

**DELISTING TARGETS FOR LOSS OF FISH & WILDLIFE HABITAT BENEFICIAL USE IMPAIRMENT AND
DEGRADATION OF FISH & WILDLIFE POPULATION BENEFICIAL USE IMPAIRMENT
OF THE DETROIT RIVER AREA OF CONCERN**

Prepared by:
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Fish & Wildlife Technical Committee

Submitted to:
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Lansing, Michigan

With assistance from:



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**PRIORITY PROJECTS FOR THE DETROIT RIVER AOC
TO ADDRESS THE FISH & WILDLIFE HABITAT AND POPULATION BUIs**

Projects Required for BUI Removal:

1. Detroit River Reefs (NE Belle Isle, Fort Wayne, Fort Wayne Expansion, and NE Grassy Island)
2. Detroit Riverfront Parks restoration
3. Belle Isle Forested Wetland Restoration
4. Lake Okonoka Restoration with River Connection
5. Milliken State Park Pocket Marsh with River Connection
6. Grassy Island Shoal Restoration
7. Hennepin Marsh Restoration
8. Stony Island Shoal Reconstruction
9. Sugar Island Restoration
10. Celeron Island Restoration and Shoal Construction

Completed (or near completion) projects Required for BUI Removal:

1. Blue Heron Lagoon Restoration – Funded
2. Shoreline Restoration near South Fishing Pier – Funded
3. US Steel Shoreline Restoration – Funded*
4. Restoration of Fish & Wildlife Habitat at Wayne County's Refuge Gateway – Complete.

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1.0 INTRODUCTION

The Detroit River Area of Concern (AOC) delisting targets project was initiated to define “how clean is clean” for the Detroit River watershed and develop endpoints that would allow for the ultimate delisting of the area as an AOC under the Great Lakes Water Quality Agreement. This report presents the delisting targets for fish and wildlife habitat and population-related Beneficial Use Impairments (BUIs), and presents an acceptable approach to the fairly common situation where the RAP documents do not recommend site specific actions and the restoration plans recommended for delisting targets need to be developed relatively independent of the existing RAP.

Current MDEQ guidance for developing BUI delisting targets includes the need to develop local restoration plans for Degraded Fish and Wildlife Populations and Loss of Fish and Wildlife Habitat. The approach reflected in the ultimate delisting target recommendations within this report reflect the need to develop the necessary site specific inventory, prioritization, and implementation steps that are part of the local restoration plan needed to actually accomplish BUI removal. These draft plans have been finalized with the assistance of the Technical Committee. The site specific projects identified as a part of setting the delisting targets include all of the potential habitat restoration projects deemed feasible by the Technical Committee considering site specific impairments, property ownership, and other considerations. Implementation of these projects will be a key step to accomplish BUI removal and a move toward full restoration thus benefiting the area residents and users of the Detroit River as well as Lake Erie.

The *Supporting Guidance for Local Restoration Criteria Development: Loss of Fish and Wildlife Habitat and Degradation of Fish and Wildlife Population* published by MDEQ outlines the process for developing delisting targets for habitat and population BUIs within Michigan’s AOCs. The guidance identifies the following six components and steps that are required for developing a local, site specific restoration plan:

- A. Narrative on the historical habitat and population issues in the AOC;
- B. Description of the impairment(s) and location for each site;
- C. Locally derived restoration target for each site;
- D. List of all on-going related habitat and population planning processes in the AOC;
- E. Scope of work for each site, including:
 1. Timetable,
 2. Funding,
 3. Responsible entities,
 4. Indicator & Monitoring,
 5. Public involvement; and
- F. Method for project reporting to MDEQ.

All items, 1 through 6, are addressed in this document. Section 2 introduces the project and provides a rationale for developing targets. Section 3 describes the historical fish and wildlife habitat and population issues in the AOC and describes the important linkages between water quality and these observed fish and wildlife impairments. Section 4 provides needed information regarding the actual fish and wildlife habitat and population impairments across the AOC, including the connections to the original issues identified in

the Detroit River Remedial Action Plan. Section 5 leads into the discussion of the actual restoration targets with supporting background information. Section 6 provides an outline of ongoing planning processes and implementation projects across the AOC that have demonstrated improvements to these habitat and population impairments. Section 7 provides a list of restoration projects, each with a defined scope of work, needed to work towards removing these two BUIs. Finally, Section 8 outlines a mechanism for reporting to the MDEQ on progress made of the implementation process.

This report was updated in 2013 to include projects that were omitted during the previous revision. This is intended to be the final version of this report and is based upon the best science available at the time of the revision. Once all projects listed in Section 7 are completed, the PAC will recommend the removal of the fish and wildlife habitat and population BUIs. During the process of updating the list of priority projects, some projects were removed, some projects were combined, and some projects were added. All projects on the updated list have been updated to reflect the needs of the River as of 2013.

The revised target projects list, including the most up-to-date information about these projects, can be found in Section 7.

The following describes the four target projects that the Habitat Subcommittee deemed unfeasible and removed from the original list:

- *Lake Muskoday Restoration Project*: Completed.
- *Maheras Park Restoration Project*: Completed.
- *Gabriel Richard Park Restoration Project*: Completed.
- *Historic Fort Wayne Restoration Project*: possible complications due to historic nature of the site, desired improvements (focus on snake habitat by creating “no mow” buffer) would be a little/no cost and could be accomplished via side conversations with the City of Detroit and interested stakeholders.
- *Frank & Poet/Brownstown Creek Floodplain Preservation and Restoration Project*: some land has been acquired. The publicly owned parcels require no restoration and there are no plans for future acquisition by USFWS or the Refuge Gateway.
- *US Steel Shoal Reconstruction*: Permitting constraints prevented this portion of the originally listed project to move forward.
- *Hennepin Marsh Shoal Reconstruction*: The habitat protected from the original shoal is still thriving. The committee members decided to leave this area undisturbed, as construction activities could cause more harm than necessary.
- *Round Island Conservation Project*: The island is currently under private ownership. There is no interest in conservation easement.

The purpose of this report is to outline the criteria for the removal of the Loss of Fish and Wildlife Habitat Beneficial Use Impairment (BUI) and the Degradation of Fish and Wildlife Population BUI from the Detroit River Area of Concern (AOC). The criteria allow for protection and restoration of the fish and wildlife habitat in the AOC and clearly define an end point for removing the Loss of Fish and Wildlife Habitat BUI. The delisting targets are presented on a project basis and were developed independent of the existing Remedial Action Plan (RAP). This planning document provides an acceptable solution to the fairly common situation where the RAP did not include specific targets for removal of each BUI. Following a project criterion, ten target habitat restoration projects are described. Successful completion of these projects will signify that these BUIs can be removed from the Detroit River AOC.

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2.0 PROJECT INTRODUCTION AND RATIONALE

The original listing of the Areas of Concern (AOCs) within the Great Lakes was based on the presence of Beneficial Use Impairments (BUIs). These BUIs were defined by the International Joint Commission (IJC) along with generalized criteria for determining when a BU was impaired. (Statewide PAC for Michigan Areas of Concern Program 2004). The first set of guidance for delisting targets was put forth in 1991 by the IJC. These criteria were fairly general, and led to a more specific set of guidance published by the U.S. Environmental Protection Agency (EPA) in 2001 (U.S. EPA 2001).

In 2008, the Michigan Department of Environmental Quality (MDEQ) updated their final delisting document applicable to AOCs within the Michigan portion of the Great Lakes (MDEQ 2008). The MDEQ guidance is very specific regarding targets for non-habitat related BUIs and, in general, can be applied throughout Michigan with minimal variation. In developing the guidance however it became apparent to the MDEQ that it would be impossible to adopt a single target for habitat/population related BUIs that could be applied throughout Michigan. There are often significant variations within an AOC with respect to the habitat and the ability of the restored habitat to support the same number and kinds of fish and wildlife populations. This observation is magnified, if a single target were applied throughout all the Michigan AOCs. Therefore, MDEQ's guidance for fish and wildlife habitat and populations related BUIs removal is based on a criteria setting process, and requires the development and implementation of an AOC-specific restoration plan for removing the habitat related BUIs within that specific AOC. MDEQ will review and approve the restoration plan and the final delisting targets determined by the Public Advisory Council in each AOC. The State of Ohio has also released a delisting guidance document (Ohio EPA 2005). These and other AOC-specific criteria were considered in the development of delisting targets for the Detroit River AOC.

The primary goal of developing delisting targets is to create a plan for the delisting/restoration of the AOC. The delisting targets develop an endpoint for measuring progress in the remediation of the river and restoration of the fish and wildlife BUIs that were identified within the AOC and documented in the Detroit Remedial Action Plans (RAP).

Ecosystem health is important to humans as well as to the fish and wildlife. The restoration of beneficial uses contributes to maintaining genetic diversity and healthy populations of fish and wildlife. The development of the fish and wildlife population and habitat related delisting targets for the Detroit River AOC will provide the tools necessary to implement actions needed to restore the environmental and/or genetic integrity of fish and wildlife within the Detroit River AOC.

The Remedial Action Plan (RAP) process for the Detroit River identified eleven of the Great Lakes Water Quality Agreement's 14 beneficial uses as impaired. This document focuses on the BUIs of "Loss of Fish and Wildlife Habitat" and "Degradation of Fish and Wildlife Populations."

3.0 HISTORICAL FISH & WILDLIFE HABITAT AND POPULATION ISSUES IN THE AOC

The bi-national Detroit River AOC drains an area approximately 700 square miles that includes land in Michigan and Ontario and over 107 square miles of the Detroit watershed. In total, 607.7 square miles (75 percent) of the AOC is within Michigan boundaries (EPA 2008). The Detroit River itself runs a total of 32 miles as it progresses from Lake St. Clair to Lake Erie. Along the way, the river passes through a heavy industrialized landscape with remnants of unique upland forests, coastal wetlands, and numerous islands. It can be misleading to think of the Detroit River as a typical river with a dendritic watershed – instead, it is a Connecting Channel, draining the Upper Great Lakes. Ninety-five percent of the total flow enters the river from Lake Huron via the St. Clair River and Lake St. Clair (MDNR 1991). There are five Michigan tributaries to the Detroit River, including the Rouge River, and AOC in its own right; Conners Creek; Monguagon Creek; Ecorse Creek; and the Frank and Poet Drain. Three additional tributaries drain the Ontario portion of the watershed: Turkey Creek, Little River, and Canard River. Lake St. Clair and two more AOCs, the Clinton River AOC and the St. Clair River AOC, are immediately upstream. Every day, the river receives waste discharges from a wide variety of industries, and provides habitats for a wide variety of fish and wildlife populations.

More than 80 political jurisdictions exist within the river's 711.97 square mile watershed, including the cities of Detroit and Windsor with combined populations of approximately five million people. About 90 percent of the river's Canadian watershed is devoted to agricultural uses while on the U.S. side, 30 percent is agricultural. On the river's U.S. side 30 percent is residential, 10 percent is industrial, and the remainder is urban. About 28.58 miles of the U.S. shoreline is privately owned and 87 percent of it has been filled and bulkheaded (Manny and Kenaga 1991).

In terms of fish and wildlife populations, the Detroit River functions as an important component of the Great Lakes Ecosystem. The Detroit River is one of 34 Waterfowl Habitat Areas of Major Concern in the United States due to the presence of significant amounts of breeding wetland habitat that is integral to over two hundred migratory bird species (Licari and Dean 2004; Wilke 2006). Southeastern Michigan sits at the convergence of the Mississippi and Atlantic flyways, two major bird migration routes in North America (Bull and Craves 2003; Wilke 2006). Furthermore, there are 27 species of waterfowl that frequent Michigan's coastal wetlands during migration, at least 17 species of raptors, 48 species of non-raptors, and numerous species of dragonflies and butterflies (Manny 2003).

Beyond providing important habitat for bird species, the Detroit River is home to over 76 fish species, 54 of which are native (Manny et al. 1988). The wetlands of the Detroit River also provide spawning and nursery habitat for 50 fish species (Hintz 2001; Wilke 2006). As a result, the river provides some of the Nation's most productive sport fisheries for walleye, bass, and muskellunge (Manny 2003). There are also over three hundred species of benthic animal populations that provide a major food source for fish populations in this river (Wilke 2006).

