project summaries can be found in the 2018-2019 RAP (DNR, 2020). Additional information including project prioritization and selection spreadsheets, project score cards, and other details from the project determination process are available upon request from the Milwaukee Estuary AOC Coordinator.

Since the proposed list of management actions were drafted in 2019, management actions were better defined as some projects entered the early stages of planning and design. After the fish and wildlife populations metrics revision process in 2022, more specific goals for each individual project was established. For example, initial stages of the "Aquatic Enhancements to the Outer Harbor – Art Museum" proposed management action was funded by the U.S. Environmental Protection Agency (U.S. EPA) Great Lakes National Program Office (GLNPO) through an Interagency Agreement (USEPA DW-096-95968901-0) with the U.S. Army Corps of Engineers (USACE) to complete pre-design investigations and conceptual design recommendations. Preliminary results from this work determined that the proposed management action was too costly for the benefits that it would provide to achieve lower estuary AOC fish metrics. This proposed management action was removed from the Management Action List (MAL) and will remain a project to be implemented outside the AOC program. Secondly, a fish passage study was funded through a Great Lakes Restoration Initiative (GLRI) Grant (GL00E02288) to evaluate the extent to which two reaches in the lower portion of the Milwaukee River are limiting native fish passage, particularly large fish that are relatively poor swimmers. This fish passage study was completed in 2022 and showed that one of the two areas of the Milwaukee River likely is a barrier to native fish passage during a range of migration season flow conditions (MMSD, 2022). Therefore, a new management action labeled "North Avenue Fish Passage" was added to the MAL.

³ 15 management actions were initially proposed in 2019 with 21 metrics for BUI removal.

3.1 Project 1A: City of Mequon Enhancements and Project 1B: Ozaukee Washington Land Trust (OWLT) Ville du Parc Enhancements

3.1.1 City of Mequon

The project setting is along approximately 3 miles of the Milwaukee River, between the Thiensville dam and Highland Road in the City of Mequon. The project is comprised of six (6) properties, totaling 218 acres, owned by the City of Mequon which are part of their Park and Open Space system. The properties are Riverview Park, Villa Grove Park, Scout Park, River Forest Nature Preserve, Shoreland Nature Preserve, and Willow Bay Nature Preserve (Figure 2).

The City of Mequon parks and nature preserves along the Milwaukee River are within a primary environmental corridor in the Milwaukee Estuary AOC. Historically this stretch of the river was a large riverine forest, bog and wetland that provided a rich source of fish and game. In 1842, the early European settlers built a dam to provide hydropower for a grist mill. The 6.5-foot high dam forms a 700-acre impoundment, the largest in Ozaukee County. The construction of the dam blocked fish passage preventing migratory species from reaching riverine habitat above the dam. In 2011, the DNR, U.S. Fish and Wildlife Service (USFWS), the City of Mequon, and the Village of Thiensville partnered with Ozaukee County to construct a nature-like fishway in the abandoned millrace adjacent to the dam. The functioning fishway has opened miles of the river, hundreds of acres of wetlands and miles of tributary streams for restoring fish passage to aquatic habitat and areas for natural reproduction of numerous critical native fish species. Enhancements to the parks and preserves just upstream of the Thiensville impoundment allows for much needed upland/shoreline enhancements to provide better habitat for fish and wildlife. Invasive plant species are threatening the diversity of these parks and nature preserves. This reach on the Milwaukee River provides important floodplain areas, riverine forest, wetlands, shrubland, and aquatic habitat for many focal species in the Milwaukee Estuary AOC.

3.1.2 Ozaukee Washington Land Trust

Ozaukee Washington Land Trust (OWLT) Ville du Parc (VdP) property is adjacent to the City of Mequon preserves and serves as an important connection to the entire corridor (Figure 2). This 19-acre property is owned by OWLT and was designated by the Southeastern Wisconsin Regional Planning Commission (SEWRPC) as an Aquatic Area of Local Significance (AQ-3). The property was last surveyed in 1996 for vegetation, which showed a variety of grassland and wetland habitat types, including 10-acres of shallow marsh, southern sedge meadow, disturbed wet meadow, shrub-carr and southern wet-mesic lowland hardwood.

Some issues impacting health of the property include the abundance of non-native and invasive species and their negative impact on the habitat supporting wildlife populations. Other issues include historical logging of the property leading to degraded natural communities and opportunities for invasive species to become well established. Logging activities have also degraded semi-aquatic habitat and hydric soils on the property, leading to the need to restore and enhance wetland habitat for breeding birds and semi-aquatic focal species.

This project provides important habitat for breeding and migratory birds associated with forest and wetland habitat. This project area also supports a wide variety of focal mammal species, which is unique for the Milwaukee Estuary AOC.

Enhancements to both of these projects areas that will benefit fish and wildlife populations include removal of invasive species and replacing with fruit- and/or nut-bearing shrubs, floodplain forest stand improvements due to loss of ash trees, preservation and enhancements to ephemeral wetlands, maintenance of aquatic buffer zones, and shoreline and connectivity enhancements to provide higher quality fish habitat.

<u>Lead Implementing Agency/Organization:</u> City of Mequon and Ozaukee Washington Land Trust NOTE: City of Mequon and OWLT will be both hiring an oversight consultant to assist with managing the phases of these projects. Therefore, the cost estimates for the initial phases of these projects are higher than one would expect for the initial stages of a project.

Estimated Cost and Timeline (calendar year):

Project Phase	City of Mequon	OWLT	Timeline
Planning/Investigation	\$250,000	\$85,000	2 years
Design/Permitting	\$275,000	\$65,000	1.5 years
Implementation/Construction	\$1,200,000	\$200,000	3 years
Reporting/Maintenance/Establishment	\$100,000	\$50,000	2-3 years
TOTAL	\$1,825,000	\$400,000	

NOTE: The Planning/Investigation phase of the OWLT project includes some additional wildlife baseline survey work. Both organizations also plan to use some type of oversight consultant for each phase, providing project management and administrative assistance. Therefore, the project costs for each phase are higher than normally expected.

Project Elements/Contribution to Removal Criteria – see Sections 4.2 and 9 for more details:

- Currently, two sites are meeting the crayfish metric at this project location
- Anticipated to contain at least one site supporting forest breeding bird, wetland breeding bird, turtle, and mammal focal species populations (sites for the focal species groups do not need to overlap)
- Anticipated to support snake species populations at two sites
- Increases the warmwater river IBI for fishes
- Improves important nursery habitat for lake sturgeon



Figure 2. City of Mequon Parks (Project 1A) and OWLT VdP Property (Project 1B) Enhancements.

3.2 Project 2: Milwaukee River Greenway Parks Enhancements

This seven-mile contiguous river corridor, approximately 628 acres of parkland containing a matrix of 240 acres of habitat, has been identified as a management action area for the degradation of fish and wildlife populations BUI. Seven out of ten parks within this area were selected as high priority habitat areas under this management action: Lincoln Park, Hubbard Park, Kern Park, Pleasant Valley Park, Gordon Park, Riverside Park, and Milwaukee River Parkway – Section 5 (Figure 3). This vital urban environmental corridor along the Milwaukee River provides important floodplain forest, upland forest, shrubland, wetland, and aquatic habitat for a diverse assemblage of fish and wildlife. The corridor also acts as a critical location for migratory species that are using these habitats during spring and autumn. These types of habitats are being severely impacted by non-native and invasive vegetation that is taking over vital habitat assemblages and impacting the supported wildlife populations. Some of the parks that have been surveyed, such as Pleasant Valley Park, have shown to contain State listed Species of Concern, which if not protected through restoration efforts could be lost.

In the lower portions of the Milwaukee River Greenway (MRG), there are floodplains that were historically under water when the North Avenue dam was still in place. When the dam was removed in 1997 the water was lowered and settled into a more streamlined channel leaving contaminated sediments in the floodplain. Some of the parks that are part of this restoration project have designated floodplains where contamination was found as part of the current AOC-wide Great Lakes Legacy Act (GLLA) project agreement for feasibility (FS) and remedial design (RD). These include (upstream to downstream):

Park	Floodplain
Kern Park	Floodplain 4
Pleasant Valley Park	Floodplain 11
Gordon Park	Floodplain 6
Riverside Park	Floodplain 7
Milwaukee River Parkway - Section 5	Floodplain 8

Any restoration work in the floodplains of these parks will be implemented by U.S. EPA GLNPO as part of the GLLA project. This will be considered during the planning and design process for the project area outside of the floodplains. All the data that is collected from this project will help inform the sediment remediation efforts in the floodplains.

In 2021, a planning study was conducted under a GLRI grant (GL00E02824) to refine the Degradation of Fish and Wildlife Populations MAL, obtain better cost estimates, and develop an Ecological Restoration and Management Plan (ERMP) of the project area to document the status of the Greenway and recommendations for how the parks within the Greenway can be enhanced to achieve meeting AOC population metrics. This work was completed in December 2021 by MCP, in collaboration with River Revitalization Foundation (RRF), Urban Ecology Center (UEC), and Village of Shorewood (Figures 4 and 5).

Benefits to fish and wildlife populations in this area include but are not limited to the removal of invasive species; upland and lowland forest stand improvements that restore the canopy, sub-canopy, and herbaceous layer of the degraded woodlands found within this corridor with an emphasis towards

planting native fruit and nut bearing species; improvements to the floodplain areas through enhancement seedings and installation of native plugs, and woody vegetation removal; enhancements to ephemeral wetlands and creation of potential additional ephemeral wetlands as part of the sediment remediation in the floodplain flats; maintenance of aquatic buffer zones through selective and appropriate reforestation of select floodplain areas; and shoreline enhancements to provide higher quality fish habitat.

Lead Implementing Agency/Organization: Milwaukee County Parks

Estimated Cost and Timeline (calendar year):

Project Phase	Cost	Timeline	
Planning/Investigation	\$50,000	1.5 years [Done]	
Design/Permitting*	\$150,000	2 years [Underway]	
Implementation/Construction**	\$1,950,000	3 years	
Reporting/Maintenance/Establishment	\$150,000	2-3 years	
TOTAL	\$2,300,000		

*Project Phase Underway

**This does not include the estimated GLLA cost for the floodplain areas in the MRG ERMP, which is estimated at \$600,000. This number is subject to change based on selected restoration alternatives that will be developed in the GLLA FS that is underway. The MRG ERMP estimated cost is reflected in Table 1.

