

**TARGETS FOR REMOVAL OF THE LOSS OF FISH & WILDLIFE HABITAT  
AND DEGRADATION OF FISH & WILDLIFE POPULATIONS  
BENEFICIAL USE IMPAIRMENTS OF THE DETROIT RIVER AREA OF CONCERN**

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Detroit River Public Advisory Council  
Fish & Wildlife Technical Committee

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## Acronyms and Abbreviations

AOC	Area of Concern
BIA	Biodiversity Investment Area
BMP	Best Management Practice
BUI	Beneficial Use Impairment
DRCC	Detroit River Canadian Cleanup
EPA	United States Environmental Protection Agency (also USEPA)
ERCA	Essex Region Conservation Authority
GLNPO	Great Lakes National Program Office
GLRI	Great Lakes Restoration Initiative
IBA	Important Bird Area
IJC	International Joint Commission
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MNFI	Michigan Natural Features Inventory
NOAA	National Oceanic and Atmospheric Administration
OMOE	Ontario Ministry of Environment
PAC	Public Advisory Council
PRD	Parks and Recreation Department
RAP	Remedial Action Plan
SOLEC	State of the Lakes Ecosystem Conference
USACE	United States Army Corps of Engineers
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey

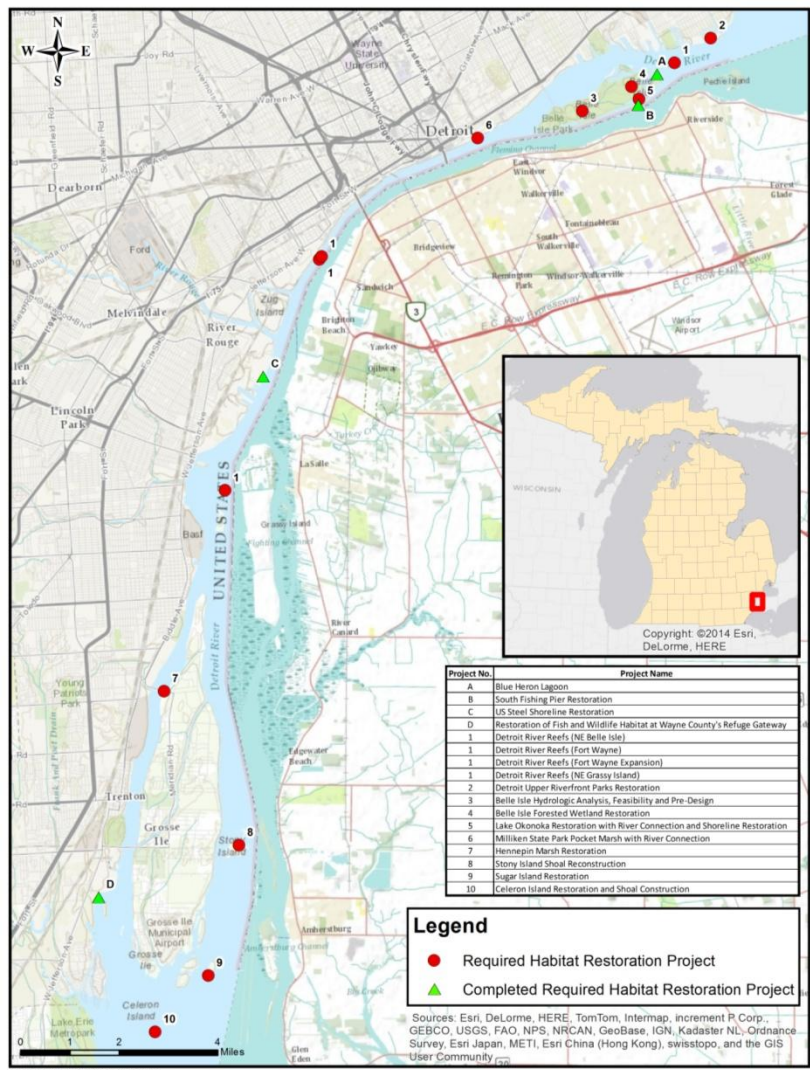
# PRIORITY PROJECTS FOR THE DETROIT RIVER AOC TO ADDRESS THE LOSS OF FISH AND WILDLIFE HABITAT AND DEGRADATION OF FISH AND WILDLIFE POPULATIONS BUIs

*Projects Required for BUI Removal (generally listed in order from upstream to downstream, not in order of importance):*

1. Detroit River Reefs
2. Detroit Upper Riverfront Parks Restoration
3. Belle Isle Hydrologic Analysis, Feasibility and Pre-Design
4. Belle Isle Forested Wetland Restoration
5. Lake Okonoka Restoration with River Connection and Shoreline Restoration
6. Milliken State Park Pocket Marsh with River Connection
7. Hennepin Marsh Restoration
8. Stony Island Shoal Reconstruction
9. Sugar Island Restoration
10. Celeron Island Restoration and Shoal Construction