In 1815, the Detroit River shoreline consisted of coastal wetland up to a mile wide on each side (Manny and Fiebich 2001). There were submersed marsh, emergent marsh, wet meadow, shrub swamp, swamp forest, and lakeplain prairie vegetative types present. Since 1815, due to channel modification, encroachment of the river, hardening of the shoreline, addition of sheet steel, cement walls, fill material, development, and contamination there have been dramatic changes (Manny 2003). Over the last few centuries the Detroit River has seen a loss of approximately 99 percent of its original coastal wetlands. In 1815 there were

approximately 10.687 square miles of coastal wetlands. By 1982, this number has decreased to only 0.1165 square miles (Manny 2003). Other losses of habitat can be attributed to removal of bedrock limestone spawning grounds for whitefish, losses of wooded areas to agriculture, and contamination from waste effluents (Manny 2003). One important feature, the Detroit River International Wildlife Refuge, contains a significant portion of the remaining wetland area. Another important area, the Fish and Wildlife Service's Humbug Marsh Unit, contains seventy-six different fish species and represents the last remaining mile of undeveloped Michigan shoreline (Gannon 2001; Wilke 2006). Furthermore, the river also carries the distinctions of American Heritage River, Canadian Heritage River, and the only bi-national heritage river in the world (USFWS 2005; Wilke 2006).

The Detroit River AOC contains important fish and wildlife populations as well as habitat. Due to a loss of habitat with industrialization and urban development, high levels of persistent contaminants, excessive phosphorus loading, and other factors, the AOC has been degraded. Table 3.1 shows the status of the beneficial use impairments of degradation of fish and wildlife populations, as well as loss of fish and wildlife habitat.

The Detroit River RAP 1996 document listed a number of water use goals that were being used to guide the development and implementation of the plan. A primary use goal provided an overarching vision:

To restore and maintain the integrity of the Detroit River Ecosystem to a standard that will provide a safe, clean and self-sustaining natural environment such that (1) self-reproducing, diverse biological communities are restored and maintained, and (2) the presence of contaminants does not limit the use or appreciation of fish, wildlife or waters of the river.

It also listed several general water use goals and specific goals for each of the BUIs. Over time however, it has become apparent that these goals do not provide an adequate basis for measuring restoration. The site-specific and population-specific restoration targets that have been developed in this document provide a clear, measurable path to the restoration of the Detroit River's wildlife habitats and populations. Table 1 lists the two BUIs, along with the associated original water use goals and status as documented in the 1996 RAP report.

Table 1 – Water Use Goals for the Habitat and Population BUIs

Use Impairment	Specific Water Use Goal	Status Documented in 1996 RAP Report
Degradation of fish and wildlife populations	To maintain a healthy, diverse and self-sustaining fish and wildlife community	The fish community is now structured more toward benthivores than it was originally, however over 60 species have been found in the river, with fish occupying all niches. Wildlife populations in the AOC have decreased due to urbanization. Some loss of reproductive capacity has occurred (bald eagles), however, this appears to be a problem associated with conditions in the Great Lakes Basin rather than specific to the Detroit River.

Use Impairment	Specific Water Use Goal	Status Documented in 1996 RAP Report
Loss of fish and wildlife habitat	Wetlands shall be maintained at zero loss in the AOC, and no net loss of the productive capacity of fish habitats. Remediation, amelioration and restoration of wetlands shall be conducted whenever feasible. Management plans for fish and wildlife should be developed, and subsequently evaluated to determine if the current level of habitat supports the management plans' goals. Additional evaluation is necessary to determine the effects of water and sediment quality on biota.	This use is impaired as a result of significant loss of wetlands and habitat which has occurred due to industrial development and urbanization. It is recognized that existing wetlands in the AOC should be protected. Draft fish community goals also emphasize the achievement of no net loss productive capacity of fish habitats and the restoration of habitats wherever possible. Fish and wildlife management goals are needed to help further determine the extent of impairment and guide further rehabilitation strategies. Impairments due to water quality concerns had not been adequately documented. This area of study needs further evaluation.

4.0 CURRENT HABITAT AND POPULATION IMPAIRMENTS AND NOTABLE AREAS

4.1 DEGRADATION OF FISH AND WILDLIFE POPULATIONS

Despite the extensive alterations of the Detroit River that have resulted in significant habitat reductions, the Detroit River is still able to support diverse fish and wildlife populations (Manny 1991; 2003). The Detroit River provides habitat for 82 species of phytoplankton, 31 species of aquatic macrophytes, 300 species of macrozoobenthos, 54 native species of fish, 27 species of waterfowl, and numerous species of mammals (Bull and Craves 2001). Owing to conflicted uses of the Detroit River, between waste disposal, water withdrawals, shipping, recreation, and fishing, innovative management will be necessary to preserve and improve fish and wildlife populations. Impacts that have resulted from centuries of mismanagement include genetic mutations in bacteria, death of macroinvertebrates, accumulation of contaminants in insects, clams, fishes, and ducks, and tumor formation in fish. Studies have also shown that areas of the river bottom that may otherwise be suitable for habitation by plants and animals were contaminated with chlorinated hydrocarbons and heavy metals and occupied by pollution tolerant worms (Manny and Kenaga 1991; Szalinska et al. 2006).

Fish Populations

Historically, the Detroit River was known for large spawning runs of lake whitefish, lake herring, and lake trout, which provided a tremendous economic resource in the area. The river was also an important spawning ground for the lake sturgeon, now a State Threatened species. As the rock outcroppings that were used for spawning were destroyed during construction of the shipping channel and water pollution increased, the spawning runs stopped by the early 1900s (Manny 1988).

The 1991 RAP Stage 1 noted that there were at least 65 species of fish commonly found in the river. Historically another 40 species had lived in or migrated through the corridor but were no longer present. Since then, of the species it listed as common, pugnose minnow is now listed as State Endangered, mooneye, sauger, and river herring are listed as State Threatened, and Silver Chub and Spotted Gar are listed as Species of Special Concern (MNFI & MDNR 1999).

More recently, 56 species of fish, representing 16 families were collected in the Detroit River during a young-of-the-year survey by MDNR, USGS, and USFWS (Citation needed from Jim Francis). Additionally, evidence of spawning by 14 species of native fish and 2 species of exotic fish was noted in constructed spawning beds near Belle Isle at the head of the river. Species using the beds included walleye, yellow perch, lake whitefish, smallmouth bass, and white bass, as well as the State Endangered northern madtom (Manny 2006; Manny et al 2007). The lower sections of the Detroit River are also a major spawning ground for fishes of the river as well as western Lake Erie (Manny 1991).

Fish populations in the Detroit River are negatively affected by contaminated sediment. Studies have found that larval channel catfish fed significantly more slowly when exposed to contaminated sediments from the Trenton Channel. When 'eyed' eggs of rainbow trout were injected with dilute extracts from the Detroit River, increased embryo mortality increased two to three fold. One year after the injection, three percent of the surviving fish have liver neoplasms. Neoplasms and pre-neoplastic lesions were also found on brown bullhead, walleye, herring, white sucker, and bowfin. Dermal or oral neoplasms were found on 14.4% of the bullhead and on 4.8% of the walleye, while liver neoplasms were found in 15.4% of the bowfin. The lower sections of the Detroit River are a major spawning ground for fishes of the river as well as western Lake Erie. Of the 39 species that spawn in or near the mouth of the Detroit River, all but one deposits their eggs on the river bottom where they are exposed to contaminated sediment (Manny and Kenaga 1991).

Comment [m5]: Does this need updating?

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Over the last few years, lake whitefish have spawned successfully in the Detroit River (Roseman et al. 2007) and increases have occurred in the lake sturgeon, walleye, and yellow perch populations in the Detroit River and Lake Erie. These are considered applicable indicators for the assessment of ecosystem health. During the early 1900's, spawning runs disappeared due to habitat loss, habitat degradation, overfishing, and pollution. In the 1960's and 1970s, lake whitefish population numbers were at an all time low. By the 1980s, a modest recovery could be seen and then, in 2006, the first confirmed spawning and successful reproduction of lake whitefish in the Detroit River was documented (Hartig 2007). The recovery of the lake sturgeon population very closely mimics the path of the lake whitefish. The lake sturgeon was abundant in Lake Erie and the Detroit River in the 1800s but populations declined due to habitat degradation and overfishing. In the 1900s, lake sturgeon began a modest recovery with the first reported sturgeon spawning in the Detroit River taking place in 2001 (Hartig et al. 2007).

Walleye live and breed in Lake Erie and the Detroit River (Manny et al. 2007). Walleye are top predators in the food webs of Lake Erie and the Detroit River making them an applicable indicator of ecosystem health. Walleye populations declined through the mid-twentieth century, and in 1970, were prohibited from consumption due to high concentrations of mercury. Through a combination of harvest quota management and improvements in water quality, the walleye population increased through the 1980s and in the last five years has been deemed "high quality" (Hartig et al. 2007). Angling effort on the Detroit River in 2002 and 2004 averaged nearly 813,000 angler hours (Thomas and Towns 2008 [in review]). This was well above the average angler effort in 1983 and 1984 (Haas et al. 1985) and is possibly the only substantial fishery in the Great Lakes waters of Michigan which increased between the early 1980s and early 2000s. The spring walleye fishery on the Detroit River has grown in popularity over the past 20 years, with numerous articles written and television fishing shows recording walleye fishing trips on the Detroit River during March and April (Thomas and Towns 2008 [in review]).

Walleye tagging studies have provided clear evidence of substantial movement of walleye from spawning locations in Lake Erie northward through the Detroit River, Lake St. Clair, the St. Clair River, and further into Lake Huron (Thomas and Haas 2005). Tagged walleye recoveries and catch locations have allowed crude estimates of the number of Lake Erie walleye migrating into the Detroit River on an annual basis. Based on the geographical distributions of tag recoveries from various tagging sites in Lake Erie, the number of migrants leaving Lake Erie and migrating north into the St. Clair system is roughly 10% of the adult population abundance of walleye in Lake Erie (Robert Haas, MDNR, personal communication). For example, when the Lake Erie adult walleye population was near 60 million in 1984 (Thomas et al. 2007), there were likely 6 million walleye migrating through the St. Clair system. Similarly, when the Lake Erie adult walleye population declined to near 14 million fish in 2004, the estimated number of walleye migrating through the St. Clair system was probably around 1.5 million fish. Creel survey estimates for the walleye harvest during the spawning run (March through May) in Michigan waters of the Detroit River were only 90,717 in 2002 and 40,027 in 2004. The walleye harvest in the Detroit River was also estimated in 2000 with a 9-week creel survey from March 11 to May 16 (Francis 2005). That survey resulted in an estimated harvest of 97,292 walleyes. The average of these three harvest estimates (76,012) is only 5% of the lowest estimate of the Detroit River walleye run of 1.4 million for the time period. So, even in the years of the lowest walleye runs in recent times, we estimate that 95% of the walleye "spawners" migrating north from Lake Erie, escape Michigan Detroit River anglers. There are additional walleye caught on the Canadian side of the river, which were not included in these creel surveys. However, limited access sites in Ontario and much lower human population densities, combined with anecdotal information from anglers, leads us to believe that fewer walleye are taken on the Canadian side (compared to the Michigan side) of the Detroit River each spring. In summary, the combined Michigan and Ontario catch of spawning adult walleye each spring is very likely less than 10% of the entire walleye run (Thomas and Towns 2008 [in review]).

Another species of concern is the yellow perch. The yellow perch is lower in the food chain than the walleye, and its population fluctuates more widely, but is highly prized as a sport and commercial fish. The yellow perch population peaked in the 1880s and decreased until the early 1900s when it reached an all-time low. Since the 1990s, the yellow perch population has begun to increase, coinciding with the return of *Hexagenia* (an important food source) (Hartig et al. 2007).

Bird Populations

The Detroit River is an integral ecosystem to the many migratory species that pass through Southeastern Michigan each year. Scientists have found that the Detroit River is at the intersection of two major flyways for birds and insects, including:

- 27 species of waterfowl;
- 17 species of raptors, including eagles, hawks, and falcons;
- 48 species of non-raptors, including loons, warblers, neo-tropical songbirds, cranes, and shore birds; and
- 35 species of dragonflies and butterflies (SOS 2001).

According to the North American Waterfowl Management Plan, an agreement between the U.S., Canada, and Mexico to restore waterfowl populations and improve habitat for other wetland dependent wildlife, the Detroit River contains “significant, international, waterfowl habitat of major concern.” Along with this distinction, the Detroit River was nominated as a focus area for habitat restoration by the U.S. Fish and Wildlife Service and as a Biodiversity Investment Area (BIA) by the U.S. EPA and Environment Canada (Manny 2003). The area was designated as an Important Bird Area (IBA) in September 2007.