Project Elements/Contribution to Removal Criteria – see Sections 4.2 and 9 for more details:

- Well-connected corridor that bridges the Upper Estuary to the Lower Estuary
- Anticipated to contain at least one site supporting forest breeding bird, wetland breeding bird, shrubland/edge breeding bird, crayfish, turtle, salamander, and mammal focal species populations (sites for the focal species groups do not need to overlap)
- Anticipated to support snake species populations at two sites
- The GLLA portion of this project in the floodplains will contribute to almost all fish population metrics (a lot of benefits). Including increasing warmwater IBI scores and providing nursery habitat for juvenile lake sturgeon



Figure 3. Milwaukee River Greenway Parks Enhancements.



Figure 4. Lincoln Park Plant Community Restoration Map as found in the MRG ERMP (MCP, 2021).



Figure 5. Greenway Plant Community Restoration Map as found in the MRG ERMP (MCP, 2021).

3.3 Project 3: Estabrook Falls Fish Passage

3.3.1 Estabrook Falls

Between 1870 and 1940 over 2-miles of the lower Milwaukee River were mined for cement production, and widened and deepened for flood control. A dam was constructed resulting in a shallow and silt-laden 103-acre impoundment. Dredged material was used to fill 150 acres of floodplain wetland for park and road construction or inundated by the impoundment. Over 1 mile of deep meandering river habitat was lost and over 1 mile of channel is shallow pavement-like bedrock absent of fish cover. The quarried river headwall (current Estabrook Falls) is a partial barrier to fish passage and access to spawning and nursery habitat (Wawrzyn, 2014).

Emergent wetlands (e.g., marsh and wet meadow) once covered thousands of acres in the Milwaukee Estuary and connecting rivers. These wetland cover types, that are important habitats for a variety of fish species, are currently absent in the dredged estuary and lower river reaches. Reaches upstream of the Estabrook Falls are low-gradient (0.3-0.59 m/km) and shallow (0.5-1.9 m). More notably, Lincoln Park is the first available area on the Milwaukee River that can provide these important wetland habitats as it is currently dominated by silt, sand, and gravel substrate. These types of habitat features are near-optimum for providing habitat for larval/juvenile lake sturgeon (Daugherty et al., 2009), but impediments for fish passage at Estabrook Falls remain.

Following the removal of roughly 176,000 cubic yards of contaminated sediment in Lincoln Park and its vicinity, and removal of the Estabrook Park Dam in 2018, a *Milwaukee River Rehabilitation Alternatives Analysis Technical Memorandum* was completed in 2018 to look at alternatives for addressing these impacts to fish habitat (Lee, 2018). This alternative analysis identified the following goals: decrease negative flood impacts; maximize sustainability of the river reach with respect to sediment transport; maximize habitat requisites for fish and other wildlife populations; enhance recreation opportunities and riparian landowner experience of the river as auxiliary benefits; improve fish passage at Estabrook Falls; contribute to removal of Milwaukee Estuary AOC BUIs related to degradation of fish and wildlife populations and loss of fish and wildlife habitat (Lee, 2018).

Consistent with the goals for rehabilitating lake sturgeon populations in the Milwaukee River, the DNR located and quantified critical habitat and barriers to migration downstream and upstream of Estabrook Falls and former Estabrook Park Dam abandoned and removed in 2018 (DNR, 2006). It was determined that Estabrook Falls was one of the remaining migration barriers for native species in the Milwaukee River. Enhancing fish movement at Estabrook Falls provides a solution to allow focal spawning fishes (i.e. lake sturgeon and northern pike) to gain access to upstream spawning locations.

Preliminary engineering was conducted under a GLRI grant (GLO0E02288) in 2021-2022 to identify alternative solutions and analyze those alternatives to identify a preferred option that improves conditions for fish passage that is also aesthetically acceptable to the community. A two-dimensional hydraulic model was developed using recent topographic and bathymetric data to analyze alternatives. Community objection to eliminating the falls feature, together with hydraulic analysis of multiple potential reconfigurations of the falls, lead to a preferred alternative in which the top of the falls would be lowered partially on the east side of the river and a channel would be cut through the falls on the west

side. With these modifications, fish will be able to ascend the west side channel during lower flows when the falls presents a vertical barrier, and during higher flows fish could ascend on the east side. This preferred alternative (#5) is shown in Figure 7, which will be further iterated to optimize predicted hydraulic conditions during final design. These fish passage improvements at Estabrook Falls will build off the current and previous work invested in fish passage at the Kletzsch Park and Estabrook Dams.

3.3.2 Fish Passage Planning Study [completed]

A planning study was conducted under a GLRI grant (GL00E02288) in 2021-2022 to refine the Degradation of Fish and Wildlife Populations MAL, obtain better cost estimates, and evaluate the extent to which two other impediments are expected to limit passage of some native fish species (Figure 6). The potential barriers studied were the Articulated Concrete Mat (ACM) reach near the former North Avenue Dam and what remains of the timber dam structure near Chambers Street.

3.3.2.1 Articulated Concrete Matting

ACM was originally placed in selected areas in the floodplain and the entire bed of the river between the former North Avenue Dam and North Avenue to protect the riverbed and shoreline when the former North Avenue dam was removed. When this was done, the river changed from a wide, slow flow river above the dam to a channelized reach with rushing water, what most stakeholders refer to as "the chute." The ACM had some noticeable deterioration immediately after the dam removal in the late 1990's that was mostly repaired. The reach was suspected to restrict fish movement due to high water velocity over a long distance with insufficient resting areas. The recent planning study confirmed this suspicion, and modification of the reach to improve conditions for fish passage was added to the MAL as described in Section 3.4.

3.3.2.2 Chambers Street Dam

The Chambers Street Dam was originally constructed in the early 1850s to harvest ice from the Milwaukee River for refrigeration and drinking purposes. Since it was shut down in the 1900s, it has been decommissioned and portions of the original wooden dam structure remain. The structure was suspected to restrict fish movement due to high velocities and low water depth across the top of the structure and potential vertical drop across the structure during low flow. The hydraulic conditions near the Chambers Street Dam were evaluated and project partners concluded that the structure does not pose a substantial barrier to fish passage during the spring migration season and hydraulic conditions are expected to further improve over time with this continued deterioration of the structure. Therefore, no further work is currently proposed at the structure.

Lead Implementing Agency/Organization: Milwaukee Metropolitan Sewerage District

Estimated Cost and Timeline (calendar year):

Project Phase	Cost	Timeline	
Planning/ Preliminary Engineering	\$340,000	1.5 years [Done]	
Design/Permitting*	\$300,000	1 year [Underway]	
Implementation/Construction	\$1,000,000	One Construction Season	
Reporting/Maintenance/Establishment	\$150,000	2 years	
Total	\$1,790,000		

*Project Phase Underway

The Planning/Preliminary Engineering phase of this project included a fish passage study. Therefore, the early stages of the project cost are higher than normally expected.

Project Elements/Contribution to Removal Criteria – see Section 4.1 for more details:

- Allows lake sturgeon and northern pike to travel (un-impeded) to the upper watershed
- Creating fish passage for native species allows fish to travel throughout the river, increasing warmwater IBI scores for several stretches in the upper part of the AOC
- This project area is next-to-last downstream of all the fish passage projects. Not having native fishes move past this impediment during the spring spawning season, will not allow fish to get through other fish passage investments, upstream to suitable spawning habitat



Figure 6. Estabrook Falls and Fish Passage Improvements.



Figure 7. Recommended Alternative #5 – Multiple Flow Path Passage. (Inter-Fluve, inc., 2022).

3.4 Project 4: North Avenue Fish Passage

When the North Avenue Dam was removed in 1997, filter fabric and an articulated concrete mat (ACM) were placed on the stream bed to isolate contaminated sediment from the dam to North Avenue. Near the upstream edge of North Avenue, a water line crosses under the river, and the ACM was placed over the top of it. This created an approximately 1000 ft long, narrow, smooth chute with an average river profile slope of 0.8% (Figures 8 and 9). The adjacent floodplain was left at an elevation too high to be regularly flooded. Due to erosive energy of high flows in the confined channel, portions of the ACM failed and were subsequently replaced by gabion baskets.

Downstream of the former dam, the river water surface is effectively the same level as Lake Michigan. When the lake is high, a substantial portion of the ACM reach is backwatered causing the upstream portion to experience fast water while the downstream water velocity remains relatively slow. However, when the lake is low, the entire reach experiences fast water speeds, particularly in the furthest downstream portion.

Fisheries biologists suspected that the high velocities through the reach create a partial fish passage barrier by exceeding swim capabilities for some species of native fish under some conditions. A planning study was conducted in 2021-2022 under a GLRI grant (GL00E02288) to evaluate the extent to which the reach is expected to limit passage of native fish, particularly those large fish that are relatively poor swimmers, such as Northern Pike and Lake Sturgeon. It is generally assumed that if these two species can successfully pass-through a given reach, other native migratory fish that are stronger swimmers will be able to pass (e.g. white suckers).

As part of the study, the reach's typical river flow rates that occur during the spawning migration season were analyzed to estimate the anticipated water velocity within the reach under a variety of lake level conditions. The velocity output was compared to published swim performance fatigue curves for the adult-sized Northern Pike and Lake Sturgeon. The results of the model indicated that the ACM reach of the river poses a fish passage barrier. For example, the fatigue curves suggest that less than half of adult northern pike (18-inch long) would be capable of swimming further than ~25 feet against water moving 5 ft/s without resting. However, the presence of the ACM creates a smooth riverbed that does not provide adequate resting habitat. Therefore, a majority of adult northern pike are not able to effectively overcome the water velocity during high flow conditions and are unable to pass through the reach. This is problematic during the spring migration season when the reach frequently experiences high water velocities.

This reach of the river is also being examined by U.S. EPA GLNPO to determine appropriate approaches for contaminated soil in the adjacent floodplains. As such, there may be overlaps in project area footprints between the soil remediation work and the fish passage work. Solutions to the fish passage impediment will be developed in consultation with the GLLA project team to efficiently meet the objectives of each effort. Following public engagement, review, and discussion of alternatives with the Tech Team, a preferred fish passage alternative will be identified for design and pursued for eventual construction. The planning study report completed an estimate of probable cost for a suggested list of alternatives.