## *Projects Required for BUI Removal – COMPLETED*

- A. Blue Heron Lagoon Restoration – Completed 2013
- B. South Fishing Pier Restoration – Completed 2013
- C. U. S. Steel Shoreline Restoration – Completed 2013
- D. Shoreline Restoration at Wayne County’s Refuge Gateway – Completed 2012



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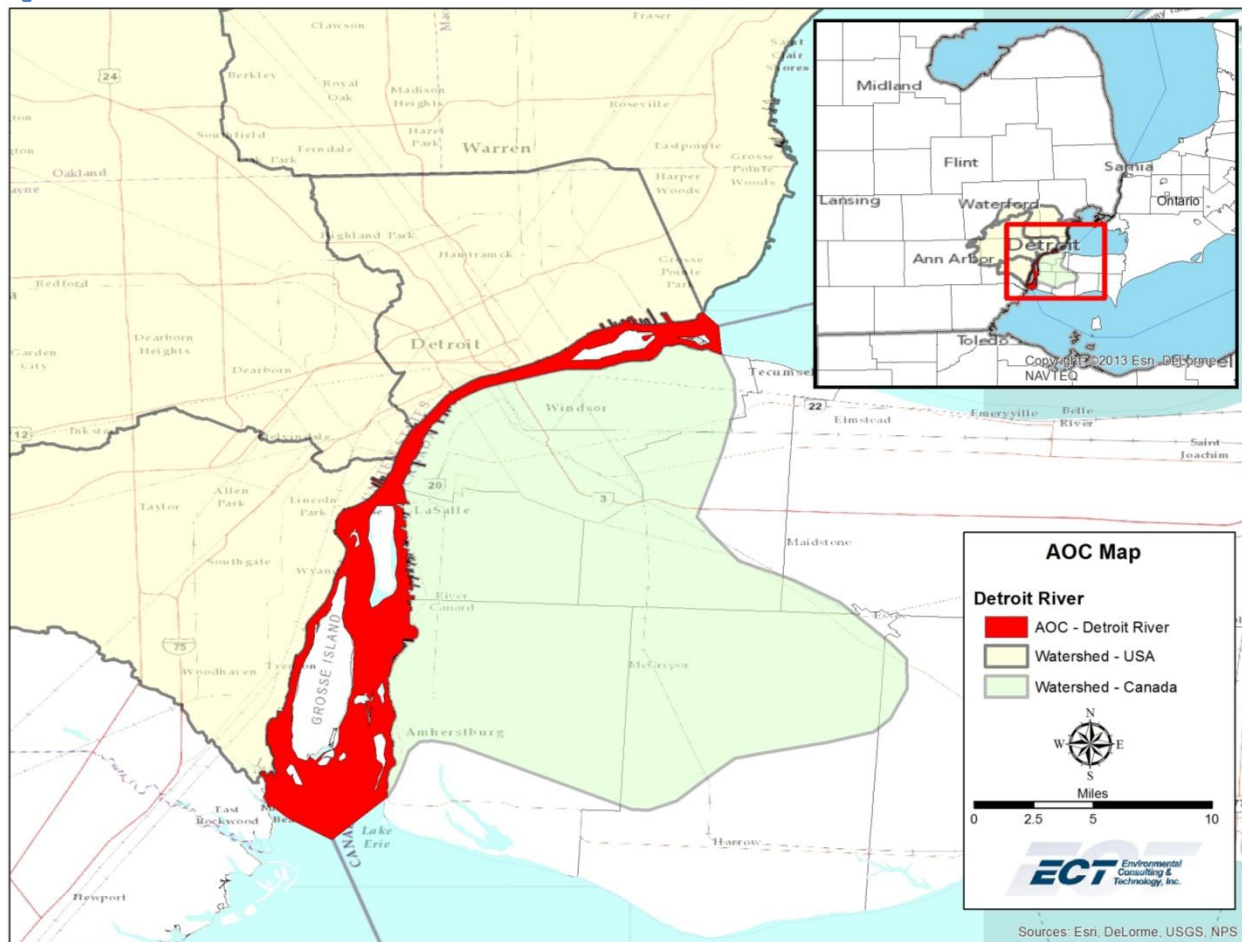
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## 1.0 INTRODUCTION

The Detroit River Area of Concern (AOC) was designated under the Great Lakes Water Quality Agreement, which required the development of endpoints that would allow for the ultimate delisting of the area as an AOC. The AOC was initially listed due to eleven Beneficial Use Impairments (BUIs). This report presents the projects required for removing the Loss of Fish and Wildlife Habitat and Degradation of Fish and Wildlife Populations BUIs. This report replaces all previous versions from 2009.