The canvasback is known to use the Detroit River as a stopover site during its spring and fall migrations. The canvasback requires large amounts of food such as wild celery, pondweeds, sedges, and other aquatic plants. Until the 1970s, the population of canvasbacks had declined dramatically as a result of droughts, market hunting, development, industrial/sewage discharges, and agricultural conversion of wetland breeding areas. In the last few decades, population numbers have increased as a result of conservation efforts, rainfall in breeding areas, and the recovery of wild celery beds (Schloesser and Manny 2007; Hartig et al. 2007).

According to Manny and Kenaga (1991), eggs of the herring gull that were collected near an industrial waste dump on Fighting Island from 1978 to 1982 contained the highest levels of PCB and hexachlorobenzene of any water body in the Great Lakes basin. In regards to diving ducks, the study found that the carcasses of 13 diving ducks that fed on contaminated sediments during the winter months near Mud Island contained higher concentrations of more toxic and persistent forms of PCBs than did common carp, aquatic worms, and sediments collected at the same time and place. Fifteen young ducks collected at the site were also found to contain high PCB concentrations (Manny and Kegana 1991).

For more than 25 years, the Canadian Wildlife Service Ontario Region has maintained two Great Lakes monitoring programs for colonial waterbirds that monitor contaminant levels in herring gull eggs and breeding populations of colonial waterbirds. These programs also track and identify trends of toxic chemicals in birds that prey on fish in the Great Lakes food web as well as the effects of those chemicals on bird populations. Herring gull eggs collected from Fighting Island showed declines of 15 percent from 1978 to 2000 for PCBs, DDE, mirex, dieldrin, hexachlorobenzene, heptachlor epoxide, and 2,3,7,8-TCDD (SOS 2001). In the 23 years preceding 2001, the number of ring-billed gull nests has increased more than 600-fold and herring gulls four- to six-fold while the number of common tern nests has declined by 98 percent. Until 2005, great blue herons and great egrets that used to nest on Stony Island had not been recorded there since 1977 (SOS 2001).

4.2 LOSS OF FISH AND WILDLIFE HABITAT

The loss of fish and wildlife habitat BUI was established 20 years ago due to loss of fish and wildlife habitat as a result of the perturbation in the physical, chemical, or biological integrity of the Detroit River AOC. This impairment was identified as a water impairment in the Stage I RAP report and the 1996 RAP report. Later reports prepared as a part of the RAP process have also identified the loss of fish and wildlife habitat as a water use impairment. Manny (2003) suggested that when the amount and quality of physical, chemical, and biological habitat required to meet fish and wildlife management goals has been achieved and protected, the BUI will be removed.

As a result of population growth and expansion, coastal wetlands have been significantly reduced over the last 200 years. In 1815, the river shoreline consisted of coastal wetlands up to a mile wide along both sides, a number that corresponds to approximately 10.7 square miles of coastal wetlands (Manny 2003). Complementary amounts of wetlands existed on the Canadian shoreline. Vegetative types included in the coastal wetlands include submerged marsh, emergent marsh, wet meadow and shrub swamp, swamp forest, and lakeplain prairie (Wilke 2006). As of 1982, the river has seen significant alterations. Due to encroachment into the river, hardening of the shoreline, concrete break walls, and addition of fill material only a tenth of a square mile of coastal wetlands remained on the Michigan mainland (Manny 2003). Furthermore, the majority of the remaining Great Lakes coastal wetlands can be found in one area, Humbug Marsh. In total, 97 percent of the coastal wetlands on both sides of the Detroit River have been lost to development (Manny 2003). More than 54 percent of the remaining wetlands are in Ontario with the largest wetland in the Detroit River immediately north of the Canard River in Essex County, Ontario. This wetland, however, has been diked for waterfowl hunting purposes and is only functional along its outer undiked margins (Manny et al. 1988). Wetlands are an integral ecological system, one that provides flood control, protection from shoreline erosion, and a filtration system for nutrients and sediment and as such, efforts must be taken to conserve remaining coastal wetlands in the Detroit River (Manny 2006; Wilke 2006).

Wetland land cover in and around the Detroit River provides habitat. Along the Canadian shore, there are five coastal wetlands totaling 1,136 hectares that have been identified by the Ontario Ministry of Natural Resources to be of particular importance. One of these areas includes the marshes of the Detroit River near Fighting Island that represents the largest wetland complex. The remaining wetlands are for the most part associated with the tributaries to the Detroit River. Included in this category are the American Wetlands found downstream of Grassy Island that are associated with the highest fish and wildlife habitat values in the lower portion of the river, the Canard River wetland complex, and the Turkey Creek Marsh (SOS 2001). The majority of the remaining vegetation along the river consists of submersed macrophytes as the land that was once occupied by the swamp-shrub-meadow has been converted to other uses or inundated by high water levels (Manny et al. 1988).

According to a report produced through the 1996 State of the Lakes Ecosystem Conference, human stressors that continue to impact the remaining wetlands include erosion from ship wakes, shoreline modification, dredging, channelization, excess nutrients, contamination of water and sediments with toxic chemicals, agricultural and urban encroachment, and invasive non-indigenous species (SOLEC 2001).

Just as wetlands have decreased in area and abundance, the vast majority of the forests within the watershed have been converted to agricultural and urban land uses. Since 1815, 95 percent of upland forests have disappeared (DRCC 1999).

Efforts have been made since the development of the RAP process to identify and characterize the remaining fish and wildlife habitat in the Detroit River. Studies produced as a result of these efforts include a 2003 study conducted by the Ontario Ministry of Natural Resources, a report produced in 1999 by Essex Region Conservation Authority, and a study of candidate sites for protection and restoration of fish and wildlife habitat in the Detroit River (Manny and Fiebich 2001; Manny 2003). The emphasis of these studies has been on the identification of natural, undeveloped areas that are considered high priority in terms of protection or remediation. Long term goals of these efforts focus on achieving diverse, healthy, and functioning ecosystems. To link the habitat work with fish and wildlife populations, the U.S. Geological Survey coordinated a Natural Resource Vision for the Detroit River that identified how much of each kind of habitat would be required to sustain the desired numbers of fish, wildlife, and plant species (Manny 2003). 104 candidate sites were identified totaling 3,433 acres. 39 of these sites, covering 1,578 acres were in private ownership. Public lands were mostly parks (24) and plots of land set aside through the Grosse Ile Open Space Program (9). 13 islands were identified with six of those owned by either federal, state, or city government. Ten of the public sites contained aquatic habitat; seven of them were on Belle Isle and two are owned by the Grosse Ile Nature and Land Conservancy. Four public sites were classified as Brownfield sites. Privately owned land is for the most part owned by business, industry, and utility companies (26). 13 sites were owned by private citizens or conservation groups and seven sites were either islands or private land located on an island. Four sites were classified as aquatic habitat and ten as privately owned Brownfield sites. In total, 2,074 acres of terrestrial habitat and 732 acres of aquatic habitat were identified for restoration and protection (Manny 2003).

Along with their work that had focused on the terrestrial part of the AOC, USGS is currently working to identify areas remaining in the aquatic environment that are suitable for fish spawning and nursery habitat based on current and historic physical and biological characteristics. The outcome of USGS's work will be the identification of all existing, and potential, aquatic habitat sites in the Detroit River that are suitable for long-term sustainability of fish and fish populations. The delisting target for restoration of fish habitat will be based on the sites identified as an outcome of this project since the results will focus only on those sites for which scientific evidence suggest are the most suitable for sustainable fish habitat.

Comment [m7]: This needs to be updated.

Conserving the remaining wildlife habitats in the Detroit River International Wildlife Refuge is also high priority for the U.S. Fish and Wildlife Service and its many partners. In order to guide this work, the Service developed a Comprehensive Conservation Plan for the Detroit River International Wildlife Refuge in 2001. The Detroit River International Wildlife Refuge began in 2001 with the preservation of the 123 hectares that included Grassy Island and Mamajuda Shoal. In 2001, Mud Island was donated to the Refuge by U.S. Steel Corporation. By 2002, the Refuge had expanded to include Calf Island. In 2003, the Lagoon Beach Unit at Fermi Power Plant and the Brancheau Unit in Monroe, Michigan were added. In 2004, Humbug Marsh was acquired by the U.S. Fish and Wildlife Service as well as the Strong Unit in Monroe, Michigan. In 2005, cooperative management agreements were signed with Automotive Components Holdings for Eagle Island Marsh Unit and with the University of Toledo for Gard Island. In 2007, the Refuge nearly doubled in its holdings by acquiring Erie Marsh along the lower portion of western Lake Erie (Hartig et al. 2007).

Comment [m8]: This should be updated, as well.

5.0 DELISTING CRITERIA FOR HABITAT AND POPULATION

The overarching delisting targets are measurable targets to be used in identifying when the fish and wildlife BUIs can officially be removed from the Detroit River AOC.

Removal of the F&W BUIs will be based on achievement of full implementation of projects outlined in Section 7 of the report. Post-implementation monitoring will need to demonstrate that adequate habitat has been restored at these project sites to a level that is expected to support a diverse fish community in the AOC.

Table 2 details the overarching targets for each of the BUIs that were agreed upon by the Technical Committee.

Table 2 – Delisting Targets for Habitat and Population BUIs

Beneficial Use Impairment	Source of Impairment	Delisting Targets
Degradation of Fish & Wildlife Populations	<ul style="list-style-type: none"> Contaminated sediments. Excessive sedimentation. Point source discharges and water intakes (temperature, flow, water quality, etc.); permitted and non-permitted discharges. Invasive species. 	<ul style="list-style-type: none"> Healthy fish and wildlife populations are determined by resource management agency(ies) to exist within the AOC at the selected sites. Loss of Fish & Wildlife Habitat BUI is removed. Degradation of Benthos BUI is removed.
Loss of Fish & Wildlife Habitat	<ul style="list-style-type: none"> Loss of spawning and nursery habitat for aquatic species. Loss of coastal wetlands (hardening of shoreline, concrete break walls, addition of fill material, hydraulic disconnection, etc.). Loss of wetlands and other terrestrial habitat throughout the watershed. 	<ul style="list-style-type: none"> The habitat restoration projects specified in Section 7.0 are completed.

6.0 RECENT AND ONGOING PLANNING AND RESTORATION EFFORTS

The following is a list of recent accomplishments that have made progress towards the eventual delisting of the beneficial use impairments that threaten the Detroit River AOC.

- In 1999, the Greater Detroit American Heritage River Initiative sponsored a Binational Conference on Soft Engineering of Shorelines, with support from Michigan Sea Grant and other partners. From that conference came the idea of a Detroit River implementation of softshore engineering, re-vegetating hardened shorelines using ecological principles and practices that will prevent erosion, stabilize shorelines, and maintain safety, while also providing wildlife habitat and increasing the aesthetic appearance. Subsequently, the report: *Best Management Practices for Soft Engineering of Shorelines* was published “to provide insights and technical advice to local governments, developers, planners, consultants and industries on when, where, why, and how to incorporate soft engineering of shoreline redevelopment projects.” (Caulk 2000). Since then nearly 30 softshore engineering projects have been undertaken along the Detroit River.
- Between 2000 and 2003, the ERCA has completed several fish habitat restoration projects in the Detroit River, including creation of nursery habitat for lake sturgeon at McKee Park and creation of lake sturgeon spawning habitat at Fort Malden.
- In 2001, the U.S. Fish and Wildlife Service developed a Comprehensive Conservation Plan for the Detroit River International Wildlife Refuge in 2001. The Detroit River is the first international wildlife refuge in North America. Since the creation of the IWR, numerous land acquisitions and donations by organizations such as the Trust for Public Lands, The Nature Conservancy, and the U.S. Army Corps of Engineers have also expanded the land included in the refuge. Notable acquisitions include:
 - 304 acres that included Grassy Island and Mamjuda Shoal in 2001.
 - Mud Island was donated to the Refuge by U.S. Steel Corporation in 2001.
 - Refuge was expanded to include Calf Island in 2002.
 - The Lagoon Beach Unit at Fermi Power Plant and the Brancheau Unit in Monroe, Michigan were added in 2003.
 - Humbug Marsh was acquired by the U.S. Fish and Wildlife Service as well as the Strong Unit in Monroe, Michigan in 2004. The area includes 410 acres of unique fish and wildlife habitat along the river, representing the last mile of natural, undeveloped shoreline on the U.S. mainland side of the Detroit River.
 - Cooperative management agreements were signed with Automotive Components Holdings for Eagle Island Marsh Unit and with the University of Toledo for Gard Island in 2005.
 - The Refuge nearly doubled in its holdings with the signing of a cooperative management agreement with The Nature Conservancy for Erie Marsh along the lower portion of western Lake Erie in 2006.
 - By the end of 2007, the Refuge had grown to over 5,047 acres with the addition of the Fix Property.
 - Plum Creek Bay and the “Lady of the Lakes” property were among the acquisitions in 2008.
 - The Detroit Riverkeeper and Friends of the Detroit River conduct an annual cleanup of the Detroit River shorelines, dikes, and islands. Since it started in 2002, they have removed on

average two tons of discarded items per year from riparian wildlife habitats. The event helps to promote stewardship of the river by the participants as well as the general public that may learn about the event through local media.