Lead Implementing Agency/Organization: Milwaukee Metropolitan Sewerage District

Estimated Cost and Timeline (calendar year):

Project Phase	Cost	Timeline	
Planning/Investigation	\$400,000	1.5 years	
Design/Permitting	\$300,000	2 years	
Implementation/Construction	\$5,600,000	Two Construction Seasons	
Reporting/Maintenance/Establishment	\$200,000	2-3 years	
Total	\$6,500,000		

Project Elements/Contribution to Removal Criteria – see Section 4.1 for more details:

- Allows lake sturgeon and northern pike to travel (un-impeded) to the upper watershed under varying flow conditions
- Creating fish passage for native species allows fish to travel throughout the river, increasing warmwater IBI scores for several stretches in the upper part of the AOC
- This project area is the furthest downstream of all the fish passage projects. Not having native fishes move past this impediment during the spring spawning season, will not allow fish to get to through other fish passage investments, upstream to suitable spawning habitat.



Figure 8. North Avenue Fish Passage Project Reach.



Figure 9. View of the Articulated Concrete Mat chute from the pedestrian bridge over the former dam.

3.5 Project 5: Havenwoods State Forest Rehabilitation

Havenwoods State Forest (HSF) is a quiet 237-acre urban state forest, but it has had an exciting and diverse background that has resulted in challenges for habitat management. The history of this property includes family homesteads from the mid-1800s transitioning to the Milwaukee County House of Corrections in the early 1900s. An Army Disciplinary Barracks, Nike Missile site, and city landfill soon followed. Progress and urbanization almost did away with Havenwoods. Thanks to a small group of citizens, community leaders, and public officials working together, this land was set aside as a green space in the middle of a large urban community. In 1979, the DNR began restoration of the area with the addition of Milwaukee Metropolitan Sewerage District (MMSD) stormwater retention basins on the property to retain runoff before reaching Lincoln Creek. Due to the disruption of the property over the past 150 years, the landscape is scarred and subject to habitat degradation and loss to invasive species.

In 2016-2017, a strategic alignment in the DNR provided different programs the need to develop statewide habitat and recreation priorities on state properties to focus limited resources and maximize habitat and wildlife impacts. These priorities were developed by using a list of predetermined criteria. While HSF fell lower on this list due to current property conditions, these planning activities and future enhancements will greatly contribute to increasing habitat management priorities. In addition, educational and recreation opportunities at HSF are currently the main drivers for property usability by the public. Increasing the accessibility and usability of the property through habitat enhancements will also develop better educational and recreational opportunities.

Habitat	Priority	Present at HSF	
Oak Forest (specifically	1	Yes – with more areas enhanced as part of this	
regeneration/perpetuation)	T	project	
Oak Savanna/woodlands	1	Yes	
Remnant and planted prairie in historic	1	Yes – with more areas enhanced as part of this	
prairie areas	T	project	
Forested Wetlands (bottomland	2	Yes	
hardwoods, floodplain and ash forest)			
Hardwoods	2	Yes	
Warmwatar Streams	2	Yes – Lincoln Creek is a NR 102, 104 Cool-Warm	
		Headwater	

Note: This AOC project is not specifically targeting large forest areas because it is underway through a forest regeneration grant with the U.S. Forest Service.

Since the designation of HSF there have been many important local partnerships to help address issues and maintenance on the property. In 1975, a local environmental organization called Equality and Quality of Life (EAQOL) solidified their relationship to HSF land by collaborating with citizens to form the Friends of Havenwoods (FOH). The FOH organizational goals are as follows: 1) help restore land at Havenwoods, 2) promote and enhance the use of Havenwoods as an environmental education facility, 3) provide space and opportunities for community participation, and 4) raise funds for the purposes. Over the course of FOH history, many citizens have joined and become active in its goals, and a few members have even remained since the early days. Along with FOH, other partnerships include those of MMSD, Johnson Controls, and the local Sierra Club Great Waters Group. In 2021, a planning study was conducted under a GLRI grant (GL00E02824) to refine the Degradation of Fish and Wildlife Populations MAL, obtain better cost estimates, and develop an ERMP of the project area to document the status of the property, broken apart by management units and recommendations for how the property can be rehabilitated to achieve meeting AOC populations metrics. This work was completed by Resource Environmental Solutions (RES) in December 2021 (Figures 10 and 11).

HSF was determined to be important for upland/terrestrial habitat for snakes and semi-aquatic habitat for frogs. This project scored the best possible cost-benefit score, as well as scoring the highest in all 34 high priority projects for benefiting from enhancements to all habitat associated breeding bird populations (forest, wetland, grassland, shrubland and airspace/urban). Enhancements to benefit fish and wildlife populations in this area include removal of invasive species, limited forest stand improvements due to loss of ash trees, backwater pond improvements, and preservation and enhancements to ephemeral wetlands and maintenance of aquatic buffer zones.

Lead Implementing Agency/Organization: Wisconsin Department of Natural Resources

Estimated	Cost and	Timeline	(calendar v	year):

Project Phase	Cost	Timeline
Planning/Investigation	\$65,000	1.5 years [Done]
Design/Permitting*	\$175,000	2 years [Underway]
Implementation/Construction	\$2,000,000	3 years
Reporting/Maintenance/Establishment	\$140,000	2-3 years
Total	\$2,380,000	

*Project Phase Underway

Project Elements/Contribution to Removal Criteria – see Sections 4.2 and 9 for more details:

- Currently, one site is meeting the wetland breeding bird, one site is meeting the grassland breeding bird, and one site is meeting the frog metric at this project location (sites for the different focal guilds may or may not be overlapping)
- Anticipated to contain at least one site supporting shrubland/edge breeding bird, crayfish, and snake focal species populations (sites for the focal species groups do not need to overlap)



Figure 10. Management Units (25) as identified by RES in 2021 for recommending habitat restoration activities at Havenwoods State Forest (RES, 2021). Green highlighted area are locations where a forest regeneration project is already underway through a separate funding avenue.



Figure 11. Ecological Restoration and Management Plan developed by RES (2021) for HSF. Additional recommendation details can be found in the ERMP.

3.6 Project 6A: Milwaukee County Grounds, Menomonee River Parkway Section9, and Hoyt Park Wildlife Enhancements and Project 6B: MMSD Basins WildlifeEnhancements

Large habitat areas in the Milwaukee Estuary AOC that support a diverse number of wildlife and fish are unique and rare throughout the region. This 165-acre property on the Menomonee River and near the confluence with Underwood Creek (Figure 12) comprises important habitat for numerous focal species in the Milwaukee Estuary AOC, as well as being a well-documented autumn roosting area for migrating monarch butterflies. While this is not part of the metrics for BUI removal, it serves as an indirect benefit towards insect pollinators because in addition to the monarchs, rusty-patched bumble bees (Federally endangered species) have been documented at this location. This property also contains 174 documented species of birds that use the property as part of their annual lifecycle and 53 species of flora and fauna that Milwaukee County Parks lists as priority conservation species within Milwaukee County. Like most areas in the AOC, these important and diverse habitat types are being threatened by a large presence of invasive species. This opportunity to restore and manage the grassland and savanna habitat types is extremely rare in the Milwaukee Estuary AOC due to existing woodlands and urban development. Important breeding habitat areas at this property include upland grassland, forest, shrubland, and wetland/emergent marsh.

Enhancements to benefit wildlife populations in this area include removal of select invasive species populations, grassland/savanna enhancements focused on increasing forb diversity, forest stand improvements such as: reforestation, woodland seeding, and wildlife shrub planting; basin improvements to wetland associated wildlife potentially creating a number of wetland scrapes in the larger basins to provide structural variability in water depths as well as temporal variations in holding water; preservation and enhancements to ephemeral wetlands, and maintenance of aquatic buffer zones through the installation of native plants.

<u>Lead Implementing Agency/Organization:</u> Milwaukee County Parks and Milwaukee Metropolitan Sewerage District

Project Phase	МСР	MMSD	Timeline
Planning/Investigation	\$50,000	\$150,000	1.5 years
Design/Permitting	\$100,000	\$200,000	1 year
Implementation/Construction	\$800,000	\$1,500,000	2-3 years
Reporting/Maintenance/Establishment	\$100,000	\$100,000	2-3 years
Total	\$1,050,000	\$1,950,000	

Estimated Cost and Timeline (calendar year):

Project Elements/Contribution to Removal Criteria – see Sections 4.2 and 9 for more details:

- Large ecotone area to support many focal species
- Currently, one site is meeting the frog, and one site is meeting the snake metric at this project location (sites for the different focal guilds may or may not be overlapping)

• Anticipated to contain at least one site supporting forest breeding bird, wetland breeding bird, and shrubland/edge breeding bird focal species populations (sites for the focal species groups do not need to overlap)


Figure 12. Milwaukee County Grounds, Menomonee River Parkway Section 9, and Hoyt Park (Project 6A), and MMSD Basins (Project 6B) Wildlife Enhancements.

3.7 Project 7: Kletzsch Park Wildlife Enhancements

A large habitat area (86.2 acres) in the Milwaukee Estuary AOC, directly adjacent to the Milwaukee River, supports a diverse number of wildlife and fish that are unique and dispersed throughout the region (Figure 13). This area on the Milwaukee River provides important grassland, forest, shrubland, and wetland habitat for several focal species in the Milwaukee Estuary AOC. The property also contains 143 species of flora and fauna that the MCP (property owner) lists as priority conservation species within Milwaukee County. Like most areas in the AOC, these important and diverse habitat types are being threatened by a large presence of invasive species. The large size of this project property provides important habitat for forest and wetland breeding and migratory birds (165 species documented using this property during a portion of their annual life cycle), and breeding mammals. This park is part of the Milwaukee River corridor and builds off the current project at Kletzsch Park for improved river access and fish passage. The Kletzsch Dam Fish Passage project is separate from this work and any shoreline or improvements made will add habitat to the east bank. The fish passage project will be complementary to the upland component.

Enhancements to benefit wildlife populations in this area include removal of select invasive species populations; upland enhancements by increasing native plant diversity, removing invasive species, and managing with prescribed burns; upland and lowland forest stand improvements such as reforestation to mitigate severe canopy loss from emerald ash borer; preservation and enhancements of ephemeral wetlands by lengthening hydro-periods, and maintenance of aquatic buffer zones through the installation of native plants.