Figure 1 – Detroit River Area of Concern



The 2008 Michigan Department of Environmental Quality (MDEQ) guidance for developing removal targets, *Guidance for Delisting Michigan's Great Lakes Areas of Concern*, includes the need to develop local restoration plans for Degradation of Fish and Wildlife Populations and Loss of Fish and Wildlife Habitat BUIs. The approach recommended within this report reflects the need to develop the necessary site specific inventory, prioritization, and implementation steps that will be part of the local restoration plan needed to accomplish BUI removal. This plan has been finalized with the assistance of the Detroit River AOC Fish & Wildlife Technical Committee (the Committee). The site specific projects identified as a part of setting BUI removal targets include all of the habitat restoration projects deemed feasible by the Committee, considering original impairments identified in the 1991 Stage 1 Remedial Action Plan (RAP), site specific impairments, property ownership, and other considerations. Implementation of these projects is required for removal of the BUIs and eventual delisting of the Detroit River AOC.

The *Guidance for Delisting Michigan's Great Lakes Areas of Concern* published in 2008 by MDEQ outlines the process for developing targets for the removal of BUIs within Michigan's AOCs. The guidance identifies the following six components and steps that are required for developing a local, site specific habitat restoration plan:

- A. A short narrative on the historical fish and wildlife habitat and population issues in the AOC, including how habitat or populations have been impaired by water quality.
- B. Description of the impairment(s) and location for each aquatic habitat or population site, or for multiple sites where determined appropriate at the local level to address all habitat or population issues identified in the RAP and RAP updates.
- C. A locally derived restoration target for each impacted habitat or population site. Sources of information for targets may include data from social science surveys, if appropriate. Habitat restoration targets may be based on restoration of fish and wildlife populations, if appropriate.
- D. A list of all other ongoing related habitat and population planning processes in the AOC, and a description of their relationship to the restoration projects proposed in the plan.
- E. A scope of work for restoring each impacted aquatic habitat or population site. The scope of work should describe specific habitat or population restoration action(s) to be completed, including:
  1. Timetable
  2. Funding
  3. Responsible entities
  4. Indicators & Monitoring
  5. Evaluation process based on indicators
  6. Public involvement
- F. A component for reporting on habitat or population restoration implementation action(s) to the MDEQ.

All of the above items, A through F, are addressed in this document. Section 2.0 of this document introduces the project and provides a rationale for developing targets. Section 3.0 describes the historical fish and wildlife habitat and population issues in the AOC and describes the important linkages between water quality and the fish and wildlife impairments. Section 4.0 provides necessary 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 RAP. Section 5.0 leads into the discussion of the actual restoration targets with supporting background information. Section 6.0 provides an outline of ongoing planning processes and implementation projects across the AOC that have demonstrated improvements to these habitat and population impairments. Section 7.0 provides a list of restoration projects, each with a defined scope of work needed to work towards removing these two BUIs. Section 8.0 outlines a mechanism for reporting to the MDEQ on progress made during implementation process. Finally, Section 9.0 provides a list of references utilized throughout the document.

This report was updated in 2014 to include new scientific information that became available after the completion of the previous reports. It is intended to be the final version of this report and is based upon the best science available at the time of the revision. During the process of updating the list of priority projects, some projects were removed, some projects were combined, and some projects were added. Once all projects listed in Section 7.0 are completed, the PAC will recommend the removal of the Loss of Fish and Wildlife Habitat and Degradation of Fish and Wildlife Populations BUIs.

The revised project list includes the most up-to-date information about each project, and can be found in Section 7.0.

Table 1 – Changes from 2009 target site list

Name/Location	Status	Notes
Lake Muskoday, Belle Isle Detroit	Completed	The Friends of Belle Isle, through a \$50,000 MDEQ grant, restored nearly 1,400 feet of the Lake Muskoday shoreline with the establishment of native vegetation, the installation of fish habitat structures and the construction of an osprey nesting platform. The work was completed in 2012.
Maheras Gentry Park Restoration Project Detroit	Completed	
Gabriel Richard Park Detroit	Completed	
Historic Fort Wayne Restoration Project Detroit	Incomplete	While a desirable project, there are possible complications due to the historic nature of the site. Some improvements such as 'no mow' zones may be pursued with the City of Detroit and other stakeholders at some point in the future; however the PAC has determined that this project is not necessary for removal of the BUIs.
Frank & Poet/Brownstown Creek Floodplain Preservation and Restoration Project various Downriver Communities	Partially Complete	Nearly 360 acres of land has been acquired by the US FWS. The now publicly owned parcels will be managed by US FWS and there are no plans for further land acquisition or restoration as part of the BUI removal process. The PAC would, however, support any proposed restoration work, conservation easement or purchase for conservation purposes of any of the privately held property in this area if the opportunity presented itself in the future.
Round Island Conservation Project Grosse Ile	Incomplete	The island is currently under private ownership with no interest to conserve the land or allow for habitat restoration. If acquisition becomes possible or the landowner wishes to explore restoration, this project should be pursued.
Grassy Island Shoal Restoration	Incomplete	Grassy Island is currently owned by the USFWS. Current focus is on completing site assessment of the island. Restoration of shoal areas near the island is not currently part of the priority USFWS projects. If the USFWS decides to undertake shoal habitat enhancements, the PAC would be supportive of the effort.