- In 2003, Bruce Szczechowski led a partnership with DTE Energy, Friends of the Detroit River, Detroit Audubon Society, Northern Michigan University, and Southgate Anderson High School to create nesting habitat for the State Threatened common tern.
- In 2004, Michigan Sea Grant in collaboration with the USGS led a project to construct three artificial spawning shoals in the Detroit River, in the waters off the southeast portion of Belle Isle in the northern section of the river. The reefs consist of three different substrates used by spawning lake sturgeon elsewhere. The project was funded by NOAA through an MDEQ Coastal Management grant with additional support from the Great Lakes Fishery Trust and Detroit Edison, a DTE-Energy Company. Michigan Sea Grant works closely with biologists at USGS and US FWS, who continue to evaluate use of the shoals for reproduction by 16 species of fish including Lake Whitefish and walleye.
- Several industrial sites (DTE, US Steel, etc.) have gained wildlife habitat certification through the Wildlife Habitat Council. Also, DTE Energy's Trenton Channel Power Plant received Wildlife Habitat of the Year Award in 2004.
- In 2005, Wayne County was awarded \$450,000 from the Clean Michigan Initiative to daylight a section of the Monguagon Creek at the Refuge Gateway site, including creating two innovative stormwater retention basins.
- Since 2006, US Steel has rehabilitated nearly 1,000 feet of Detroit River shoreline at their Great Lakes Works facility in Ecorse, Michigan. Restoration work included reshaping of the riverbank, removal of invasive species and re-vegetation with native plants. Additional work completed by US Steel includes restoration (cleanup of stockpiles and debris, removal of invasive species, and re-vegetation with native species) of 29 acres of riparian land and removal of contaminated sediments from the Detroit River along the Main Plant site.
- In 2006, Wayne County was awarded \$1 million from the National Coastal Wetlands Conservation Program through the U.S. Fish and Wildlife Service to restore coastal wetlands at the Refuge Gateway site. Final design and engineering work is underway.
- In 2007, U.S. Fish and Wildlife Service, IVM Partners, and ITC entered into a partnership to control invasive species at Humbug Marsh Unit, including Phragmites, buckthorn, and other exotic species.
- In 2007, the Essex Region Conservation Authority (ERCA) facilitated a partnership of Environment Canada – Great Lakes Sustainability Fund, Canada – Ontario Agreement, Ontario Ministry of Natural Resources, Ontario Great Lakes Renewal, U.S. Fish and Wildlife Service, Michigan Wildlife Conservancy, BASF Corp., DTE Energy, and USGS to construct 12 spawning shoals at northeast Fighting Island in Canadian waters of the Detroit River International Wildlife Refuge. Since construction in October of 2008, use of the spawning shoals by Lake Whitefish has been monitored by the USGS with funding from ERCA.
- In 2008, the Detroit River International Wildlife Refuge in partnership with the Detroit Water and Sewerage Department, Detroit Recreation Department, Detroit Zoo, and the US FWS restored nesting habitat for the common tern, a state threatened species.

Detroit River AOC Projects Needed for Fish & Wildlife Habitat BUI removal

7.0 SITES FOR HABITAT AND POPULATION BUI RESTORATION

Sites identified in the USGS study “Physical and Biological Characteristics of and Changes in the St. Clair – Detroit River Waterway – Past and Present” will comprise the list of aquatic habitat target sites to be addressed in order to remove the Loss of Fish and Wildlife Habitat BUI. Once the project is complete, the RAP will be able to identify the location of each site, actions required to restore the physical characteristics of the sites for spawning and nursery habitat, and the size of each restoration. This section of the plan will be updated and this information included once it is produced. Figures 7.1 through 7.3 provided in the Appendix show the location of the restoration projects recommended by the Technical Committee and summarized in this section. Numbers noted on the map correspond with the project numbers identified below.

Prior to any site-specific habitat restoration work, detailed work plans will be necessary and funding will need to be sought to support development of these work plans. Summaries of specific restoration projects are as follows:

PROJECT LISTS

Projects Required for BUI Removal:

11. Detroit River Reefs (NE Belle Isle, Fort Wayne, Fort Wayne Expansion, and NE Grassy Island)
12. Detroit Riverfront Parks restoration
13. Belle Isle Forested Wetland Restoration
14. Lake Okonoka Restoration with River Connection
15. Milliken State Park Pocket Marsh with River Connection
16. Grassy Island Shoal Restoration
17. Hennepin Marsh Restoration
18. Stony Island Shoal Reconstruction
19. Sugar Island Restoration
20. Celeron Island Restoration and Shoal Construction

Completed (or near completion) projects Required for BUI Removal:

5. Blue Heron Lagoon Restoration – Funded
6. Shoreline Restoration near South Fishing Pier – Funded
7. US Steel Shoreline Restoration – Funded*
8. Restoration of Fish & Wildlife Habitat at Wayne County’s Refuge Gateway – Complete.

Projects to be removed from the list (and reasoning for removal):

1. Lake Muscoday Restoration – Completed
2. Maheras Park Restoration – Completed
3. Gabriel Richard Park Restoration – Completed
4. Historic Fort Wayne Restoration – possible complications due to historic nature of the site, desired improvements (focus on snake habitat by creating “no mow” buffer) would be a little/no cost and could be accomplished via side conversations with the City of Detroit and interested stakeholders
5. Frank & Poet/Brownstown Creek Floodplain Preservation & Restoration – some land acquired, no plans of the Refuge and the FWS Conservation Plan for the area.

Projects to be included in narrative of report as deemed valuable and supported by the PAC, but based on current situations, not viable options for the priority list of projects:

1. US Steel Shoal Reconstruction

Detroit River AOC Projects Needed for Fish & Wildlife Habitat BUI removal

2. Hennepin Marsh Shoal Reconstruction
3. Round Island Conservation – privately owned, no current interest in creating conservation easement or the like.

Detroit River Reefs (NE Belle Isle, Ft. Wayne, Ft. Wayne Expansion, and NE Grassy Island)

Project description:

Project location – three locations (four projects) in the Detroit River: just upstream of Belle Isle; offshore of Historic Fort Wayne; just upstream of Grassy Island.

Northeast Belle Isle: This site was located by the Bennion-Manny geospatial, hydrodynamic model in deep, fast-flowing, US waters, about 2500 feet upstream of the small, but successful, 2004 Belle Isle fish spawning reef (Manny 2006). This area has the cleanest water in this river and is outside the shipping channel, in close proximity to a large, documented walleye spawning ground (Manny et al. 2010), and directly upstream of the only coastal wetland (potential larval fish habitat) by the South Fishing Pier on Belle Isle, in the upper Detroit River.

Fort Wayne Reef/ Fort Wayne Reef Expansion: This is the largest area in the river where conditions are predicted to be optimal for fish spawning habitat restoration, by the Bennion-Manny geospatial, hydrodynamic model (Bennion and Manny, In press). The river bottom is flat and smooth, hard-pan clay, and the water is deep and fast flowing, conditions attractive to spawning-ready adults of target fish species. Preliminary studies show that the area is already used for spawning by both walleye and whitefish, but the scattered rock-gravel substrates currently available lack interstitial space to adequately protect fish eggs from dislodgement and predation. Lake sturgeon are known to spawn on coal cinders near Zug Island, a mile downstream (Caswell et al. 2004), and will likely find this new reef site relatively quickly. Project partners have a grant from the National Fish and Wildlife Foundation to establish a 1-acre, fish spawning reef in U.S. waters, offshore from the Historic Fort Wayne, and have already designed and sought permits for a 4-acre reef, in anticipation of opportunities to expand that reef.

Northeast Grassy Island: Historically, this area was used by spawning lake sturgeon and the area supported a large commercial fishery for lake whitefish (cf. McClain and Manny 2000; Goodyear et al. 1982). In addition, it is predicted by the Bennion-Manny model to be deep and fast-flowing, in proximity to a documented walleye and lake whitefish spawning site (USGS, unpublished egg-mat data), across the shipping channel from a documented staging area for spawning-ready lake sturgeon (Caswell et al. 2004). The proposed offshore area near Grassy Island is publicly owned as part of the Detroit River International Wildlife, protected from human impacts and outside dredged shipping lanes.

Brief site background – The Detroit River is a 51km-long international connecting channel joining Lake St. Clair and the upper Great Lakes to Lake Erie. It has been an important international shipping route since the early 1800s and is one of the busiest navigation channels in the United States. It was also historically one of the most significant sources of recruitment for the diverse Lake Erie fishery, for example, supporting one of the most profitable lake whitefish commercial fisheries in the Great Lakes (Roseman et al., 2007). Since 1874, however, the lower Detroit River has been systematically and extensively modified by the construction of deep-water channels to facilitate commercial shipping traffic. Large-scale dredging, disposal of dredge spoils, and construction of water-level compensating works has greatly altered channel morphology and flow dynamics of the river, disrupting ecological function and fish productivity in the river. The large diameter, layered, rock-rubble substrate, needed to protect fish eggs from dislodgement and predation, and to fulfill life history requirements of many fish species, exists today in only widely-scattered locations in the Detroit River (USGS unpublished data).

Habitat to be addressed – Rock-rubble substrate for fish spawning to benefit a number of important fish species with similar spawning requirements. Target species include: lake sturgeon (*Acipenser fulvescens*), a threatened species in the State of Michigan and Province of Ontario; walleye (*Sander vitreus*), a popular sport fish that supports a valuable recreational fishery in Lake Erie; and lake whitefish (*Coregonus clupeaformis*), which sustains the largest commercial fishery in the Great Lakes.

Justification as target site – The Detroit River is a binational Area of Concern (AOC) under the U.S.-Canada Great Lakes Water Quality Agreement with eleven identified Beneficial Use Impairments. The Loss of Fish and Wildlife Habitat (BUI 14), is a direct result of large-scale dredging activities in the AOC that removed critical habitat for lithophilic spawners. Impacts on fish and wildlife populations, BUI 3, also resulted from dredging and other activities. This proposed project will focus on three fish habitat restoration projects identified by this process as essential to removing these two BUIs.

Detroit River Reefs (NE Belle Isle, Ft. Wayne, Ft. Wayne Expansion, and NE Grassy Island)

Property owner (Responsible entities): Responsible entities for bottom lands at the reef construction areas in the Detroit River have not been fully confirmed but are assumed as follows: Northeast Belle Isle, City of Detroit Parks and Recreation Department; Fort Wayne Reef, City of Detroit Parks and Recreation Department; Northeast Grassy Island, Detroit River International Wildlife Refuge, U.S. Department of Interior.

Project purpose:

Goal – The construction of artificial fish spawning reefs targeted for native fish species to address the Loss of Fish and Wildlife Habitat BUI in the Detroit River AOC.

Objective – Conduct a thorough biological and physical assessment, design, secure permits and construct up to 9 acres of fish spawning habitat in the Detroit River.

Actions – Four tasks are essential to restoring spawning habitat in the proposed locations: (1) evaluate physical conditions in the proposed restoration areas; (2) design and permit the projects; (3) conduct pre-and post-restoration biological monitoring; and, (4) construct spawning reefs.