Lead Implementing Agency/Organization: Milwaukee County Parks

Estimated Cost and Timeline (calendar year):

Project Phase	Cost	Timeline
Planning/Investigation	\$75,000	1.5 years
Design/Permitting	\$150,000	1.5 years
Implementation/Construction	\$600,000	3 years
Reporting/Maintenance/Establishment	\$275,000	2-3 years
Total	\$1,100,000	

- Currently, one site is meeting the airspace/urban breeding bird metric at this project location.
- Anticipated to contain at least one site supporting forest breeding bird, wetland breeding bird, and turtle focal species populations (sites for the focal species groups do not need to overlap)
- This project is separate from the Kletzsch Dam Fish Passage project but will be complementary to the habitat site restoration work on the east bank of the park.



Figure 13. Kletzsch Park Wildlife Enhancements.

3.8 Project 8: Schlitz Audubon Cleaver Property Enhancements

The Schlitz Audubon Cleaver property is a rare, 38.68-acre property that supports a diverse number of wildlife in the Milwaukee Estuary AOC. Schlitz Audubon is currently pursuing conservation easements, through different funding sources, on portions of six additional privately held parcels immediately east of and adjacent to the Cleaver property. Acquisition of these easements has the potential to increase the total area under management by Schlitz Audubon to 66.21-acres (Figure 14; the property currently owned by the National Audubon Society, Inc. is labeled as parcel number 1111).

This area on the Milwaukee River is within a primary environmental corridor and provides important riparian forest, shrubland, grassland, and wetland habitat for many focal species in the Milwaukee Estuary AOC. It is one of the few areas in the AOC that support Blue-spotted Salamander with multiple ephemeral ponds on the property. These ephemeral ponds have succumbed to invasive species and are in dire need of increasing the hydroperiods to better support semi-aquatic focal species. The forested property has a lot of undergrowth invasive species that threaten rare native habitat in the Milwaukee River corridor. Given the diversity of wetland and ephemeral pond habitat in this project area, it drives the biological diversity of semi-aquatic and wetland species throughout the section of this corridor. This property also provides rare backwater habitat in Milwaukee County along the Milwaukee River to support important fish cover and nursery habitat.

Enhancements to benefit fish and wildlife populations in this area of the Milwaukee River include removal of invasive species, upland and lowland forest stand improvements due to loss of ash trees, shoreline improvements to provide better fish spawning and nursery habitat for focal species, preservation of ephemeral wetlands, and maintenance of aquatic buffer zones through the installation of native plants.

Lead Implementing Agency/Organization: Schlitz Audubon

Estimated	Cost and	Timeline for	Im	olementation	(calendar	year):
						-

Project Phase	Cost	Timeline
Planning/Investigation	\$190,000	1.5 years
Design/Permitting	\$120,000	1.5 years
Implementation/Construction	\$540,000	2-3 years
Reporting/Maintenance/Establishment	\$150,000	2-3 years
Total	\$1,000,000	

- Currently, one site is meeting the salamander metric at this project location. There are very limited abilities to support salamanders in the AOC, making this site a priority.
- Anticipated to contain at least one site supporting forest breeding bird, crayfish, turtle, snake, and mammal focal species populations (sites for the focal species groups do not need to overlap)
- Benefits nursery habitat for lake sturgeon within the complex of islands in the river channel.



Figure 14. Schlitz Audubon Cleaver Property Enhancements.

3.9 Project 9: Menomonee River Parkway – Sections 5 and 6 Enhancements

Menomonee River Parkway – Section 5 encompasses 135 acres of land, most of which is covered by declining floodplain forest (from emerald ash borer) and contains offline wetlands, as well as ephemeral ponds (Figure 15). As a result, it provides important wetland, forest, and spawning fisheries habitat for focal species in the Milwaukee Estuary AOC. This area has the potential to become valuable through much needed enhancements to the degraded forest canopy and sub-canopy, reconnection of offline wetlands, replacement of dead ash trees, and removal of invasive species.

Menomonee River Parkway – Section 6 covers 43 acres of natural habitat, which supports a diverse group of focal species not found anywhere else in the lower sections of the Menomonee River Parkway (Figure 15). This provides important habitat for unique semi-aquatic species through five offline ephemeral ponds. Preservation and enhancements to these valuable habitat types in the Milwaukee Estuary AOC is vital for meeting the degradation of fish and wildlife populations BUI metrics.

Enhancements to benefit fish and wildlife populations in this area include removal of select invasive species populations; forest stand improvements such as reforestation, woodland seeding, and select canopy thinning due to the decline of ash trees; basin improvements to wetland associated wildlife, such as mammals, and fishes to improve spawning habitat; preservation and enhancements to 18 offline ephemeral wetlands; and maintenance of aquatic buffer zones through the removal of debris jams and the installation of native plants.

Lead Implementing Agency/Organization: Milwaukee County Parks

Estimated Cost and	Timeline for Im	plementation	(calendar y	/ear):

Project Phase	Cost	Timeline
Planning/Investigation	\$150,000	1.5 years
Design/Permitting	\$200,000	2 years
Implementation/Construction	\$2,700,000	3 years
Reporting/Maintenance/Establishment	\$200,000	2 years
Total	\$3,250,000	

- Currently, two sites are meeting the frog, and one site is meeting the salamander metric at this project location
- Anticipated to contain at least one site supporting forest breeding bird, wetland breeding bird, snake, and mammal focal species populations (sites for the focal species groups do not need to overlap)
- Anticipated to support crayfish species populations at two sites
- Supports habitat and a large complex for northern pike spawning
- Important for warmwater IBI of upper Menomonee River



Figure 15. Menomonee River Parkway – Sections 5 and 6 Enhancements.

3.10 Project 10: Currie Park Fish Passage Improvements

The Menomonee River Watershed covers 136 square miles, originating in wetlands in southeastern Washington County and flowing 28 miles south and east where it joins the Milwaukee River just upstream from its confluence with Lake Michigan. The Menomonee River Watershed is 80% urbanized, and has been impacted by past filling activities, development, river channelization, agricultural runoff, and urban stormwater discharges. Despite this, most of the upper Menomonee River system contains fair to good warm water fish habitat. The river system is now undergoing a renaissance with recent removal of 4,000 feet of concrete channel downstream, as well as removal of four other low-flow fish passage barriers and construction of one rock ramp in downstream Hoyt Park of Wauwatosa. This previous work was completed by the MMSD in coordination with the DNR as management actions for the loss of fish and wildlife habitat BUI. While this has addressed several major barriers to fish migration, other fish passage barriers still exist in the watershed.

The project includes removal of the low-head concrete slab bridge on the Menomonee River and in the Currie Park Golf Course property (Figure 16). This property is owned and managed by Milwaukee County and is directly between Menomonee River Parkway Sections 5 and 6 (see previous Management Action and #9 on the project location map). This golf course has three separate access bridges for golf carts and foot traffic throughout the 18-hole course. The middle access bridge is a low-head concrete slab that is a non-permitted structure and was historically placed on top of roughly a dozen small culverts. Removal of this bridge and stabilization of the shoreline along the Menomonee River will allow fish passage improvements for focal species (i.e. northern pike) during low flow and will provide better displacement of built up sediment and debris. Approximately 10 miles of connectivity will be re-established along the main stem until the next major stream barrier in Menomonee Falls. It is estimated that the project would also enhance connectivity for several miles of tributary streams leading to the Menomonee River. When this fish passage impediment is removed, this area on the Menomonee River will no longer deter movement of native fishes to move upstream during their spawning season.

Lead Implementing Agency/Organization: Wisconsin Department of Natural Resources

Project Phase	Cost	Timeline
Planning/Investigation	\$5,000	0.5 years
Design/Permitting	\$10,000	.25 years
Implementation/Construction	\$60,000	One construction season
Reporting/Maintenance/Establishment	\$5,000	2 years
Total	\$80,000	

Estimated Cost and Timeline for Implementation (calendar year):

- Creating fish passage for native species allows fish to travel throughout the river, increasing warmwater IBI scores for several stretches in the upper part of the AOC
- Low cost big impact



Figure 16. Currie Park Fish Passage Improvements.

3.11 Project 11: Menomonee River – N 16th to N 25th Street Fisheries Improvements

The lower region of the Milwaukee Estuary AOC has limited fish habitat and cover in its three tributaries (Milwaukee River, Menomonee River, and Kinnickinnic River) due to channelization. Historically, the natural productivity, functions, and values of the Milwaukee Estuary were driven by extensive and diverse aquatic primary producers, local sediment transport, and morphology. Engineered vertical bulkheads, dredging to maintain commercial navigation depth, sediment quality, and greatly reduced light transparency currently limit rooted aquatic plants. These lower portions of the tributaries are impacted by multiple river hydrology inputs (i.e. urban runoff, warm/cool water discharge, lake upwelling and seiche effects, etc.). Common seasonal water temperatures and flow regimes are impacted by all these factors.

The main channel of the Menomonee River is deep (>15ft) downstream of the 16th street bridge. A large portion of the main channel is bordered with a hardened shoreline and provides limited surface area for fish habitat. The Menomonee River, between the N 16th to N 25th Street bridges, was previously decertified as a federal commercial navigation channel and had previously been part of a sediment characterization and feasibility study (FS) for remediation (Figure 17). This section of the river contains the former West Side Manufactured Gas Plant (MGP) Facility, which will be remediated under the GLLA for the Menomonee and Milwaukee project based on a selected alternative.

The plan and design of this project will coincide with the selected alternative (Alternative 5A – Hydraulic Dredging/CDF Disposal) as part of the FS for remediation in Operable Unit 1 of the Milwaukee & Menomonee GLLA project area (CH2M HILL, 2019). The benefit of having this project implemented post-remediation is the well-known information and data available in this section of the Menomonee River. Hydrologic modeling has been completed as part of the FS for the Milwaukee & Menomonee project. Determination of scouring and deposition has been previously investigated for this project area. Shoreline stability and bulkhead structure conditions have been inspected, and geotechnical and chemical data have been gathered for this stretch of the Menomonee River. There are two Areas of Interest (AOI) for remediation between N 25th and N 16th Street bridges within this project reach. These areas will be included as part of the planning and design efforts to ensure coordination between the GLLA work and the degradation of fish and wildlife populations BUI.