## 2.0 PROJECT INTRODUCTION AND RATIONALE

The purpose of this report is to outline the criteria for the removal of the Loss of Fish and Wildlife BUI and the Degradation of Fish and Wildlife Populations BUI from the 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 and Population BUIs. The removal targets are presented on a project basis. Following a project criterion, ten target habitat restoration projects are described. Successful completion of these projects will demonstrate that these BUIs can be removed from the Detroit River AOC.

The original listing of the AOCs within the Great Lakes was based on the presence of BUIs. These BUIs were defined in the 1987 Great Lakes Water Quality Agreement. The first set of guidance for establishing restoration targets to remove BUIs was put forth in 1991 by the International Joint Commission (IJC) (IJC 1991). 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 (EPA 2001).

In 2008, the MDEQ updated its 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 difficult to adopt a single target for habitat and population related BUIs applicable to all Michigan AOCs due to significant variation in habitat and population composition throughout the state. Therefore, MDEQ's guidance for fish and wildlife habitat and populations related BUIs is based on a criteria setting process, and requires the development and implementation of an AOC-specific restoration plan. Restoration plans are developed locally by the Public Advisory Council (PAC) in each AOC for MDEQ review and approval.

Ecosystem health is important to humans as well as to 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 removal 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.

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

*Although the Detroit River is listed as a bi-national AOC, separate implementation processes exist on both sides of the river. This Fish & Wildlife Restoration Plan is for the U.S. side of the Detroit River only.*

The bi-national Detroit River AOC drains an area of 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 heavily 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 strait connecting Lake Huron to Lake Erie, the Upper to the Lower Great Lakes. Lake Huron water comprises 95% of the flow of the Detroit River via the St. Clair River and Lake St. Clair (MDNR 1991).

There are five Michigan tributaries to the Detroit River, including the Rouge River (an AOC in its own right); Conner 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 industrial and municipal sources, yet provides habitat for a large variety of fish and wildlife species.

More than 80 political jurisdictions exist within the river's 711.97 square mile watershed, including the cities of Detroit, Michigan and Windsor, Ontario, with combined populations of approximately five million people. Approximately 64 percent of the river's Canadian watershed is devoted to agricultural uses (Green et al. 2010) while on the U.S. side, 30 percent is agricultural (Manny and Kenaga 1991). On the river's U.S. side, 30 percent is residential, 10 percent is industrial, and the remainder is urban. Almost 29 miles (nearly 90%) of the U.S. shoreline (not including islands) is privately owned and 78 percent of the US shoreline has been filled and bulkheaded (Manny and Kenaga 1991 and Muth et al 1986).

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). Southeastern Michigan sits at the convergence of the Mississippi and Atlantic flyways, two major bird migration routes in North America (Bull and Craves 2003). 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).

Nearly 40 species of amphibian and reptile are known to occur within the Detroit River and adjacent habitat. Multiple rare and sensitive species, including the Eastern Fox Snake, Queen Snake, Black Rat Snake, Butler's Garter Snake, Blanding's Turtle, Northern Map Turtle, Northern Leopard Frogs, Small-mouth Salamander, and Mudpuppy, (obligate host to the State Endangered and Federal Species of Concern Salamander Mussel) use the Detroit River. The Detroit River is an important corridor along the U.S. side, but is likely an important corridor for species crossing the river between the U.S. and Canada (Harding 1997, Holman 2013, Mifsud 2007).

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). 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 submerged marsh, emergent marsh, wet meadow, shrub swamp, swamp forest, and lakeplain prairie vegetative types present. Since 1815, channel modification, encroachment of the river, hardening of the shoreline, addition of sheet steel, cement walls, fill material, development, and contamination have led to dramatic changes (Manny 2003). Over the last few centuries, the Detroit River has seen a loss of nearly all of its original coastal wetlands. In 1815, there were approximately 10.7 square miles of coastal wetlands on the U.S. side of the river. 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, including the Humbug Marsh Unit, which contains 76 different fish species and represents the last remaining mile of undeveloped Michigan shoreline (Gannon 2001). Furthermore, the river carries the distinctions of American Heritage River and Canadian Heritage River, the only bi-national heritage river in the world (USFWS 2005).