Task 1: Evaluate Physical Conditions at Reef Areas

Evaluate existing information about proposed reef restoration areas to finalize reef site locations, prepare permit applications and plan monitoring. The following sources of information will guide reef project plans:

- Published and unpublished assessment data from previous spawning habitat projects to identify attributes of successful spawning habitat restoration (e.g., Roseman et al. 2011, Manny et al. 2010).
- Surveys of fish egg deposition and larval production in the Detroit River in order to site reefs close to known fish spawning areas and make them accessible to spawning- ready, adult fish.
- Output from a geospatial, hydrodynamic model (Bennion and Manny, in press) indicating where water depth and velocity are most suitable for fish spawning habitat construction.
- Existing sediment contaminant data from sampling locations close to the proposed reefs.
- MDEQ water quality data from any nearby river or other point source discharge sites.
- Existing three-dimensional particle transport model for the Detroit River to evaluate the potential movement of chemicals or material originating from river outlets or known point source discharge sites in the vicinity of the reefs. This will help evaluate and select reef locations that are unlikely to be impacted by chemicals discharged during heavy rain events or from combined sewer overflow events. In addition, the particle transport model will be used to help predict how fish larvae produced on the reefs are likely to drift and determine, if the reef locations are connected by water flows to suitable fish nursery areas. This data will facilitate coordination of the proposed reef restoration work with fish nursery habitat enhancements and guide the development of fish habitat monitoring plans.

Conduct a field assessment of each of the proposed reef areas, including side-scan sonar, underwater video, a bathymetric survey and water velocity measurements, and survey the surficial base substrate at the sites. This information will help identify locations for the reefs in relatively flat areas with a hard-pan clay bottom, where there is no debris or biological activity on the river bottom. Use existing surveys and conduct additional measurements of egg deposition and larval production in the vicinity of the three proposed reef areas. Areas with relatively high egg deposition and low larval production could benefit by the addition of rocky substrate that will attract spawning fish and increase the survival of deposited fish eggs.

Task 2: Design and Permit Spawning Reef Construction Projects

Once background data has been compiled and reviewed and reef coordinates finalized, drawings of each reef project, construction specifications and permit applications will be prepared. To prepare a base map for reef project drawings, high resolution bathymetric survey data of each site will be processed and referenced. Calculations must be completed to determine what effect the placement of stone material will have on the water conveyance capacity of the river channel.

Complete the forms and written descriptions required to submit a joint permit application to the Michigan Department of Environmental Quality (MDEQ) and US Army Corps of Engineers (COE) to fill or place structures within the Detroit

Detroit River Reefs (NE Belle Isle, Ft. Wayne, Ft. Wayne Expansion, and NE Grassy Island)

River, as required under the provisions of the Natural Resources and Environmental Protection Act 451,P.A. 1994, Part 301 Inland Lakes & Stream, Part 325 Submerged Lands, and Section 404 of the Federal Clean Water Act, and Section 10 of the Federal River and Harbors Act of 1899. The permit application will include a description of the project purpose, site selection criteria, alternatives considered, and spawning reef plans.

Task 3: Pre and Post Construction Monitoring

A number of factors should be monitored prior to and after reef construction, including: water flow and sediment patterns, colonization by invasive species, and use of the reefs by target fish species including the endangered Northern Madtom catfish and other adult fish attracted to and using the constructed reefs during their spawning season. Particular attention will be paid to the three target fish species: lake sturgeon, walleye, and lake whitefish. Egg mats and larval fish nets will be deployed for up to 8 weeks upstream, at , and downstream of each spawning reef in spring and fall each year, to measure fish egg deposition per unit area of each spawning reef, and hatch and drift of larval fish per unit volume of river water. Underwater cameras and divers will be used to capture images of the arrangement and structure of the reef and any changes in the use of the reef by fish, over time.

Task 4: Reef Construction

The proposed fish spawning reefs will be designed using attributes that have been successful at the other sites in the Detroit and St. Clair. A single bed of 4-8 inch limestone, 2 feet thick, has been found to successfully attract fish, incubate fish eggs, and be cost effective. Construction should be planned for the second year, providing time to evaluate reef areas, design, permit, and bid the project.

Indicators & Monitoring: Robust monitoring plans will be implemented before and after reef construction. Biological assessment plans will focus on several metrics before and after reef construction to demonstrate the impacts of reef construction for target fish species at several critical stages in their life history. Monitoring will focus on the reefs as well as connected habitats known to support larval and juvenile fish growth and development. A particle transport model and detailed maps of aquatic habitats will identify connected nursery habitats.

Projected costs: Total project costs including construction, scientific assessment and monitoring by the USGS and the US Fish and Wildlife Service, before, during, and after all three reef construction projects, totaling 9 acres of restored fish spawning habitat in the Detroit River: approximately \$6.5 million (Design, permitting, and construction of each reef: approximately \$1.1 million).

Timetable (design, permitting, construction, monitoring):

Project Activities	Year 1				Year 2				Year 3			
	W	S p	S u	F	W	S p	S u	F	W	S p	S u	F
Task 1 – Evaluate Priority Areas												
● Gather and review existing information	X											
● Evaluate particle transport	X											
● Conduct physical assessment of reef areas		X	X									
● Identify specific reef locations			X									
Task 2 – Design and Permit Projects												
● Secure landowner permission				X								
● Prepare project drawings, maps and construction specifications				X								
● Prepare permit applications				X								
Task 3 – Pre and Post Monitoring												
● Spring spawning assessment		X				X				X		
● Adult and juvenile fish assessment			X				X				X	

Detroit River Reefs (NE Belle Isle, Ft. Wayne, Ft. Wayne Expansion, and NE Grassy Island)

● Fall spawning assessment				X				X				X
Task 4 – Reef Construction												
● Bid project, develop contract					X							
● Construction prep, order rock						X						
● Build Reefs							X					

Public involvement: Work with the Detroit River PAC and other experienced stakeholders to ensure that reef projects make use of the best available science and directly support the remediation of the Detroit River AOC and removal of BUIs associated with loss of fish and wildlife habitat.

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Detroit Upper Riverfront Parks Restoration

Project description:

Project location – Mariner Park, Lakewood East Park, A.B. Ford Park, see attached map. All three parks are located within the City of Detroit and on the U.S. shoreline of the upper Detroit River, due west of the area where Lake St. Clair flows in the Detroit River.

Brief site background – All three sites are located at the head waters of the Detroit River in part of what was once an extensive Great Lakes marsh, referred to as “Grand Marais” or “great marsh” on early maps (See attached map). In the intervening years, the marsh has been filled and the natural shoreline has been replaced by seawalls. Canals still extend back from the shoreline along the parks’ margins, and could easily be expanded, providing opportunities for critical wetland and shallow water habitat.

Habitat to be addressed – Shoreline and deep water.

Justification as target site – Within the City of Detroit as well as along most of the Detroit River, natural shorelines are rare. These three sites are public park lands that offer realistic potential to significantly increase fish nursery and spawning habitat in the area and provide additional habitat for reptiles, amphibians, and breeding and migratory birds.

Property owner (Responsible entities): City of Detroit, Recreation Department & General Services Department.

Project purpose:

Goal – Reduce the amount of seawalls and riprap along the Detroit River and restore the aquatic and shoreline habitats.

Objectives – The broad objective is to work with community partners to gather support and funding, establish scope of work, hire design consultant(s), bid project, and manage construction. Restore approximately 600 LF of shoreline at Mariner Park. Restore approximately 1,000 LF of shoreline and establish approximately 1 acre of wetland habitat at Lakewood East Park. Establish approximately 7 acres of wetland habitat at A.B. Ford Park.

Actions – Remove approximately 600 LF of existing riprap shoreline and restore the shoreline with native wetland edge and spawning shelves at Mariner Park. Improve approximately 1,000 LF of existing soft shoreline and modify approximately 1 acre of upland into wetland habitat at Lakewood East. Remove approximately 200 LF (total) of steel seawall at two locations and create approximately 7 acres of wetlands and shallow and deep water habitats at A.B. Ford.

Indicators & Monitoring: Pre and post construction monitoring of wildlife use of the area should be incorporated into the overall project to assess its success. Species groups to be monitored include adult and larval fish, reptiles, amphibians, and breeding and migratory birds. Monitoring should be conducted for minimum of 1 season prior to restoration and no less than two seasons following restoration. Assessments should emphasize habitat use, spatial distribution, presence of various life stages, reproductive success, and overall population size.

Projected costs: TOTAL \$5,000,000

Mariner Park	\$750,000
Lakewood East	\$1,250,000
A.B. Ford	\$3,000,000

Timetable (design, permitting, construction, monitoring): Mariner Park – design/6 months, permitting/6 months, construction/6 months, monitoring 3 years. Lakewood East – design/6 months, permitting/6 months, construction/6 months, monitoring 3 years. A.B. Ford - design/8 months, permitting/8 months, construction/9 months, monitoring 3 years.

Detroit Upper Riverfront Parks Restoration

Public involvement: There are multiple community partners in the Jefferson/Chalmers area that could facilitate planning and educational workshops; organize volunteer planting; maintenance and monitoring activities; and raise awareness through site tours, interpretive signage, and marketing materials.

Belle Isle Forested Wetland Restoration

Project description:

Project location – Belle Isle, Detroit (see map)

Brief site background – Belle Isle supports a large forested wetland complex (classified as wet-mesic flatwood community by the Michigan Department of Natural Resources) on the east half of the island. The large wetland complex drains via a canal system to the Detroit River. In addition to the canals, the roads and fill material have also affected site hydrology and wetland quality. The approximately 200 acre habitat is fragmented by multiple roads that bisect the complex and interrupt natural connections between the wooded wetlands and adjacent grassland, marsh, and open water habitats. Historic grazing from nonnative fallow deer, encroachment of multiple invasive plants, and uncontrolled populations of subsidized predators have altered community composition and overall ecosystem quality, function, and wildlife diversity.

Habitat to be addressed – wet-mesic flatwood community

Justification as target site – Belle Isle is a Detroit River Biodiversity hotspot and critical habitat for a variety of rare and sensitive fish and wildlife. At approximately 200 acres, the complex is one of the largest in the Detroit River watershed and is strategically located area bordered to the north, east, and south by other AOC restoration areas. The wet-mesic flatwood community type has been ranked according to Heritage Methodology as G2G3 S3 that is “vulnerable to imperiled globally and imperiled within the state.” Although degraded, it represents the largest remaining instance of this community type in the entire state. Continued efforts are being made in adjacent areas to improve habitat for fish and wildlife that utilize permanent or semi-permanent aquatic habitats. However, adjacent seasonally flooded wetland systems and the species that occupy these wetlands have not been addressed in this region. Amphibians and reptiles are recognized as key bioindicators: gauges of environmental health, due in part to their high sensitivity to environmental pollutants and habitat disturbance. Their presence, richness, and distribution are important metrics for determining the health of communities such as wet-mesic flatwoods. Restoration emphasizing amphibians and reptiles has been under represented in the Detroit River and necessary to support strong health functioning ecosystems. Belle Isle historically supported a diverse community of amphibians and reptiles and presumably aquatic macroinvertebrates. The island and its protective woods provide an important migratory bird stop over as a shelter and feeding site. Portions of the island and the target area still continue to support some rare and sensitive species though available habitat has been degraded and reduced. Restoration of this area is a critical part of the long-term viability of the Detroit River and a necessary step in the removal of the loss of fish and wildlife habitat BUI.

Property owner (Responsible entities): City of Detroit (Potentially managed by MDNR)

Project purpose:

Goal – Restore wet-mesic flatwood community function with emphasis on historic amphibian and reptile species community through repatriation/reintroduction following established wetland restoration.

Objectives –

- Restore approximately 200 acre of wetland complex and adjacent habitat.
- Restore hydrology/topography that supports restoration of the entire wet-mesic flatwoods community capable of supporting native aquatic macroinvertebrates, amphibians, and reptiles.
- Improve migratory bird flyway habitat and food resources within wetland complex.
- Restore understory herbaceous plant community within wet-mesic flatwoods restoration area that preserves the unique genetic structure of the natural community.
- Reduce habitat fragmentation and restore connectivity to adjacent natural areas.
- Reduce road related mortality with an emphasis reptile and amphibian communities.
- Reduce populations of invasive species and subsidized predators.
- Create a fringe of marsh and wet prairie along Nashua Canal and Sylvan creek opposite the forest on the site of the former Belle Isle Zoo.
- Develop a management plan for continued long term control of invasives species and subsidized predators.