Implementing a fisheries project, bound by bulkhead steel sheet pilings, will require placing habitat features in specific locations to generate the best water flow throughout the year, while staying within regulations of potential changes to the floodplain. Possible features include but are not limited to a meandering bottom morphology using clean, washed coarse gravels that benefit spawning fishes and set as submerged bars with specific slopes and elevations to keep the flow in the main channel; establishment of native rooted submergent, emergent, and floating macrophytes in shallow bars; enhancement of larger rock material to provide a majority of the cover on staggered, alternating sides of the channel to increase water flow; enhancements to woody habitat by placing structures in combination with added boulders.

Lead Implementing Agency/Organization: Milwaukee Metropolitan Sewerage District

Estimated Cost and Timeline for Implementation (calendar year):

Project Phase	Cost	Timeline
Planning/Investigation	\$200,000	1.5 years
Design/Permitting	\$350,000	1 year
Implementation/Construction	\$4,000,000	One construction season
Reporting/Maintenance/Establishment	\$0	2 years
Total	\$4,550,000	

- High score for fish focal species
- One of the higher scores for fish sub-focal species
- Very important to meet the large river IBI and Lower Milwaukee Estuary fish metrics



Figure 17. Menomonee River N 16th to N 25th Street Fisheries Improvements.

3.12 Project 12: Little Menomonee River Parkway – Section 1 Fish and Wildlife Enhancements

The Little Menomonee River Parkway – Section 1 (owned and managed by MCP) is one of the largest (215.7 acres) and most important habitats in the Milwaukee Estuary AOC, and it supports a diverse number of fish and wildlife (Figure 18). While this area on the Little Menomonee River is directly adjacent to the AOC boundary, it provides important riparian forest, shrubland, grassland, and wetland habitat for many focal species in the Milwaukee Estuary AOC and as a result, addresses many degradation of fish and wildlife populations BUI metrics for multiple habitat types. It also provides important migratory stopover habitat for waterfowl (Documented: 18 species of ducks, 2 species of geese, 5 species of cranes/herons/egrets, 5 species of grebes/rails, 4 species of gulls/terns, and 9 species of shorebirds) and spawning habitat for northern pike. The property also contains 97 species of flora and fauna that the MCP lists as priority conservation species within Milwaukee County. The diversity of this property is currently being threatened by a large presence of invasive species. A portion of the property is an old quarry that flooded and reverted to a variety of shallow water wetlands/emergent marshland. Former excavated gravel piles in the wetlands offer one of the only areas within the AOC where turtles can potentially nest safely. These piles are surrounded by water, which block access for nest predators such as raccoons and skunks.

It is important that this property receives the much-needed enhancements, as it is the ecological engine for the entire Little Menomonee River corridor to the south within the AOC, to better support reproducing populations that are impaired in the Milwaukee Estuary AOC. This property provides the opportunity for earthwork habitat enhancements which are limited in other areas of the Little Menomonee River corridor due to previous superfund cleanup efforts downstream until the confluence with the Menomonee River. The large size of this project area provides important habitat for forest, grassland, and wetland breeding birds, and mammals.

In 2022, a planning study was conducted under a GLRI grant (GL00E02824) to refine the Degradation of Fish and Wildlife Populations MAL, obtain better cost estimates, and develop an ERMP of the project area to document the status of the project area and recommendations for how Section 1 of the parkway can be enhanced to achieve meeting AOC population metrics (MCP, 2022). This work was completed by MCP in Summer 2022 (Figure 19).

Enhancements to benefit fish and wildlife populations in this area include: removal of select invasive species populations that are degrading the ecological functions of the wetlands; grassland enhancements through the removal of woody vegetation; upland and lowland forest stand improvements such as reforestation, woodland seedings, and select forest thinning to improve canopy diversity; wetland creation through shallow scrapes and the installation of water control structures; maintenance of aquatic buffer zones; shoreline and backwater pond enhancements to improve fish spawning habitat; woody vegetation removal on turtle nesting islands and potentially the installation of solar powered electric fencing to deter nest predators; woody structure installations to provide higher quality fish habitat; and, semi-aquatic improvements through the installation of native plants for a variety of herptiles.

Lead Implementing Agency/Organization: Milwaukee County Parks; Ozaukee County Planning and Parks

Estimated Cost and Timeline for Implementation (calendar year):

Project Phase	Cost	Timeline
Planning/Investigation*	\$100,000	1.5 years [Done]
Design/Permitting*	\$450,000	4 years [Underway]
Implementation/Construction	\$5,540,000	3 years
Reporting/Maintenance/Establishment	\$150,000	2 - 3 years
Total	\$6,240,000	

*Project Phase Underway

NOTE: Planning for the upland portion of the project has been completed. Planning and Design for the aquatic portion of the project is underway. Design for the upland portion of the project is estimated to start in 2023.

- Highest score semi-aquatic habitat out of all 34 high priority projects
- Best score possible for northern pike spawning habitat
- Currently, one site is meeting the wetland breeding bird metric, once site is meeting the airspace/urban breeding bird metric, one site is meeting the crayfish metric, one site is meeting the frog metric, one site is meeting the snake metric, and one site is meeting the mammal metric at this project location.
- Anticipated to contain at least one site supporting forest breeding bird, shrubland/edge breeding bird, grassland breeding bird, and turtle focal species populations (sites for the focal species groups do not need to overlap)
- Extremely important for fish and wildlife metrics



Figure 18. Little Menomonee River Parkway - Section 1 Fish and Wildlife Enhancements.



Figure 19. Planned restoration activities at LMR Parkway – Section 1 as found in the ERMP (MCP, 2022).

3.13 Project 13: Kohl Park Wildlife Enhancements

The land that constitutes Kohl Park, 266-acres in total, has been donated to the MCP over the course of a decade, including the most recent and final donation in 2018, by the Herb Kohl family (Figure 20). The formerly leased agricultural lands (51.5 acres) contained within this property provide a unique opportunity for the creation of wildlife habitats that are essential actions to address the wildlife population impairments in the Milwaukee Estuary AOC. On the west side of Kohl Park is a UW-Extension leased parcel (46 acres) that is outside the scope of this project and will be omitted from surveys/data and future enhancements as part of this project. UW-Extension uses this land for community gardens and restoration education. Both leased areas can be found in Figure 21. This large habitat area has the potential to support significantly more diverse wildlife populations through restoration efforts included in this proposed project, because it is strategically located between other large publicly protected parcels directly connecting it to the Milwaukee Estuary AOC. Kohl Park, in near proximity to the Little Menomonee River, will be able to provide important forest, shrubland, grassland, and wetland habitat for Milwaukee Estuary AOC focal species.

Kohl Park falls outside the immediate boundary of the AOC. However, in the highly urbanized Milwaukee Estuary AOC, there are few opportunities to create large habitat areas for focal species. While this is outside the AOC boundary that is limited to the riverine area, this project is critical to attaining the BUI removal metrics. In addition, finding a within AOC substitute project would add time, require additional funding and likely would translate to a greater number of projects. This area was selected as a viable project based on the wildlife species inventory that used a 0.5-mile buffer to determine what species were likely impaired due to the AOC. Kohl Park falls between other large, protected properties such as MMSD Greenseams parcels, Mequon Nature Preserve, and the LMR Parkway. The creation of new habitat and enhancement of existing habitat at Kohl Park would complement other habitat areas listed above and create a 1,143-acre habitat block, which would be the largest habitat block within the Milwaukee Estuary AOC. Therefore, the AOC will be connected to a much larger ecologically viable area increasing the odds of attracting and maintaining focal species. Plans for this area include prairie restoration, and the expansion of the forested/shrubland areas to fill-in a larger contiguous corridor on the northern portion of Milwaukee County.

Lead Implementing Agency/Organization: Milwaukee County Parks

Estimated Cost and Timeline for Implementation (calendar year):

Project Phase	Cost	Timeline
Planning/Investigation	\$50,000	1.5 years
Design/Permitting	\$150,000	1.5 years
Implementation/Construction	\$2,100,000	3 years
Reporting/Maintenance/Establishment	\$100,000	2-3 years
Total	\$2,400,000	

NOTE: Implementation/Construction of this project has the potential to be funded through GLRI FA1 or FA4, to be determined during the planning and design phase.

- Unique opportunity to restore agricultural fields into habitat that has the capability of addressing many metric categories that are not available elsewhere in the AOC
- Currently, two sites are meeting the airspace/urban breeding bird metric, and two sites are meeting the frog metric at this project location
- Anticipated to contain at least one additional site supporting forest breeding bird, wetland breeding bird, shrubland/edge breeding bird, and grassland breeding bird focal species populations (sites for the focal species groups do not need to overlap)
- Anticipated to support snake species populations at two sites
- Greatly enhance the connectivity through the northern part of Milwaukee County



Figure 20. Kohl Park Wildlife Enhancements.



Figure 21. Agricultural and UW-Extension Leased Property within Kohl Park.

3.14 Project 14: Lincoln Park Oxbow Fisheries Improvements

The Lincoln Park Oxbow and Estabrook Impoundment was remediated in two phases (2012 and 2015) as part of a GLLA cleanup project which removed roughly 176,000 cubic yards of contaminated sediments (Figure 22). As the remediation work concluded, the GLLA project restored shoreline and bank areas impacted by sediment excavation. Shoreline stabilization was completed with the placement of rip rap, soil lifts, live stakes, erosion control blankets and/or seeding. Restoration activities that were completed also included buffer and riparian plantings, and minimal river-bed regrading. These post-remediation activities were supportive of future habitat and recreational enhancements that could be completed but were beyond the scope of the remedial action. The GLLA project's primary focus on stabilizing excavated or impacted shorelines means there is an opportunity to improve the larger oxbow area for fish and wildlife populations. This project is a unique opportunity to provide those enhancements and represents an important contribution to the overall effort of partners such as Ozaukee County, Milwaukee County, Milwaukee Riverkeeper (MRK), UEC and others to restore the Milwaukee River.