Extensive historical industrial and urban development led to the loss of wetland habitat along the Detroit River. The Loss of Fish and Wildlife Habitat BUI was listed as impaired in the 1991 Detroit River RAP. The 1991 RAP determined this use is impaired as a result of the significant physical loss of wetlands and habitat which has occurred due to industrial growth and urban development. The majority of the extensive marshland along the Michigan and Ontario shores has been filled and bulkheaded, eliminating the emergent plants and reducing the littoral zone. Dredging activities in the lower river have also resulted in habitat loss. The maintenance and protection of existing wetlands is critical to the fish and wildlife populations in the AOC (OMOE and MDNR 1991).

In the 1991 RAP Report, fish populations were determined to be not impaired and the status of wildlife populations was left ambiguous. The not impaired determination for fish was based on what was considered healthy fish community composition and the high quality economic, social and recreational benefits provided by the current fish populations in the river. The 1991 RAP acknowledged that changes in fish community structure have taken place and some degradation of fish populations had occurred, but found return to a historic fish community structure was not possible or realistic due to major disturbances such as dredging, invasive species, changes and loss of habitat and overfishing.

The 1996 Detroit River RAP Update Report noted that in a 1992 IJC review of the 1991 RAP, half of the reviewers felt that the data presented in the report did not support a no impairment conclusion for either fish or wildlife populations. Although the status of wildlife populations was clarified in the 1996 RAP Update to "unknown" to reflect incomplete or inconclusive information in 1991 RAP, fish populations remained not impaired because intense research has not identified any populations which can be considered impaired due to causes within the AOC and the fishery is fulfilling all fishery plans and goals (MDEQ, 1996). The 1996 RAP Update did note that some local fish populations may be impacted by loss of habitat.

## 4.0 CURRENT HABITAT AND POPULATION IMPAIRMENTS AND NOTABLE AREAS

### 4.1 LOSS OF FISH AND WILDLIFE HABITAT

The Loss of Fish and Wildlife Habitat BUI was designated over 20 years ago as a result of the perturbation in the physical, chemical, or biological integrity of the Detroit River AOC. This 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 could be removed.

As a result of population growth and industrial development, coastal wetlands (including submerged marsh, emergent marsh, wet meadow and shrub swamp, swamp forest, and lakeplain prairie) 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). Due to encroachment into the river, hardening of the shoreline, concrete break walls, and addition of fill material, until only a tenth of a square mile of coastal wetlands remains on the Michigan mainland (Manny 2003).

Nearly all of the coastal wetlands on both sides of the Detroit River have been lost to development (Manny 2003). The majority of the remaining Detroit River U.S. coastal wetlands can be found in one area, Humbug Marsh. 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).

Wetland land cover in and around the Detroit River provides valuable habitat for fish and wildlife. In a recent GIS study by Essex Region Conservation Authority (ERCA), a total of 1250 hectares of existing wetlands were identified in the Detroit River watershed, including coastal areas (ERCA 2013). One of these areas includes the Detroit River marshes near Fighting Island that represents the largest wetland complex on the Canadian side of the Detroit River. The remaining wetlands are for the most part associated with the tributaries to the Detroit River. 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 (SOLEC), 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 on the Canadian side of the river (DRCC 1999). With such drastic alterations to the natural environment, it is not possible to return all habitat to pre-European conditions. However, it is important to understand the historic habitat changes that have occurred and the impacts to fish and wildlife populations.

Efforts have been made since the development of the 1991 RAP process to identify and characterize the remaining fish and wildlife habitat in the Detroit River. Numerous studies have been conducted on the identification of natural, undeveloped areas that are considered high priority in terms of protection or restoration. Long term goals of these efforts focus on achieving diverse, healthy, and functioning ecosystems. In 2000, the U.S. Geological Survey (USGS)

coordinated a Natural Resource Vision for the Detroit River that identified 104 candidate habitat sites totaling 3,433 acres (Manny 2003).

Along with their earlier work that had focused on the terrestrial part of the AOC, in 2012 the USGS completed work 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 work by the USGS was to identify all existing and potential aquatic habitat sites in the Detroit River that are suitable for long-term sustainability of fish and fish populations. The target list of projects in this 2014 revised plan addresses the loss of the fish and wildlife habitat BUI and is based on scientific evidence from the many Detroit River studies, sites identified as an outcome of the 2000 and 2012 USGS projects, and the expertise and experience of this plan's many contributors, in order to identify the most suitable and feasible projects for sustainable restoration of habitat in the Detroit AOC.