Belle Isle Forested Wetland Restoration

Actions –

- Conduct hydrologic analysis to evaluate and guide restoration targets.
- Construct eight to ten vernal pools within existing road bed within wetland complex that supports successful reproduction of rare and sensitive amphibian and reptile indicator species.
- Construct wildlife barrier fence and four wildlife culverts running east-west at Lakeside Dr between wetland complex and Blue Heron Lagoon.
- Remove Central Ave from east of Vista Ave to Lakeside Dr and restore to bottomland forest.
- Convert Oakway Trail and Woodside Dr to hike/bike trails and restrict vehicular access to emergency vehicles only with breakaway gates. Incorporate interpretive signage.
- Support natural regeneration of the forest. If seeding or planting is required along forest/road margins, a conservative approach that preserves the unique genetic structure of the natural community should be utilized (local genotypes when possible).
- Remove invasive shrubs and herbaceous plants best known practices and adaptive management.
- Remove/block ditches that presently drain some interior areas of the forest.
- Enhance/restore watercourses that pass through wetland complex.
- Work with USDA wildlife services for subsidized predator control.
- Incorporate native fruit bearing shrubs (using local genotypes when possible) associated with wet-mesic flatwood community and along edge of woods and when appropriate in the interior to provide food and cover for resident and migratory passerine birds.
- Restore/create a fringe of marsh and wet prairie along Nashua Canal and Sylvan creek opposite the forest on the site of the former Belle Isle Zoo.
- Incorporate additional features such as turtle nesting areas, snake hibernacula etc. on the site of the former zoo.
- Evaluate restoration condition and identify source site for potential reintroduction of extirpated amphibians and reptiles that historically would have occurred on Belle Isle.
- Create detailed management plan that addresses long-term management of habitat on east half of Belle Isle.

Indicators & Monitoring: Pre and post construction monitoring of wildlife use of the habitat with emphasis on aquatic macroinvertebrates, amphibians, reptiles and birds should be incorporated into the overall project to assess its success. Assessment of invasive species should be incorporated to reduce risk of re-colonization. Monitoring should be conducted for minimum of one season prior to restoration and no less than two seasons following restoration completion with potential up to five years total to accurately assess community composition and system function. Assessments should emphasize habitat use, spatial distribution, presence of various life stages, reproductive success, and overall population size.

Monitoring should incorporate volunteer programs when possible to supplement professional wildlife biologist assessments. The Michigan Breeding Bird Atlas, eBird, Michigan Frog and Toad Survey, and Michigan Herp Atlas, are all active and well participated programs that currently collect data regularly in Southeast Michigan. In addition, the Department of Environmental Quality is evaluating the potential for a pilot program to monitor vernal pools.

Projected costs: \$???.??

Timetable (design, permitting, construction, monitoring): Design and feasibility six to nine months, permits six months, construction 1.5 years, and monitoring two to five years post construction.

Public involvement: The unique nature and interest in Belle Isle makes it a desirable place for community involvement. Volunteers can assist with invasive species removal and control, habitat creation and placement, and community outreach, and participate in organized volunteer monitoring events, and stewardship.

Belle Isle Forested Wetland Restoration



Lake Okonoka Restoration with River Connection

Project description:

Project location – Belle Isle, Detroit, Michigan. Lake Okonoka is a 24-acre lake situated in the south-east corner of Belle Isle.

Brief site background – The lake is a linear system with several forested islands that serves to create a diversity of terrestrial and aquatic habitats. Most of the lake is shallow water (approximately 4-5 feet deep) with deeper pools and some open water. It is part of the Isle's canal and lake system that is hydrologically maintained and controlled by a pump system that utilized river water to artificially control the water levels for aesthetic, recreation and habitat functions. The canals and lakes are currently elevated above the Detroit River and the Lake's level is regulated via a stop log structure at the east adjacent to Lakeside Drive. At this location, the Lake discharges into Blue Heron Lagoon which is now fully on-line with the Detroit River. During periods of exceptionally high River levels, the existing stop-log structure becomes inundated and Lake Okonoka and Blue Heron Lagoon become hydrologically connected without the use of pump water. The existing canal system is the source of water and discharges into Lake Okonoka at the north-west corner of the Lake where the existing vehicular bridge is currently being replaced.

Habitat to be addressed – In 2010 US EPA awarded GLRI grant funding for the Blue Heron Lagoon Rehabilitation project which connects this 41 acre wetland habitat to the Detroit River at the eastern tip of the Isle. The primary purpose of the project allowed for direct connectivity between the Lagoon and the large spawning shoals documented by USGS to exist at the eastern point of the Isle providing important nursery habitat for larval fish species.

Justification as target site – The proposed habitat enhancements to Lake Okonoka expand upon the connectivity created by the Blue Heron Lagoon Restoration project by:

- Vastly improving the hydrologic functions of Blue Heron Lagoon by reversing the flow of Lake Okonoka resulting in a flow-through current that would discharge back to the Detroit River in the vicinity of the South Fishing Pier,
- Adding an additional 24 acres of fish nursery to the 41 acre Blue Heron Lagoon system bringing a total of 65 acres of habitat permanently on-line with the River,
- Enhancing habitat for birds, amphibians and reptiles including the state threatened eastern fox snake (*Pantherophis gloydi*), and the state special concern Blanding's turtle (*Emys blandingii*) currently documented at Blue Heron Lagoon.

Property owner (Responsible entities): City of Detroit with possible collaboration with the State of Michigan (possible new ownership), Friends of Detroit River, Detroit Recreation Department, and Belle Isle Conservancy.

Project purpose:

Goal – Enhance habitat for birds, fish, amphibians, and reptiles.

Objective – Improve the hydrologic function of Lake Okonoka and its connectivity with Blue Heron Lagoon and the Detroit River. Increase available fish nursery habitat connected to the Detroit River by 24 acres.

Actions – To successfully complete this project, the following actions are necessary:

- Bathymetric survey of determine locations where dredging of Lake Okonoka soils will be required and verify proposed flow-through pipe elevations,
- Soil sampling and testing to determine soil disposal requirements and to fulfill permit requirements,
- Replacing the existing stop log structure with culvert pipe(s) connecting Blue Heron Lagoon with Lake Okonoka below Lakeside Drive. Pipe(s) shall be sized to maximize fish passage and flow-through current.
- Minor excavation is anticipated at the outlet of Blue Heron Lagoon and Lake Okonoka to improve this connectivity.
- Locate and construct a similar culvert pipe(s) system below The Strand connecting Lake Okonoka with the Detroit River. The proposed connection point is anticipated to be down river from the recently restored South Fishing Pier and no impacts to this project are anticipated.

Lake Okonoka Restoration with River Connection

- Dredging of soils from Lake Okonoka to improve hydrologic connectivity between Blue Heron Lagoon and Detroit River in response to lowering the water level of Lake Okonoka. It is assumed that certain mud-flat conditions will add species diversity by expanding habitat for shorebirds but a balance between maintaining the aesthetic character of this Lake, maximizing flow-through current and balancing habitat diversity will be the primary criteria in determining the extent of dredging.
- Possible aquatic plant restoration to portions of the Lake will be necessary due to dredging impacts.

Indicators & Monitoring: Pre and post construction monitoring of both fish and wildlife use should be incorporated into the overall project to assess its success. Other possibilities for volunteer monitoring include existing student groups such as the Stream Team, NWF's Earth Tomorrow program or new programs for youth within the Detroit Recreation Department and/or the Belle Isle Nature Zoo.

Projected costs: \$2.2 million

Timetable (design, permitting, construction, monitoring):

- Design and permitting: 1 year
- Construction and restoration: 1 year
- Monitoring: 2 years

Public involvement: The Detroit Recreation Department typically solicits public input during the planning and permitting stages of major projects. Public input during the planning phase of this project would be critical—Lake Okonoko is in the more naturally maintained portion of Belle Isle, occurs within the Historic core area of the park and is utilized extensively for recreational fishing and wildlife viewing. When the project is completed, public involvement will be critical in ensuring the long-term success of the project.

Milliken State Park Pocket Marsh with River Connection

Project description:

Project location – In Milliken State Park on U.S. (north) side of the Detroit River main channel just downstream of Belle Isle. Area involved includes a stretch of steep, riprap shoreline immediately upstream from the previously created perched wetland in the park.

Brief site background – The shoreline along this portion of the main river channel has been almost entirely hardened and converted to vertical seawall or steep rock riprap with almost no shallow water along the shore. Larval and juvenile fish from the previously constructed spawning reefs and shallow habitat areas just upstream around Belle Isle require shallow, off-channel natural habitat if they are to survive. Recent efforts by the MDNR Fisheries Division to collect spawning Great Lakes Muskellunge from the Detroit River for egg collection has determined these spawning fish congregate around the western shore of Belle Isle immediately upstream of this project area. In addition, fish sampling from the Maheras Park pocket marsh (similar to the one proposed here) found juvenile muskellunge were using that site and the presence of spawning adults around Belle Isle makes it likely the juveniles would utilize this site as well.

Habitat to be addressed – Removal of the steep riprap wall currently present in this area and cutting the shore back 50-100 feet will create an off-channel area with shallower water depths and gentler current. The recessed shoreline would be naturalized to enhance this feature and wave breaks would be installed to protect the area.

Justification as target site – With almost the entire river channel shoreline composed of vertical seawall and steep riprap banks in this portion of the river, there is currently very little shallow water habitat along this portion of the mainland river bank. Near shore, shallow water habitat has been shown to be the most valuable type of aquatic habitat in lakes and large rivers. Previous survey efforts by Fisheries Division of the MDNR has shown every marsh or shallow area along the Detroit River is heavily utilized wherever they occur. This makes every similar feature that much more valuable due to the scarcity and high value of this type of habitat. In addition, Belle Isle (located immediately upstream) is an important herpetofauna hot spot in the Detroit River. The proximity of Milliken State Park makes any off-channel habitat created there a potentially important corridor and critical mainland refugia for several indicator species of amphibians and reptiles. Eastern Fox Snake (State Threatened), Blanding's Turtle (Special Concern), and Mudpuppies (Species of Greatest Conservation Need) are all known to occur on Belle Isle and could utilize the off-channel marsh area proposed herein.

Besides the ecological value of the proposed marsh, the location of this project within the State Park and its incorporation into the master plan for the entire park would ensure it is highly visible to the public and make it a valuable educational tool.

Property owner (Responsible entities): The State of Michigan owns the entire project area as well as the areas immediately upstream and downstream. Parks and Recreation Division of the MDNR has a master plan for the entire park that includes the habitat restoration detailed in this project outline as funding becomes available.

Project purpose:

Goals –

- Create a naturalized area of nearshore, protected, shallow water habitat and shoreline with direct connection to the Detroit River main channel. Specific features could include native shoreline vegetation, aquatic vegetation beds, mudpuppy habitat, turtle nesting areas, snake hibernacula, and large woody material for both fish habitat and reptile basking structures.
- Utilize the educational opportunities and resources available through the State Park System to make people aware of the value of restoring these types of habitats to the river system.

Objectives –

- Remove 350-400 feet of vertical riprap shoreline.
- Cut shoreline back up to 100 feet to create a protected, off-channel shallow water area.

Milliken State Park Pocket Marsh with River Connection

- Naturalize the new shoreline to enhance the quality of the marsh habitat created in the off-channel area. This would include native vegetation on the shore and in the shallow water as well as large woody material scattered along the shore/water interface.
- Construct several reptile nesting and habitat areas on the shoreline.
- Incorporate the restored marsh habitat into the Park's educational programs and outreach efforts within the Detroit AOC.

Actions –

- Develop final design to coordinate with development of rest of the State Park Property
- Remove existing riprap and seawall along approximately 350 feet of shore.
- Excavate and re-establish shoreline and nearshore area up to approximately 100 feet back from main river channel and re-contour shoreline and new, nearshore open water area.
- Construct breakwall between main river channel and off-channel open water area with large riprap and/or boulders.
- Install large woody material along new shoreline.
- Construct reptile nesting and habitat structures.
- Re-vegetate the new shoreline and nearshore, shallow water areas with native terrestrial and aquatic plant species.
- Develop educational programs and information to educate park visitors about values/functions of these types of habitats.

Indicators & Monitoring: Measures of progress would include amount of use of the new habitat by fish, amphibians, birds, and other animals. Progress could also be measured through increased level of awareness of the public towards the AOC issues associated with habitat restoration. Direct sampling of the aquatic organisms utilizing the new habitat area both before and after the project would show how much use it gets. Parks staff could also “sample” visitors to the park to see how this project affects their awareness of the issues involved.

Projected costs: Project cost could vary considerably depending on final plans. For budgeting purposes, a rough cost estimate for the shallow water habitat creation and shoreline restoration would be approximately \$800,000.

Timetable (design, permitting, construction, monitoring): Overall project 4 years.

- Design and permitting – 1 year,
- Construction – 1 year,
- Monitoring – 2 years.