Emergent wetlands, such as those previously found at the Lincoln Park Oxbow, once covered thousands of acres in the Milwaukee Estuary and connecting rivers that were critical for a diversity of fish and wildlife species. These wetland cover types, that are important habitats for a variety of fish species, are currently absent in the estuary and lower river reaches. This area of the Milwaukee River provides the best opportunity for establishing new emergent wetlands, which will directly support life stages of important fish focal species (i.e. northern pike, lake sturgeon, greater redhorse, and smallmouth bass). The close proximity of this project to the lower Milwaukee Estuary is important because wetland habitat is severely limited in the lower reaches of the AOC. This stretch of the Milwaukee River has been determined as an important location that if restored, would benefit numerous fish and wildlife focal species.

In addition to establishing emergent wetland, a goal of this project is to direct sediment deposition that is occurring in the western and center channels of the Oxbow to promote expansion of wetland areas along channel margins and create deeper scour holes through the center channel. As a result, wetlands will be sustained and will be able to serve as a spawning and nursery area for Milwaukee Estuary AOC fish focal species and more pools will be created to provide cover. Enhancements to these areas include--but are not limited to--enhancing wetland and backwaters for spawning and juvenile fish development; establishing and maintaining native wetland vegetation; placing wood for bank protection, localized scour development, and habitat cover for fish and wildlife; improving shoreline and riparian buffers for stabilization and cover as well as turtle nesting areas; and adding large rock in the river channel. Work completed in this area of the Oxbow as part of the GLLA project will be evaluated to ensure that previous restoration work will not be severely impacted.

Preliminary engineering was conducted under a GLRI grant (GL00E02288) in 2021-2022 to characterize hydraulic conditions and resulting sediment transport capacity in the project reach and identify alternative habitat features and appropriate locations for those features. Habitat elements and locations are shown in Figure 23 and will be refined during final design. Coordination with Milwaukee County Parks is ongoing to ensure that this project and the Lincoln Park portion of the Enhancements to Milwaukee River Greenway Parks project are complementary and are efficiently completed.

Lead Implementing Agency/Organization: Milwaukee Metropolitan Sewerage District

Estimated Cost and Timeline for Implementation (calendar year):

Project Phase	Cost	Timeline
Planning/Investigation	\$250,000	1.5 years [Done]
Design/Permitting*	\$400,000	1.5 years [Underway]
Implementation/Construction	\$5,100,000	2-3 years
Reporting/Maintenance/Establishment	\$250,000	2 years
Total	\$6,000,000	

*Project Phase Underway

- Best score possible for fish focal species
- Important for turtle nesting habitat and backwater spawning habitat for northern pike
- Highest score for sub-focal species in all 34 high priority projects
- Provides the greatest enhancement for fish populations in the Upper Estuary portion of the Milwaukee River
- High score for lake sturgeon spawning and rearing habitat



Figure 22. Lincoln Park Oxbow Fisheries Improvements



Figure 233. Preliminary Engineering Recommended Alternative. (Inter-Fluve, inc., 2022).

3.15 Project 15: Outer Harbor (Summerfest Lagoon) Aquatic Enhancements

The outer Milwaukee Harbor is an important transitional habitat that is the interface between the inner harbor and Lake Michigan. Sediment and nutrients are carried from the three tributaries that converge in the inner harbor and discharged under the Hoan Bridge into the outer harbor. The outer harbor encompasses many different types of habitats and varying depths. The largest area of littoral zone habitat in the outer harbor is a 30-acre area in the northwest corner near the Art Museum, at the center of two biological hotspots (the Summerfest Lagoon and Green Breakwall) that were previously identified by Dow, 2018 and Geisthardt, 2017, respectively. This 30-acre area provides sparse macrophyte growth, minimal rocky habitat, and shallowing depths. While there are shallow water depths (< 3m) in this location, sunlight penetration and muck substrate are not conducive for macrophyte growth with macrophytes currently present in small isolated patches. These isolated patches of rock/stone and macrophyte habitat cover types provide limited spatial connectivity between the Discovery World/Summerfest Lagoon and Veterans Park/McKinley Marina/Green Breakwall areas. Isolated patches of habitat may reduce fish colonization rates and recruitment. Wave action may also be the contributor to reduced macrophyte growth and sedimentation by fines over coarse substrates in this region.

The Summerfest Lagoon is a nursery habitat area that supports a large diversity of centrarchid species (sunfishes) which, throughout the year, have been found foraging on the outer harbor Green Breakwall (Geisthardt, 2017)(Figure 24). The route in which these centrarchids travel to the Green Breakwall is unknown, but it is believed that they follow the shoreline stretching from Discovery World to Veterans Park. The existing features between these two locations is lacking in cover and provides a unique opportunity to increase near-shore, open water rock/stone and macrophyte habitat cover types and habitat connectivity to benefit multiple life stages of many species in the outer harbor (Figure 25).

Summerfest Lagoon: This project is currently at 90% design, which was completed by Ramboll, formerly O'Brien & Gere (OBG), for UWM SFS. The current design of the project has a cost estimate of roughly \$1.6M for implementation (as of September 2022). This Lagoon is well connected to Lake Michigan and often experiences temperature fluctuations due to seasonal changes and abrupt events (i.e. upwelling and seiche) in the outer harbor as well as significant water level fluctuations. The project design included considerations for these abrupt and seasonal changes to include, a shallower shoreline to allow for a better slope and provide additional cover to enhance what is sub-optimal nursery habitat. Introductions of rocky habitat are staged as tiers or shelves to allow similar slopes as an inland lake. Native macrophyte root stock and woody structures are proposed for placement along these shelves to provide more cover for fish. One goal of this project is to provide a better connection from the western shoreline to the eastern shoreline through rocky and woody cover. These project components were included based on the need to spread spawning habitat around the lagoon, instead of just in "pocket" locations.

Lead Implementing Agency/Organization: U.S. EPA GLNPO

Estimated Cost and Timeline (calendar year):

Project Phase	Cost	Timeline
Planning/Investigation	\$0	1.5 years [Underway]
Design/Permitting	\$200,000	1 year
Implementation/Construction	\$1,300,000	One Construction Season
Reporting/Maintenance/Establishment	\$100,000	2 years
Total	\$1,600,000	

NOTE: Previous cost estimate was from 2019. This cost estimation includes inflation as of September 2022.

- Best score possible for fish focal species
- Highest fish score out of all 34 high priority projects
- Provides the greatest enhancement for fish populations in the Lower Milwaukee Estuary/Outer Harbor



Figure 244. Outer Harbor (Summerfest Lagoon) Aquatic Enhancements. Locations of habitat improvements (Ramboll, 2020).



Figure 255. Outer Harbor (Summerfest Lagoon) Aquatic Enhancements. Spawning bed habitat plan on the western shoreline (Ramboll, 2020).

3.16 Project 16: Milwaukee River Downtown – E Cherry Street to N Humboldt Avenue Fisheries Improvements

The lower region of the Milwaukee Estuary AOC has limited fish habitat and cover in its three tributaries (Milwaukee River, Menomonee River, and Kinnickinnic River) due to channelization. Historically, the natural productivity, functions, and values of the Milwaukee Estuary were driven by extensive and diverse aquatic primary producers, local sediment transport, and morphology. Engineered vertical bulkheads, dredging for commercial navigation maintenance depth, sediment quality, and greatly reduced light transparency currently limit rooted aquatic plants. These lower portions of the tributaries are impacted by multiple river hydrology inputs (i.e. urban runoff, warm/cool water discharge, lake upwelling and seiche effects, etc.). Common seasonal water temperatures and flow regimes are impacted by all these factors. The Milwaukee River, being the largest and having the best water quality of the three tributaries, provides the best potential to generate better fish populations in the lower Milwaukee Estuary AOC. This section of the river is dominated by silt-- substrate and depths in most locations exceed the light penetrating photic zone. Other areas along the shoreline have experienced considerable shoaling and in combination with improved water quality provide potential habitat for macrophyte growth.

The Milwaukee River between E Cherry Street and N Humboldt Avenue (Figure 26), which stretches 0.9 miles, is part of GLLA project. The characterization of this section of river has been completed. Results from this characterization highlighted that reach four contains the most known remaining sediment contamination in the Milwaukee Estuary AOC (> 600,000 CY of sediments contain total PCB concentrations greater than 1mg/kg). This project will be completed as part of the post-remediation work in Reach 4 of the Milwaukee River as part of the GLLA project. The plan and design of this project will vary depending on the alternative that is selected for remediation in the Milwaukee Downtown reach of the Milwaukee River during the current FS. Implementing a fisheries project, bound by bulkhead steel sheet pilings, will require placing habitat features in specific locations to generate the best water flow throughout the year, while staying within regulations of potential changes to the floodplain.

Possible features include, but are not limited to: A meandering bottom morphology using clean, washed coarse gravels that may benefit spawning fishes and set as submerged bars with specific slopes and elevations to keep the flow in main channel; the addition of sand/gravel bars along channel sides at appropriate varying elevations; establishment of native rooted submergent, emergent, and floating macrophytes in shallow bars; enhancement of larger rock material to provide a majority of the cover on staggered, alternating sides of the channel to increase water flow; and enhancements to woody habitat by placing structures in combination with added boulders.

Lead Implementing Agency/Organization: U.S. EPA

Estimated Cost and Timeline for Implementation (calendar year):

Project Phase	Cost	Timeline
Planning/Investigation/Feasibility*	\$0 [underway]	2.5 years
Design/Permitting	\$500,000	2 years
Implementation/Construction	\$4,000,000	1 year
Reporting/Maintenance/Establishment	\$0	1-2 years
Total	\$4,500,000	

*Project Phase Underway

NOTE: Selected remedial action objectives will determine what can be constructed as part of this management action. Monitoring to be completed as part of post-remediation surveys.

- Best score possible for fish focal species (including northern pike & lake sturgeon)
- High score for fish sub-focal species
- Very important to meet the large river IBI and Lower Milwaukee Estuary fish metrics



Figure 266. Milwaukee River Downtown – E Cherry Street to N Humboldt Avenue Fisheries Improvements

4. Criteria for Measuring Fish and Wildlife Population Goals

Detailed Metrics for Degradation of Fish and Wildlife Populations

4.1 Fish Metrics

4.1.1 Lower Milwaukee Estuary AOC

(Downstream of the former North Avenue Dam on the Milwaukee River; Downstream of the N 25th Street on the Menomonee River; Downstream of W Becher Street on the Kinnickinnic River)

A stated criterion of BUI removal for native fishes within the Lower Milwaukee Estuary AOC is an increase of any magnitude in population abundance* in three focal species (lake sturgeon, northern pike, and greater redhorse) AND an increase of any magnitude in 80% of native focal families (suckers, minnows, and shiners, bullheads and catfishes, sunfishes, and perches) to be considered AND an overall mean value from all large river IBI sampling efforts of "Fair" or better (i.e. 41-60).