Implementation of the projects listed and described in this document will provide significant restoration of aquatic habitat, coastal wetlands, and forested areas that have been lost due to decades of development and industrialization. Completion of these projects will provide valuable spawning, breeding, nesting and feeding habitat in order to sustain healthy populations of aquatic macroinvertebrates, insects, fish, amphibians, reptiles, migratory and passerine birds, and mammals sufficient to remove both the Loss of Fish and Wildlife Habitat and the Degradation of Fish and Wildlife Populations BUIs.

## **4.2 DEGRADATION OF FISH AND WILDLIFE POPULATIONS**

Conflicted uses of the Detroit River between waste disposal, water withdrawals, shipping, recreation, hunting and fishing, have caused impacts that include significant loss of aquatic and wetland habitat, alterations in fish population and community structure, 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).

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, numerous species of mammals (Bull and Craves 2001) and nearly 40 species of reptiles and amphibians (Harding 1997, Holman 2012).

### **Fish Populations**

Historically, the Detroit River was known for large spawning runs of lake whitefish, lake herring, and lake trout, that had provided tremendous economic benefit to the area. The river was also an important spawning ground for the lake sturgeon, which is now designated as a threatened species by the State of Michigan due, in part, to the destruction of sturgeon spawning habitat for construction of Detroit River shipping channels, overfishing and pollution. As the rock outcroppings that were used for spawning were destroyed during construction of the shipping channel and water pollution increased, the large 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 Michigan Department of Natural Resources (MDNR), USGS, and United States Fish and Wildlife Service (USFWS) (Francis et al. In Press). Additionally, evidence of spawning by 14 species of native fish and 2

species of exotic fish were 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, redhorse sucker, white sucker, and bowfin. Dermal or oral neoplasms were found on 14.4% of bullhead caught 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 may be exposed to contaminated sediment (Manny and Kenaga 1991).

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 1900s, spawning runs disappeared due to habitat loss, habitat degradation, overfishing, and pollution. In the 1960s and 1970s lake whitefish population numbers were at an all-time low. By the 1980s a modest recovery could be seen, and in 2006 the first confirmed spawning and successful reproduction of lake whitefish in the Detroit River was documented (Hartig et al. 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 human 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 early 2000s has been deemed "high quality" (Hartig et al. 2007). Angling efforts on the Detroit River in 2002 and 2004 averaged nearly 813,000 angler hours (Thomas and Towns 2008). 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 that 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).

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).

Another species of interest within the AOC is the yellow perch. The yellow perch is lower in the food chain than the walleye and its population fluctuates more widely, but it 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 and Insect Populations**

The Detroit River is an integral ecosystem for 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
- 35 species of dragonflies and butterflies

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 USFWS 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).

For more than 25 years, the Canadian Wildlife Service Ontario Region has maintained two Great Lakes monitoring programs 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 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 due to loss of habitat and predation. Until 2005, great blue herons and great egrets that used to nest on Stony Island had not been recorded there since 1977 (SOS 2001).

### **Herpetofauna Populations**

The Detroit River supports a diversity of amphibians and reptiles despite the significant loss of habitat. Few assessments have been conducted in the Detroit River, though the majority were conducted in the last 10 years. Both rare and sensitive species are found throughout the Detroit River and its associated islands and coastal habitats

(Mifsud 2004, Mifsud 2005). This area is critical for movement of animals between Lake St. Clair and Lake Erie. It is also an important corridor for amphibians and reptiles using habitats both on the U.S. and Canadian sides. Despite the erroneous reputation as negatively impacting game fish and waterfowl, amphibians and reptiles are significant members to the Detroit River landscape. Eastern Snapping Turtles feed on dead and dying animals. Northern Water Snakes and Mudpuppies actively consume round gobies, and Mudpuppies are the obligate host to the Salamander Mussel, an endangered species in the state of Michigan.

All species have declined in the Detroit River, some more than others. Habitat loss and persecution are the major threats to amphibians and reptiles in the Detroit River. Water quality, contaminants, and invasive species (including subsidized predators) also negatively impact amphibians and reptiles (Mifsud 2007). Though the watershed is heavily urbanized, these species have adapted and many have become successful where even moderate quality habitat persists. Recent efforts to improve habitat for amphibians and reptiles and shifting attitudes toward them within the Detroit River have helped reduce further loss and improved conditions.

## 5.0 BUI REMOVAL CRITERIA FOR HABITAT AND POPULATION

Criteria for removing each of the 14 potential BUIs in all Michigan AOCs were developed with guidance from the State to ensure consistency and clarity amongst all Michigan AOCs. Based on these criteria, the Detroit River PAC has established restoration targets to be used in identifying when the RAPs have achieved their goals and when a BUI can officially be removed from an AOC. This report focuses on the removal of two BUIs: Loss of Fish and Wildlife Habitat and Degradation of Fish and Wildlife Populations.