Public Involvement: Conduct community stakeholder meetings to discuss the technical aspects of the restoration project. Conduct outreach efforts with local, state, and federal stakeholders to increase awareness of the habitat value to the AOC efforts.

Grassy Island Shoal Restoration

Project description:

Project location – See Photo. Grassy Island is a 74-acre island located in the central part of the Detroit River, in the city Rouge River. The site is under the jurisdiction of the US Fish and Wildlife Service and under the management of the Detroit River International Wildlife Refuge.

Brief site background – The geography of the island itself has changed dramatically in the last 6 decades. The site was once a lowland marshy area comprising of two smaller islands surrounded by wetlands and a marshy narrows between the islands. Beginning in the 1950's and into the 1960's, the islands were surrounded by an earthen and stone dike and used for the next three decades as a contaminated dredging spoils deposit area by the US Army Corps of Engineers. Currently the island is off limits to the general public and consists of a grass prairie on the north end, with stands of phragmites and cottonwood dominating the remainder of the site.

Habitat to be addressed – The shore line of the island is dominated by armor stone along the north, east, and southern ends. The western side of the island, that faces the islands macrophyte weed beds, is less armored and is dominated by small limestone rock and gravel shorelines. In the mid part of the 1900's, as part of a ship navigation system, a long dike was constructed as part of a range light system. This dike started from the shore of the northwest side of the island and proceeded out from the island in an angle towards the southwest for approximately 1,500 feet. This dike created a man made bay impoundment that protected the wetland that once existed on the western side of the island. Over the past few decades high water and erosion reduced the dikes to a submerging shoal area covered by 2 to 6 feet of water. Reconstruction of this dike system would recreate the protective bay and allow for the re-emergence of wetlands and the regeneration of emergent shoreline plants to this area.

Justification as target site – The most valuable habitat connected with this site is a large area; approximately 10 acres in size, of submergent macrophyte weed beds that can be found off the western shore of the island. Past fisheries studies by the USFWS and the MDNR have found this weed bed extremely prolific with young of the year fish of numerous species. These weed beds are also very important as feeding sites for migrating and wintering species of waterfowl. Waterfowl using the upper and mid part of the river have very few locations in which they can conjugate undisturbed during the migration period. The bay impoundment created by this project could provide a vital refuge area for migrating ducks.

Property owner (Responsible entities): This site is owned by the U.S. Fish and Wildlife Service and is managed under the Detroit River International Wildlife Refuge. Project implementation will require USFWS approval.

Project purpose:

Goals – Provide additional protection to a valuable fish nursery area as well as provide for the re-emergence of lost historical coastal wetlands that exists off the northwest side of this island.

Objectives – The reconstruction of approximately 1500' of shoal/dike along the northwest side of the island.

Actions – The actions taken will be determined by the adoption of a pre-construction engineering design plan and where feasible will include the following: the construction of a barrier shoal/dike, the construction of dedicate turtle nesting beaches with southern exposure, the placement of logs in the shallows along the shoal for basking turtles and fish cover, and the creation of Mudpuppy and fish spawning habitats along the shoal area.

Indicators and Monitoring: Monitoring should be conducted both prior to construction (as part of the design phase) as well as post-construction. Ideally, the site would be allowed to recover from the construction period for one year prior to the collection of post-construction monitoring data. Monitoring shall include: Pre and post construction monitoring of wildlife use of the habitat including fish, aquatic macro-invertebrates, amphibians, and reptiles will be incorporated into the pre and post construction monitoring of wildlife use of the habitat including aquatic macro-invertebrates, amphibians, and reptiles should be incorporated into the overall project to assess its success.

Projected costs: Cost of the construction is based upon the creation of approximately 1,500 feet of dike using marine construction methods, including items listed under the action section is estimated to be approximately \$2.6 million.

Grassy Island Shoal Restoration

Timetable: There are currently no active plans in process for this project at this time. The planning of this project and a construction time table would depend on an agreement to engage by the USFWS.

- Feasibility – 2 years;
- Design and Permitting – 1 year;
- Construction – 1 year;
- Monitoring – 2 years (including a 1 year period of ecological stabilization post-construction).

Public Involvement: This project will not only provide great fish and aquatic habitat, but will also provide excellent fishing, hunting, bird watching and boating opportunities for the public. Grassy Island, under the ownership of the USFWS and managed by the Detroit International Wildlife Refuge would be responsible for the implementation of a public involvement plan.

Hennepin Marsh Restoration

Project description:

Project location – See photo. The Hennepin Marsh site is located in the Trenton Channel, along the western shore of Grosse Ile Township, on the up and downstream side of the Grosse Ile Toll Bridge. The North Hennepin Marsh area consists of 106-acre wetland falls under the jurisdiction of the Township of Grosse Ile, with interests owned by the Grosse Ile Land Conservancy. The South Hennepin Marsh covers about 48 acres of coastal wetlands and 3 barrier islands.

Brief site background – This shallow wetland area once contained large stands of native cattail. This area like many other wetland areas in the Lower Detroit River suffered greatly with the high water levels of the 1970's. Being on a narrow and very busy water way, this wetland has suffered a great loss of its natural emergent vegetation due to wave action and ship surges. Today this area is mostly a submergent aquatic macrophyte area, 2 to 8 feet deep and an important feeding area for waterfowl and fish stocks. This site was shown to be an important fish nursery habitat in recent fish population surveys by the USFWS and MDNR. The shoreline area is almost completely dominated by phragmites.

The main component of this project would reduce wave action erosion through construction of a series of several long and narrow emergent shoals that would run in an arc starting from the northern end of the wetland site and curve out towards the channel, then turning south to run parallel to the Grosse Ile shoreline. The combined length of these shoal islands could approach 2,500 feet in length, with actual distances beginning determined by the ultimate spacing of the individual shoal/dikes. The actual length and scope of this protective shoal would need to be determined through an engineering and hydrological review. The second component of this would include elimination and continued control of phragmites and re-vegetation of native emergent plants along the adjacent shoreline.

The South Hennepin Marsh is located in the Trenton Channel, along the northwestern side of Grosse Ile, just below the Grosse Ile Toll Bridge. This 48-acre wetland is located just downstream of the Grosse Ile Toll Bridge. Bordered by a series of three small island dikes to the east and a large portion of undeveloped vacant land along the Grosse Ile shoreline to the west, the balance of this wetland contains a very shallow macrophyte plant and rush beds. Much of the shoreline along Grosse Ile is part of an undeveloped parcel of property that is currently for sale. Acquisition of this property would assure no further development and potential shoreline hardening in this area.

Like the Northern Hennepin Marsh, this site also has a phragmites problem along its shoreline. But unlike the northern marsh the small border islands in the southern marsh have worked well in protecting the southern marsh from the effects of surge driven erosion. Unfortunately, these islands are rapidly eroding. Because of the shallow nature of the waters surrounding the river side of these island dikes, much of the rebuilding materials (sand, gravel and clay) could be dredged up from the area and then rebroadcast onto the islands to rebuild them up several feet above the current elevations of the river and improve the protection they provide to the marsh behind them.

Habitat to be addressed – Wetland.

Justification as target site – Restoration of this site will help improve and protect a valuable fish nursery area, given that this site is adjacent to a major fish spawning and migration route through the Trenton Channel. This area's macrophyte weed beds and muddy bottom provide essential habitats for indigenous macroinvertebrates, local and migrating waterfowl, fish, amphibians, and shorebirds.

Property owner (Responsible entities): This site has a number of property owners including; the BASF Corporation, the Township of Grosse Ile, and a number of private residents. Although there are a number of landowners of this site, it is believed that there would be support for a restoration project of this nature. Authorization and project oversight will fall into the jurisdiction of the community of Grosse Ile, the adjacent private property owners, MDNR, US Army Corps of Engineers and the BASF Corporation would all have jurisdiction over the bottom lands of the marsh.

Project purpose:

Goals – Protect and enhance the existing wetlands.

Hennepin Marsh Restoration

Objectives – The upper Hennepin Marsh would receive a protective shoal/dike with a length up to 2500', the South Hennepin Marsh would benefit by the rebuilding of the protective barrier islands with materials dredged from around the islands and placed on site. Remove evasive phragmites. Purchase approximately 10 acres of upland and coastal wetlands.

Actions – The actions taken will be determined by the final engineering design, but may include, the construction of shoal/dikes parallel to the upper Hennepin marsh, and the reconstruction of approximately 500' of barrier islands in the lower Hennepin marsh area, the removal of evasive phragmites, possible purchase of 10 acres of wetland and upland vernal woodland and replanting of native vegetation within the construction zone. The project will also include the incorporation of small stone/gravel in riprap areas to facilitate better movement and connectivity between aquatic and terrestrial habitats. The inclusion of turtle nesting beaches with southern exposures and the addition of branches in shallow water will provide nesting structure for amphibians and logs in shoal areas will allow for reptile basking and cover for fish. Limestone sheet rock shall be included for mudpuppy habitat and lace structure to encourage use and colonization of native aquatic mussel beds where feasible.

Indicators and Monitoring: Monitoring should be conducted both prior to construction as well as post-construction. Ideally, the site would be allowed to recover from the construction period for one year prior to the collection of post-construction monitoring data. Monitoring shall be incorporated into the overall project to assess the success of the project and will include: pre and post construction monitoring of wildlife use of the habitat including fish, aquatic macroinvertebrates, amphibians, and reptiles.

Projected costs: Cost of the construction based upon the completion of approximately 2,500 feet of dike using marine construction methods and is estimated to cost approximately \$2.6 million. This figure however could be much less depending on the overall amount of shoal that would be approved in the final project design. The cost of barrier island reconstruction is based upon the current cost of dredging; with an estimate of approximately 7,500 to 10,000 cubic yards of material to be moved using marine construction methods and is estimated to cost around \$75,000 to \$100,000 based on a \$10 per cubic yard placement cost. Phragmites control and re-vegetation with indigenous emergent plants would cost from \$50,000 to \$125,000. The cost of the purchase of the 10+ acres of upland woods, emergent shoreline and coastal wetland, including barrier island is estimated to be approximately \$400,000.

Timetable: There are currently no active plans in process for this project at this time. Planning of this project and a construction time table would depend on an agreement to proceed from the property owner(s). The actual construction work described in this proposal could be done in the course of one or two construction seasons.

- Feasibility – 2 years;
- Design and Permitting – 1 year;
- Construction – 1-2 years;
- Monitoring – 2 years (including a 1 year period of ecological stabilization post-construction).

Public Involvement: This project with its proposed off shore shoal/dike area will not only provide great fish and aquatic habitat, but will also provide excellent fishing, hunting, bird watching and boating opportunities for the public. This project also lends well for volunteer efforts in the phragmites mitigation and emergent reconstruction portion of the project using local NGO's and conservation groups like the Grosse Ile Nature and Land Conservancy.

Stony Island Shoal Reconstruction

Project description:

Project location – See photo. Stony Island is a large uninhabited 52-acre island in the Lower Detroit River, located in the Township of Grosse Ile. The island's wetland portion is owned by the State of Michigan, is under the jurisdiction of the Pointe Mouillee State Game Area, and is open to the general public.

Brief site background – Once owned by a local dredging company, the island housed dozens of families, construction buildings and equipment during the early 1900's construction of the adjacent Livingston Shipping Channel. Today, the island has largely reverted to its once natural state.

Habitat to be addressed – The Island's two major wetland areas, known locally as the upper and lower bays were created by the construction of limestone dikes which provided the necessary protection from the river's currents and wave surges to create two large emergent wetland areas. Both bays provide tremendous fisheries for local fish stock, including important spawning grounds for local pike populations. The large rush beds that have replaced the once abundant cattail stands also provide habitat for a large population of muskrat. The area has long been a very productive waterfowling spot, providing nesting and feeding areas for many species of ducks. This wetland and the adjacent tree stands between the two bays also contain the rivers largest Great Blue Heron rookery, containing over 200 active nests.

Justification as target site – The upper bay dike adjacent to Grosse Ile had been eroded down below the current water level over a length of approximately 750 feet. The shoal that protects the wetlands of the lower bay has also disappeared under the effects of decades of erosion. The remaining submerged shoal runs perpendicular to the southeast end of the island in the lower bay (beginning at the islands old bridge crossing) and extends off of the island approximately 1,250 feet in a curve linear direction to the southeast. Reconstruction of these shoal dikes would provide desirable protection to Stony Island.