*Relative to the 2014-2016 USGS Study.

Note: Species and families below only apply to the Lower Estuary AOC population abundance metrics as large river IBI scores encompass all species that are captured during sampling.

Focal Species

Sturgeons – lake sturgeon* Pikes – northern pike Suckers – greater redhorse

*Lake sturgeon are actively being stocked in the Lower Milwaukee Estuary AOC.

Focal Families

Suckers – golden redhorse, shorthead redhorse, silver redhorse, longnose sucker Minnows and Shiners – emerald shiner, mimic shiner, rosyface shiner, sand shiner, spottail shiner, spotfin shiner, redfin shiner, blackstripe topminnow*, banded killifish* Bullheads and Catfishes – yellow bullhead, flathead catfish, channel catfish Sunfishes – bluegill, pumpkinseed, longear sunfish, black crappie, white crappie, largemouth bass, smallmouth bass, rock bass Perches – walleye, yellow perch *Blackstripe topminnow and banded killifish are in the family Fundulidae (topminnows) but are lumped with minnows and shiners for the purposes of this metric.

Note: Very tolerant species (i.e. white sucker, golden shiner, black bullhead, green sunfish) are not included on this list for the potential to skew focal family population abundance. Documenting new species (excluding invasive and very tolerant species) that have not been previously found in the lower estuary should be considered for this metric. New appearances are likely due to improving habitat availability for a larger diversity of species through restoration activities.

4.1.2 Upper Milwaukee Estuary AOC

(Upstream of Humboldt Avenue on the Milwaukee River to Bridge Road on Cedar Creek; Upstream of N 25th Street on the Menomonee River to Brown Deer Road on the Little Menomonee River; No upper reach for the Kinnickinnic River)

A stated criterion of BUI removal for native fishes within the Upper Milwaukee Estuary AOC is the presence of the focal species, lake sturgeon, utilizing spawning habitat in the upper reaches of the Milwaukee River, AND the presence of the focal species, northern pike, utilizing spawning habitat in the upper reaches of the Menomonee River AND an overall mean value of all warmwater IBI sampling efforts of "Good" or better (i.e. 51-65) in the upper reaches of the Milwaukee River AND an overall mean value from all warmwater IBI sampling efforts of "Fair" or better (i.e. 31-50) in the upper reaches of the Menomonee River.

After completing the management actions, a three-year post-implementation monitoring assessment will be used to determine if the metrics are being met. The post-implementation assessment for the lower estuary will mimic methodology and work completed by the 2014-2016 USGS Study. More frequent sampling is also recommended to capture variability from season-to-season and year-to-year. Additional sampling methodology should be considered for collecting a more holistic snapshot of focal fish population abundances. The post-implementation assessment for the upper estuary will follow warmwater IBI sampling protocols and generate an overall mean value of all warmwater IBI sampling efforts conducted over a three-year period in each of the upper portions of the Milwaukee and Menomonee Rivers. If complications or issues are encountered for sampling during the three-year post-implementation monitoring assessments (i.e. weather impacts, limited data collection, poor representative sample events), additional year(s) should be considered to build case for BUI removal.

*Fish metric boundaries for the Milwaukee Estuary AOC are shown on the next page.



*Upper and lower fish metric boundaries for the Milwaukee Estuary AOC.

4.2 Wildlife Metrics

The wildlife metrics assessment will include potential sites within a 0.5-mile buffer of the AOC and its tributaries. While the AOC boundary works well to determine ecological effects for river species, a larger area is needed to determine when recovery is met for wildlife species. In the 2014-2017 assessment, it was determined that a 0.5-mile buffer of the AOC and its tributaries was adequate to conduct a wildlife species inventory and determine what species were likely impaired due to the AOC. The 2014-2017 assessment area can be found in Appendix A. The post-implementation monitoring assessment will use the same 0.5-mile buffer of the AOC as the 2014-2017 assessment to determine if the metrics are being met for the reasons outlined below:

- Many Focal Breeding Bird Species are migratory.
- Many Focal Breeding Bird Species have a relatively large feeding range during the mating season.
- The tributaries are connected hydraulically to the AOC, thus, are also ecologically connected.
- Many of the Focal Mammal Species' range encompasses a large part of the study area.
- While the herptile groups do not have as large of a range as the mammal or breeding bird groups, restoring and maintaining these populations in areas adjacent to the AOC is essential to ensure there are source focal species populations adjacent to the AOC. Focal species found in the areas immediately adjacent to the AOC are more likely to re-establish or grow in numbers within the AOC.
- Matching the study area for the 2014-2017 assessment allows for some pre- and post-project implementation comparisons.

4.2.1 Breeding Birds

The breeding bird metrics are divided into five different habitat types as follows (Forest, Wetland, Shrubland, Grassland, and Airspace/Urban):

Forest and Wetland: At least 9 sites in the AOC support at least 2 breeding bird focal species for each habitat type.

Shrubland/edge and Grassland: At least 6 sites in the AOC support at least 2 breeding bird focal species.

Airspace/Urban Habitat: At least 9 sites support at least 1 breeding bird focal species.

After completing the management actions, a three-year post-implementation monitoring assessment will be used to determine if the metrics are being met. The post-implementation assessment will monitor sites for potentially breeding focal species during that species known breeding window via stationary point counts or acoustic surveys, which can include visual or auditory detection of a species. Point counts should be conducted following appropriate protocols and using breeding codes outlined in the <u>Wisconsin</u> <u>Breeding Bird Atlas II Handbook</u>. The breeding window for different species in Wisconsin is documented on the <u>Wisconsin Breeding Bird Atlas II Breeding Guideline Bar Chart</u>. A site will be considered supporting the focal species if the species, at a minimum, exhibits probable breeding behaviors based the Breeding Bird Atlas II Handbook for two of the three years monitored. Persistence at a site may also be used as evidence of probable breeding as documented by duration present during the breeding season using audio recorders. In the case of the * species, confirmed breeding behaviors, as described in the Wisconsin breeding Bird Atlas II Handbook, are required to consider the site to be supporting that species. Data collected from eBird during this period may also be used to supplement monitoring efforts.

Breeding Bird Focal Species:

Forest Habitat Species- American Woodcock, Veery, American Redstart*, Bald Eagle*, Redshouldered Hawk*, Black-billed Cuckoo, Carolina Wren, Hooded Warbler*, Yellow-breasted Chat*, Long-eared Owl*, Acadian Flycatcher*, Least Flycatcher, Merlin*, Nashville Warbler*, Ovenbird, Red Crossbill*, Red-headed Woodpecker, Wood Thrush*, Yellow-billed Cuckoo*, Blackand-white Warbler

Wetland Habitat Species- American Woodcock, Veery, American Redstart*, Bald Eagle*, Redshouldered Hawk*, Alder Flycatcher, Willow Flycatcher, Blue-winged Teal, Sedge Wren, American Bittern, American Black Duck, Bank Swallow, Black-crowned Night-Heron, Common Gallinule*, Great Blue Heron*, Great Egret*, Least Bittern*, Marsh Wren, Osprey*, Pied-billed Grebe, Purple Martin, Sora, Virginia Rail, Yellow-crowned Night-Heron*, Hooded Merganser, Green Heron, Wilson Snipe*

Shrubland/edge Habitat Species- American Woodcock, Veery, Black-billed Cuckoo, Carolina Wren, Hooded Warbler*, Yellow-breasted Chat*, Alder Flycatcher, Willow Flycatcher, Loggerhead Shrike*, Vesper Sparrow*, Blue-winged Warbler, Brown Thrasher, White-eyed Vireo*, Clay-colored Sparrow, Orchard Oriole, Field Sparrow

Grassland Habitat Species- Long-eared Owl*, Blue-winged Teal, Sedge Wren, Loggerhead Shrike*, Vesper Sparrow*, American Kestrel, Bobolink, Dickcissel, Eastern Meadowlark, Field Sparrow, Grasshopper Sparrow*, Henslow's Sparrow*, Western Meadowlark*, Clay-colored Sparrow, Orchard Oriole, Savanna Sparrow

Airspace/Urban Habitat- Purple Martin, Chimney Swift, Common Nighthawk*

4.2.2 Herptiles/Crayfish

The herptiles/crayfish metrics are divided into two different habitat types as follows (Semi-aquatic Habitat, Upland/Grassland Habitat):

Semi-aquatic

- At least 10 sites support at least one crayfish focal species.
 - At least one site needs to be supporting the Devil Crayfish
 - At least one site needs to be supporting the Digger Crayfish
 - At least one site needs to be supporting the Prairie Crayfish
- At least 15 sites support at least one frog focal species.
 - At least 6 of the focal species must be supported within the AOC to ensure that the AOC is supporting a variety of focal species.
- At least 8 sites support 1 focal salamander.
- At least 6 sites support at least one turtle focal species.
 - At least 3 of the focal species must be supported within the AOC to ensure that the AOC is supporting a variety of focal species.

Upland/Grassland

• At least 15 sites in the AOC support at least 2 different focal species of snakes.

After completing the management actions, a three-year post-implementation monitoring assessment will be used to determine if the metrics are being met. The presence of focal species on each site will be confirmed through proper survey methods, which may include visual encounter surveys, acoustic surveys
(frog only), turtle basking, trapping, and nesting surveys, aquatic funnel traps, and snake cover board surveys. This post-implementation assessment will also assess each site for evidence of reproduction such as egg masses or juvenile age classes present.

Support Criteria:

Crayfish: A site will be considered supporting crayfish if both sexes and multiple ages classes are present or evidence of reproduction, such as females carrying eggs or persistence at the site during the breeding season, is present during two of the three years monitored.

Frogs: A site is considered supporting focal frog species if calling males during their breeding season are confirmed for at least two of the three years monitored, or tadpoles or eggs are confirmed for at least two of the three years monitored.

Salamanders: A site is considered supporting a focal salamander species if egg mass or trapping surveys confirm the presence of eggs, adults are present at a breeding pond, or the species is persistent during the breeding season for at least two of the three years monitored.