Removal of these two BUIs will be based on achievement of full implementation of projects outlined in Section 7 of the report. Post-implementation monitoring will be needed 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.

## 6.0 RECENT AND ONGOING PLANNING AND RESTORATION EFFORTS

The following is a summary of on-going and completed habitat-related projects in the Detroit River AOC as of 2007. Highlights of prior habitat protects can be found in the initial 2007 Fish and Wildlife Restoration Plan. Table 2 contains U.S. projects. Table 3 contains Canadian projects.

Table 2 – List of major habitat projects in the Detroit River AOC (US) since 2007.

Started	Completed	AOC Target site	Project Title	Description	Location	Lead	Cost
2006	2007	Yes	Gabriel Richard Park Restoration Project	Stabilization and restoration of 290 meters of Detroit River shoreline to provide an aesthetically pleasing environment, create fish habitat, and include the integration of two fishing overlooks.	Detroit, MI	Detroit Riverfront Conservancy	\$300,000
2007	2008	na	BASF Riverview fish spawning restoration	Following the remediation of contaminated sediment at BASF's Federal Marine Terminal, incidental habitat was added to 366 meters of steel sheet piling, and one acre of walleye, smallmouth and largemouth bass, and sturgeon spawning habitat was created	Riverview, MI	BASF	\$100,000
2007	2009	na	Frank & Poet Drain Restoration	Excavation and stabilization of Frank & Poet Drain shoreline, planting emergent wetland plants and creation of an upland buffer area with wildflowers and prairie grasses.	Trenton, MI	Friends of Detroit River	\$80,000
2008	2009	na	Milliken State Park	Demonstrate innovative storm water management and aquatic habitat rehabilitation through construction of a storm water retention basin that treats runoff from adjacent neighborhood and rehabilitated shoreline habitat using soft engineering techniques.	Milliken State Park, Detroit, MI	MDNR	\$1M
2010	2010	na	Acquisition of Sugar Island	Sugar Island was purchased in 2010. It is a 30 acre tract managed by the USFWS National Wildlife Refuge System to protect Great Lakes island habitat important to threatened and endangered species and migratory birds.	Grosse Ile, MI/Detroit River	USFWS	\$500,000
2010	2013	Yes	Shoreline Restoration near South Fishing Pier	To contribute to the restoration of beneficial uses, this project provides a nursery area for fish in an area of the Detroit River with very little nursery habitat. The project goal is to increase fish populations by providing connectivity between fish spawning and nursery areas in the river through the following actions: 1) create 2.5 acres of coastal wetland immediately downstream of an existing artificial spawning reef and 2) create deep and shallow water habitat in the flat bottomland of the Belle Isle South Fishing Pier.	Belle Isle, MI	USEPA, Friends of Detroit River, City of Detroit	\$500,000
2010	2013	Yes	Blue Heron Lagoon Habitat Enhancement	The project reconnected and naturalized the connection between Blue Heron Lagoon and the Detroit River, restoring fish access to over 95 acres of existing wetlands, shallow and deep-water habitat and over 2.2 miles of canal habitat. In addition, the project enhanced coastal wetlands specifically designed for fish rearing and nursery habitat.	Belle Isle, MI	USEPA, Friends of the Detroit River, City of Detroit	\$1,459,649