This project, with its off shore dike area, will not only provide great fish and aquatic habitat, but will also provide excellent fishing, hunting, bird watching and boating opportunities for the public. Given that this property is part of the State Game Area, the protection of the existing wetlands and the potential regeneration of wetlands that could be anticipated by the improvements described in this project will provide additional opportunities for both the hunting as well as the non-hunting public.

Property owner (Responsible entities): This property is owned by the State of Michigan and managed by the DNR under the Pointe Mouillee State Game Area.

Project purpose:

Goals – The reconstruction of the shoals will protect further degradation of the valuable wetland habitat.

Objectives – The upper bay dike will at a minimum be restored the length of the 750 feet of shoal/dike that has been eroded below the current water level (based on 2013 water levels). The lower bay shoal/dike shall be restored a minimum of the 1,250 feet as described above.

Actions – The actions taken will be determined by the feasibility study, but not limited to include: reconstruction of shoal/dikes around the western side of the upper bay and southwest side of the lower bay of the island; the incorporation of small stone/gravel in riprap areas to facilitate better movement and connectivity between aquatic and terrestrial habitats; inclusion of turtle nesting beaches with southern exposures; the addition of logs to shoal areas for reptile basking and cover for fish; addition of branches in shallow water to provide nesting structure for amphibians; installation of limestone sheet rock for mudpuppy habitat; include lace structure to encourage use and colonization of native aquatic mussel beds; and incorporate control measures for invasive plants within the construction zone with emphasis around vernal pool and coastal wetlands.

Indicators and Monitoring: As this project is the reconstruction of existing shoals, it is not anticipated that drastic changes would be evident. The key is that the preservation of the shoals will in turn preserve the valuable habitat that currently exists. Monitoring should be conducted both prior to construction as well as post-construction. Ideally, the site would be allowed to recover from the construction period for one year prior to the collection of post-construction monitoring data. Monitoring shall

Stony Island Shoal Reconstruction

be incorporated into the overall project to assess the success of the project and will include: pre and post construction monitoring of wildlife use of the habitat including fish, aquatic macroinvertebrates, amphibians, and reptiles.

Projected costs: The cost of this project is based on the construction of approximately 2,000 feet of dike using Marine construction methods as described in the Actions section and are estimated to cost approximately \$3.5 million.

Timetable: The Friends of the Detroit River, as acting fiduciary for the Detroit River PAC has successfully applied for and due to receive funding from NOAA to conduct a feasibility and engineering design study for this project. This study is to be completed within 18 months of the final approval date. It is anticipated that once this study is completed, the feasibility and design engineering approved, construction project funds would immediately be sought to bring this project to completion.

- Feasibility Study – 18 months
- Design and Permitting – 12 months
- Construction – 24 months
- Post-Construction Monitoring – to begin 1 year after the completion of construction and last for 24 months

Public Involvement: Public involvement will be an important component to the success of this project. Because this island is an important recreational asset to the area for fishing, hunting and other recreational activities, the public will be educated to the value of this project through local media outlets and project presentations.

***** NOTE: In 2013 NOAA approved funding of the feasibility and design portion of this project.**

Sugar Island Restoration

Project description:

Project location – See photo. Sugar Island is a medium sized uninhabited 34 acre island located in the Township of Grosse Ile at the mouth of Lake Erie and adjacent to the US/Canadian border. The island was recently purchased by the US Fish and Wildlife Service.

Brief site background – Sugar Island was formerly the site of a popular amusement park beginning in the late 1890's through the 1940's. For decades, it continued to be a popular destination spot for day boaters, campers, and beach goers. Today the island has all but absorbed the structures of its earlier history and has reverted to its once natural state of large maple and oak hardwoods and is surrounded on its east and west flanks with large sandy beaches. It is one of only two beach locations in the lower Detroit River that the public has access. Under its current ownership it is open to seasonal hunting and limited public access.

Habitat to be addressed –

Justification as target site – The island's maple and oak hardwoods along with its dense bush cover provides important habitat for migratory birds to stage and roost. It is also frequented on a regular basis by the local eagle population. The surrounding shoreline sandy shoal areas once saw millions of spawning smelt fill its waters. Currently several species of suckers, log perch, and other fish species use the island's shallows annually. In the deeper waters that can be found off the eastern side of the island, large numbers of migrating walleye pass through the area in the spring along with many pike that traverse its shoreline shoals. The remaining cement piers that lie just off the western side of the island are the site of a proposed development for a common tern nesting area.

Property owner (Responsible entities): This property is under the ownership of the US Fish and Wildlife Service and management by the Detroit River International Wildlife Refuge. Project implementation would require USFWS approval.

Project purpose:

Goals – The construction of a barrier shoal/dike system around the southern end of the Island will protect this end of the island from further degradation from the forces of Lake Erie and will create an area conducive for the creation of additional coastal wetland, wildlife and fisheries habitat.

Objectives – The creation of a shoal/dike system that would be approximately 1300' in length.

Actions – The southern end of the island extends out into Lake Erie. It was once protected by large stand of cattails that helped to break the impact of the lakes wave action, but now it is exposed to the full force of the lake as a result of years of erosion. Hundreds of feet of the island and many of the large trees have eroded off the bluff that now dominates the lower 1/3 of the island. In order to stop further erosion two possible construction solutions could be employed. Both projects would require about 1300' of rock work, with the second proposal requiring more material than the first.

1. Placement of a course of limestone rock along the length of the southern end of the island, armoring the island against the forces of the lake.
2. The preferred and more beneficial method, would be to create an emergent shoal that parallels the southern shoreline approximately 100 feet or more off the island, creating a shoal/dike barrier protecting the island from the lakes hydraulic forces.

The actions taken will be determined by the adoption of a pre-construction engineering design plan and where feasible will include the following: the construction of a barrier shoal/dike; the construction of dedicate turtle nesting beaches with southern exposure; the addition of logs along the islands shoreline within the shoal area for reptile basking and cover for fish; the incorporation of small stone/gravel riprap to facilitate better movement and connectivity between aquatic and terrestrial habitats; the placement of branches in shallow water to provide nesting structure for amphibians; placement of flat limestone sheets in shallow water to provide Mudpuppy habitat; and the control of invasive plants within the construction zone.

Indicators and Monitoring: Monitoring should be conducted both prior to construction as well as post-construction. Ideally, the site would be allowed to recover from the construction period for one year prior to the collection of post-construction

Comment [m9]: The text that was here fit better in the Actions section.

Sugar Island Restoration

monitoring data. Monitoring shall be incorporated into the overall project to assess the success of the project and will include: pre and post construction monitoring of wildlife use of the habitat including fish, aquatic macroinvertebrates, amphibians, and reptiles.

Projected costs: Cost of this project with the construction of around 1,300 feet of shoal/dike and the items included in the action item section would be approximately \$2 million.

Timetable: There are currently no active plans in process for this project at this time. The planning of this project and a construction time table would depend on an agreement to engage by the USFWS, through the Detroit International Wildlife Refuge, which has previously voiced an interest in participating in a project of this type.

- Feasibility Study – 18 months
- Design and Permitting – 12 months
- Construction – 24 months
- Post-Construction Monitoring – to begin 1 year after the completion of construction and last for 24 months

Public Involvement: Under the ownership of the US Fish and Wildlife Service, management and public involvement is regulated through the Detroit International Wildlife Refuge. Local groups have taken an interest in maintaining public access to the island and local recreational, sporting and environmental groups have provided their services in doing annual cleanups of the site. Protection of the existing coastal shoreline, through the project mentioned, will continue to provide excellent fishing, hunting, beach going and bird watching opportunities for the public while protecting the island from further erosion. It is expected that there will be much public support for this project.

Celeron Island Restoration and Shoal Construction

Project description:

Project location – See photo. Celeron Island is a 68-acre island in the lower Detroit River at the mouth of Lake Erie, in the Township of Grosse Ile and contains important coastal wetland and upland areas. The island is owned by the State of Michigan and is managed by MDNR through the Pointe Mouillee Game Area.

Brief site background – Named after a French Commander, it was previously owned by a family who had a summer cottage on its northern end. In the early 70's there still existed a perimeter road that traversed around the entire island. The central portion of the island contained a large enclosed bay that had only a small entrance on its western side. The island has reverted to its natural state and is currently home to many species of plants, animals, birds and aquatic species. It is also an important resting spot for migratory birds and waterfowl. With the high water levels that ensued in the late 70's and again in the early 90's, much of the protective shoreline that ran along the narrow causeway on its east to southeastern side was washed away from the wave actions of the lake.

Habitat to be addressed – The loss of the protective shoreline has led to the loss of much of the coastal wetlands that lined the outer shoreline and the inner bay, at the center of the island. Today the island is actually two separate islands due to decades of erosion. To address this problem the construction of an off shore emergent shoal would help to break up the force of incoming waves from the lake during seasonal storms and allow for the regeneration of the islands outer shoreline emergent vegetation. Such a shoal would also create additional coastal wetland, fish and amphibian habitat, provide additional hunting opportunities and provide a protected area for migratory waterfowl and shorebirds to roost.

Justification as target site – This project, with its off shore dike area, will not only provide great fish and aquatic habitat, but will also provide excellent fishing, hunting, bird watching and boating opportunities for the public. Given that this property is part of the State Game Area, the protection of the existing wetlands and the potential regeneration of wetlands that could be anticipated by the improvements described in this project will provide additional opportunities for both the hunting as well as the non-hunting public.

Property owner (Responsible entities): Celeron Island is owned by the State of Michigan, managed by the DNR, under the Pointe Mouillee State Game Area. Authorization and project oversight will fall into the jurisdiction of the community of Grosse Ile, MDNR Pointe Mouillee Game Area and the US Army Corps of Engineers, who have jurisdiction over the bottom lands of the island and that of the surround waters.

Project purpose:

Goals – Prevent further degradation to the southern end of the island.

Objectives – Construction of approximately 3500' of a shoal/dike system along the outer perimeter of the east to southern end of the island, which is exposed to the hydrological forces of the lake.

Actions – The final actions taken will be determined by the feasibility study, but not limited to include: the construction of a barrier dike/shoal(s) around the southeast to southwest side of the island; the incorporation of small stone/gravel in riprap areas to facilitate better movement and connectivity between aquatic and terrestrial habitats; the inclusion of turtle nesting beaches with southern exposures; the addition of logs to shoal areas for reptile basking and cover for fish; the addition of branches in shallow water to provide nesting structure for amphibians; install limestone sheet rock for mudpuppy habitat; include lace structure to encourage use and colonization of native aquatic mussel beds; and incorporate control measures for invasive plants within the construction zone with emphasis around vernal pool and coastal wetlands.

Indicators and Monitoring: As this project is the reconstruction of existing shoals, it is not anticipated that drastic changes would be evident. The key is that the preservation of the shoals will in turn preserve the valuable habitat that

Celeron Island Restoration and Shoal Construction

currently exists. Monitoring should be conducted both prior to construction (as part of the design phase) as well as post-construction. Ideally, the site would be allowed to recover from the construction period for one year prior to the collection of post-construction monitoring data. Monitoring shall be incorporated into the overall project to assess the success of the project and will include: pre and post construction monitoring of wildlife use of the habitat including fish, aquatic macroinvertebrates, amphibians, and reptiles.

Projected costs: Cost of the construction is based upon the creation of approximately 3,500 feet of dike/shoal using marine construction methods as described in the action section is estimated to cost approximately \$6 million.

Timetable: The Friends of the Detroit River, as acting fiduciary for the Detroit River PAC has successfully applied for and due to receive funding from NOAA to conduct a feasibility and engineering design study for this project. This study is to be completed within 18 months of the final approval date. It is anticipated that once this study is completed, the feasibility and design engineering approved, construction project funds would immediately be sought to bring this project to completion.

- Feasibility Study – 18 months
- Design and Permitting – 12 months
- Construction – 24 months
- Post-Construction Monitoring – to begin 1 year after the completion of construction and last for 24 months

Public Involvement: Public involvement will be an important component to the success of this project. Because this island is an important recreational asset to the area for fishing, hunting and other recreational activities, the public will be educated to the value of this project through local media outlets and project presentations.

***** NOTE: In 2013 NOAA approved funding of the feasibility and design portion of this project.**

8.0 REPORTING ON IMPLEMENTATION OF RESTORATION PROJECTS

The Detroit River PAC will take an active role in reporting any activities related to significant fish and wildlife restoration efforts. All progress on associated targets will be reported to MDEQ and EPA via the PAC chair. Progress reports will be made on an annual basis (every 6 months) in written format and discussed with the Detroit River AOC coordinator from MDEQ.

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Appendix A: Figures