Turtles: A site is considered supporting focal turtle species if the species is present for at least two of the three years monitored and evidence of breeding is obtained for one of the years present, such as nesting observed, adult females carrying eggs (as evidenced by palpation or radiography), or presence of juvenile age classes.

Snakes: A site is considered supporting focal snake species if the species is present for at least two of the three years monitored, and gravid females or juvenile age classes are documented for one of the years present at the site.

Herptiles/Crayfish Focal Species:

Crayfish Species- Devil Crayfish, Digger Crayfish, Prairie Crayfish Frog Species- Cope's Gray Treefrog, Gray Treefrog, Wood Frog, Spring Peeper, Boreal Chorus Frog, Northern Leopard Frog, Green Frog, Blanchard's Cricket Frog Salamanders- Blue spotted salamander, Spotted Salamander, Eastern Tiger Salamander, Common Mudpuppy, Central Newt Turtle Species- Eastern Spiny Softshell, Northern Map Turtle, Blanding's Turtle, Eastern Musk

Turtle

Snake Species- Butler's Gartersnake, Common Gartersnake, Eastern Milksnake, Dekay's Brownsnake, Northern Red-bellied Snake, Common Watersnake, Eastern Foxsnake, Queensnake

4.2.3 Mammals

The AOC will target five focal species.

The metric will be considered met if at least 5 sites in the AOC support at least 2 mammal focal species, and each focal species occupy at least one site within the AOC.

After completing the management actions, a three-year post-implementation monitoring assessment will be used to determine if the metrics are being met. The post-implementation assessment will monitor sites for the presence of mammals using standard survey techniques that may include trail cameras, winter track surveys, and/or visual encounter surveys. Third party records may also be utilized if available, such as Zooniverse reports with photo documentation that can be verified. In this assessment, a site will be considered supporting a focal species if the mammal is documented on the site on multiple occasions within a year or evidence of reproduction is obtained (e.g., nesting or pups present) for at least two of the three years of monitoring.

Mammal Focal Species- American Beaver, American Mink, North American River Otter, Common Muskrat, Star-nosed Mole

5. Summary Criteria for Measuring Fish and Wildlife Population Goals Summary of Metrics for Degradation of Fish and Wildlife Populations

Fish – Lower Milwaukee Estuary

- An increase of any magnitude in population abundance in three focal species*
- Increase of any magnitude in 80% of native focal families
- Overall mean value from all large river IBI of "Fair" or better (i.e. 41-60)

*Relative to the 2014-2016 USGS Study.

Fish – Upper Milwaukee Estuary

- Presence of lake sturgeon utilizing spawning habitat on the Milwaukee River
- Presence of northern pike utilizing spawning habitat on the Menomonee River
- Milwaukee River: Overall mean value from all warmwater IBI of "Good" or better (i.e. 51-65)
- Menomonee River: Overall mean value from all warmwater IBI of "Fair" or better (i.e. 31-50)

Wildlife

Breeding Birds

- Forest Habitat: At least 9 sites in the AOC support at least 2 breeding bird focal species
- Wetland Habitat: At least 9 sites in the AOC support at least 2 breeding bird focal species
- Shrubland/Edge Habitat: At least 6 sites in the AOC support at least 2 breeding bird focal species
- Grassland Habitat: At least 6 sites in the AOC support at least 2 breeding bird focal species
- Airspace/Urban Habitat: At least 9 sites in the AOC support at least 1 breeding bird focal species

Mammals

• At least 5 sites in the AOC support at least 2 mammal focal species, and each focal species occupy at least one site within the AOC

Herptiles/Crayfish

Semi-Aquatic

- Crayfish: At least 10 sites support at least 1 crayfish focal species
 - At least one site needs to be supporting the *Devil Crayfish*.
 - At least one site needs to be supporting the *Digger Crayfish*.
 - At least one site needs to be supporting the *Prairie Crayfish*.
- Frogs: At least 15 sites support at least 1 frog focal species
 - At least 6 of the focal species must be supported within the AOC to ensure that the AOC is supporting a variety of focal species.
- Salamanders: At least 8 sites support focal salamanders
- Turtles: At least 6 sites support at least 1 turtle focal species
 - At least 3 of the focal species must be supported within the AOC to ensure that the AOC is supporting a variety of focal species.

Upland/Grassland

• Snakes: At least 15 sites in the AOC support at least 2 different focal species of snakes.

According to the target that was finalized in April 2020, RAP updates will be evaluated to reflect current conditions.

These conditions will be determined in a post-verification monitoring effort to show that the management actions addressed the status of this BUI. See Appendix A for more information.

6. Milwaukee Estuary AOC Technical Advisory Committee

EA, Engineering, Science, and Technology GEI Consultants Great Lakes Ecological Services, LLC. Harbor District, inc. Milwaukee County Parks Milwaukee Metropolitan Sewerage District Milwaukee Riverkeeper Ozaukee County Planning and Parks Resource Environmental Solutions River Revitalization Foundation Short Elliott Hendrickson, Inc. Southeastern Wisconsin Regional Planning Commission Urban Ecology Center U.S. Army Corps of Engineers

U.S. Environmental Protection Agency Great Lakes National Program Office

U.S. Fish and Wildlife Service

Community Advisory Committee

U.S. Geological Survey

University of Wisconsin - Milwaukee School of Freshwater Sciences

Wisconsin Department of Natural Resources

7. List of Acronyms

AOC	Area of Concern
AOI	Area of Interest
ACM	Articulate Concrete Mat
BUI	Beneficial Use Impairment
CAC	Community Advisory Committee
DNR	Wisconsin Department of Natural Resources
EAQL	Equality and Quality of Life
EPA	U.S. Environmental Protection Agency
ERMP	Ecological Restoration and Management Plan
FOH	Friends of Havenwoods
FS	Feasibility Study
GLLA	Great Lakes Legacy Act
GLNPO	Great Lakes National Program Office
GLRI	Great Lakes Restoration Initiative
HDI	Harbor District, inc.
HSF	Havenwoods State Forest
IBI	Index of Biotic Integrity
LMR	Little Menomonee River
MAL	Management Action List
MCP	Milwaukee County Parks
MGP	Manufactured Gas Plant
MMSD	Milwaukee Metropolitan Sewerage District
MRG	Milwaukee River Greenway
MRK	Milwaukee Riverkeeper
OBG	O'Brien & Gere
OCPP	Ozaukee County Planning and Parks
OWLT	Ozaukee Washington Land Trust
PA	Project Agreement
RAP	Remedial Action Plan
RD	Remedial Design
RRF	River Revitalization Foundation
SEH	Short Elliott Hendrickson, Inc. (SEH)
SEWRPC	Southeastern Wisconsin Regional Planning Commission
SFS	School of Freshwater Sciences
Tech Team	Fish and Wildlife Technical Advisory Committee
UEC	Urban Ecology Center
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWM	University of Wisconsin – Milwaukee
VdP	Ville du Parc

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9. Populations-to-Metrics Management Action Matrix

	Breeding Birds					Semi-Aquatic					
SITE AREAS	Forest	Wetland	Shrubland/Edge	Grassland	Airspace/Urban	Crayfish	Frogs	Salamander	Turtle	Snakes	Mammals
Management Actions											
Havenwoods State Forest Rehabilitation		1	1	1	0	1	1			1	0
Milwaukee County Grounds, Menomonee River Parkway Section 9, Hoyt Park, and MMSD Basins Wildlife Enhancements		1	1	0	0		1			1	0
Kletzsch Park Wildlife Enhancements		1	0	0	1		0		1	0	1
Schlitz Audubon Cleaver Property Enhancements		0	0	0	0	1	0	1	1	1	1
Menomonee River Parkway - Sections 5 and 6 Enhancements		1	0	0	0	2	2	1		1	1
City of Mequon Parks and Ozaukee Washington Land Trust (OWLT) Ville du Parc Property Enhancements		1	0	0	0	2			1	2	1
Milwaukee River Greenway Parks Enhancements		1	1	0	0	1		1	1	2	1
Little Menomonee River Parkway - Section 1 Fish and Wildlife Enhancements		1	1	1	1	1	1		1	1	1
Kohl Park Wildlife Enhancements		1	1	1	2		2			2	0
Habitat Management Project Locations Anticipated to meet the metric											
Little Menomonee Parkway Grassland Restoration Project										2	
Bay View Wetland/Grand Trunk Wetland Restoration										1	
Total Non-Management Actions locations meeting metric (2014-2017)											
Schlitz Audubon Nature Center		1	1		1		1	1	1		
Noyes Park				1			1				
Veterans Park				1							
St. Francis Archdiocese				1	1			1			
Lake Park					1						
South Shore Park					1						
Three Bridges Park					1						
Brown Deer Park					1		1				
MMSD Property Western Corner of AOC						1	1			1	
MKE County Parks Land Near Granville Dog Park						1	1	1			
Little Menomonee Parkway							3				
Menomonee River Parkway							1				
Milwaukee County Zoo								1			
Lynden Sculpture Garden							1	1			
Total Sites Anticipated to Meet the Metric	9	9	6	6	10	10	17	8	6	15	6
METRIC GOAL (Sites Species)	9 2	9 2	6 2	6 2	9 1	10 1	15 1	8 1	6 1	15 2	5 2

KEY	
	Maintain habitat that is already here; do no harm to populations already occupying area.
	Already meeting metric at this site; assume maintaining habitat that is already here; do no harm to populations alre
	This project area is close to meeting the metric at this project location, or the 2014-2017 assessment indicated the
	felt that this area would be unlikely to meet the metric again in the post-verification monitoring. More work is need
	Targeted species work needed at this site to meet metric.
	Assume targeted work done for other species at this site will also benefit this species and contribute to meeting me
	is planned at the site.
	Focal species are unlikely to occupy this project area.

According to the Populations-to-Metrics Management Action Matrix, the Milwaukee Estuary AOC should have enough sites supporting focal species to meet wildlife population metrics after the sediment remediation is completed, population and habitat projects have been implemented, and an adequate recovery time has passed.

NOTE: Numbers in each cell of the above matrix are associated with the number of sites that are contributing to achieving wildlife metrics for BUI removal.

eady occupying area.

metric is being met, but the tech team ded.

etric; no targeted work for this species