Started	Completed	AOC Target site	Project Title	Description	Location	Lead	Cost
2010	2013	Yes	U. S. Steel Shoal Reconstruction	This project enhances approximately 1000 feet of shoreline and 5 acres of adjacent upland habitat along the Detroit River shoreline.	Ecorse, MI	USEPA, USS, Friends of Detroit River	\$670,000
2010	2016	na	Fish Habitat Enhancement Strategies for the Huron-Erie Corridor	USGS scientists are working toward restoring and enhancing native fish habitat and populations in the Detroit River and St. Clair Rivers. A bi-national partnership is identifying, assessing, and prioritizing sites for fish spawning and nursery habitat restoration to address Beneficial Use Impairments in the Detroit River and St. Clair River Areas of Concern (AOCs). USGS is providing information to help define what constitutes adequate restoration in the AOCs.	Detroit and St. Clair Rivers	USEPA, USGS	\$1.5M (2010) + 800,000 (2011) + \$675,000 (2012)
2010	2011	na	Restoration of the Common Tern Population in the Detroit River International Wildlife Refuge	Conduct monitoring, research, and management that guides restoration of the common tern ( <i>Sterna hirundo</i> ) breeding population in the Detroit River and conduct a workshop to convene agencies, universities, and other scientific advisors to develop a management target and monitoring program for common terns in the Detroit River AOC.	Detroit River	USEPA, USFWS	\$55,000
2010	September 2014	na	Investigate/ Plan Remedy for Grassy Island	USFWS is facilitating the final closure of Grassy Island, a unit of the Detroit River International Wildlife Refuge that is currently owned and operated by the USFWS. Grassy Island is a 72-acre dredge disposal property located in the Detroit River that contains contaminated sediments. USFWS will complete a feasibility study to determine and implement the best closure design scenario.	Detroit River	USFWS	\$2.8M
2010	2011	na	Elias Cove Fish Habitat Native Plantings	In 2005, contaminated sediments were removed from the Black Lagoon and portions of the shoreline were physically restored. Funds for this project allowed the city of Trenton to plant aquatic vegetation in the emergent wetland shelf and wet meadow riparian edge around the Cove, providing critically needed spawning and nursery habitat for native fish species in the Detroit River.	Trenton, MI	USEPA, City of Trenton	\$14,000
2011	2013	Yes	Coastal Restoration at the Refuge Gateway and Humbug Marsh	This project restored 10 acres of upland buffer habitat and enhanced plantings across 6 acres of restored coastal wetland. Additional work on the Humbug site is required, including tree and shrub plantings, invasive plant removal, and the school ship dock and fishing pier that will construct fish habitat in the river.	Trenton, MI	USEPA, USFWS	\$500,000
2012	2014	Yes	Restoring Fish Spawning Habitat in the Detroit River	This project will construct a hectare reef in the Detroit River to increase spawning habitat for fish in the Detroit River and will facilitate the removal of the loss of fish and wildlife habitat BUI. The project will include pre- and post-construction assessments focused on the life stages of key target species – lake sturgeon, northern madtom,		USFWS	\$800,000

Started	Completed	AOC Target site	Project Title	Description	Location	Lead	Cost
				lake whitefish, and walleye.			
2013	on going	Yes	Stony and Celeron Island Habitat Restoration Design Project	Engineering and design plans will be developed to determine the appropriate restoration techniques to restore wetland and submerged habitat within the degraded and eroded areas adjacent to Stony and Celeron Islands in the Detroit River AOC. Once implemented, restoration is expected to result in the creation and protection of at least 10,000 linear feet of coastal shoreline and more than 100 acres of marsh and submerged habitat.	Celeron and Stony Islands, Detroit River, MI	NOAA, Friends of Detroit River	\$480,620

Table 3 – List of major habitat projects in the Detroit River AOC (CDN) since 2008.

Started	Completed	Project Title	Description	Location	Lead	Cost
2008	2008	Lake Sturgeon Habitat Restoration at Fighting Island	Constructed sturgeon spawning reefs in a known historical spawning location off of the northeast corner of Fighting Island. The spawning habitat may also be used by other important Detroit River fish species such as walleye and whitefish. Post-construction monitoring has confirmed the use of the reef for spawning by lake sturgeon, lake whitefish, and walleye. The northern madtom, an aquatic species-at-risk, was also observed at this site. This project was a great example of international collaboration for habitat restoration.	Northeast corner of Fighting Island between Canadian mainland and island.	Essex Region Conservation Authority, U.S. Fish and Wildlife Service	\$320,000
1999	on-going	Biodiversity Conservation Strategy Implementation	Utilizing the Biodiversity Conservation Strategy (BCS), numerous high priority habitat restoration projects have been completed, primarily with private landowners throughout the AOC. Since 2000, over 260 hectares of new habitat have been established in the AOC through restoration projects. The majority of the restored habitat has included forest restoration (250 ha) (using machine planting and pit-and-mound forest restoration techniques) with smaller areas of wetland (6 ha) and fish habitat restoration (2.5 ha).	Throughout watershed	Essex Region Conservation Authority	\$3,395,150 (as of 2008)
2001	2012	Detroit River/Canard River Stewardship Initiative	Improvement of water quality and natural heritage features along the riparian areas and main tributaries of the Canard River through landowner involvement in habitat enhancement programs. Tallgrass prairie, native shrubs and trees, and wetland habitats have been restored, enhanced and created. Projects include public education, wetland creation, marsh recovery plans, corridor connections, and public workshops. Public open houses and tours have been held at project sites and have been attended by over 600 people and partners.	Throughout watershed	Essex County Stewardship Network	1,072,440
2008	2009	Turkey Creek Sediment Remediation	Removal of approx. 975 m <sup>3</sup> of PCB-contaminated sediment began in August 2008 and was completed in November 2008. In addition, 10, 425 m <sup>3</sup> of soils were removed to increase drain capacity so that storm water could flow down the channel and prevent flooding.	Grand Marais drain (Windsor) which is part of Turkey Creek	Ontario Ministry of the Environment, Essex Region Conservation Authority and City of Windsor	2.65 million



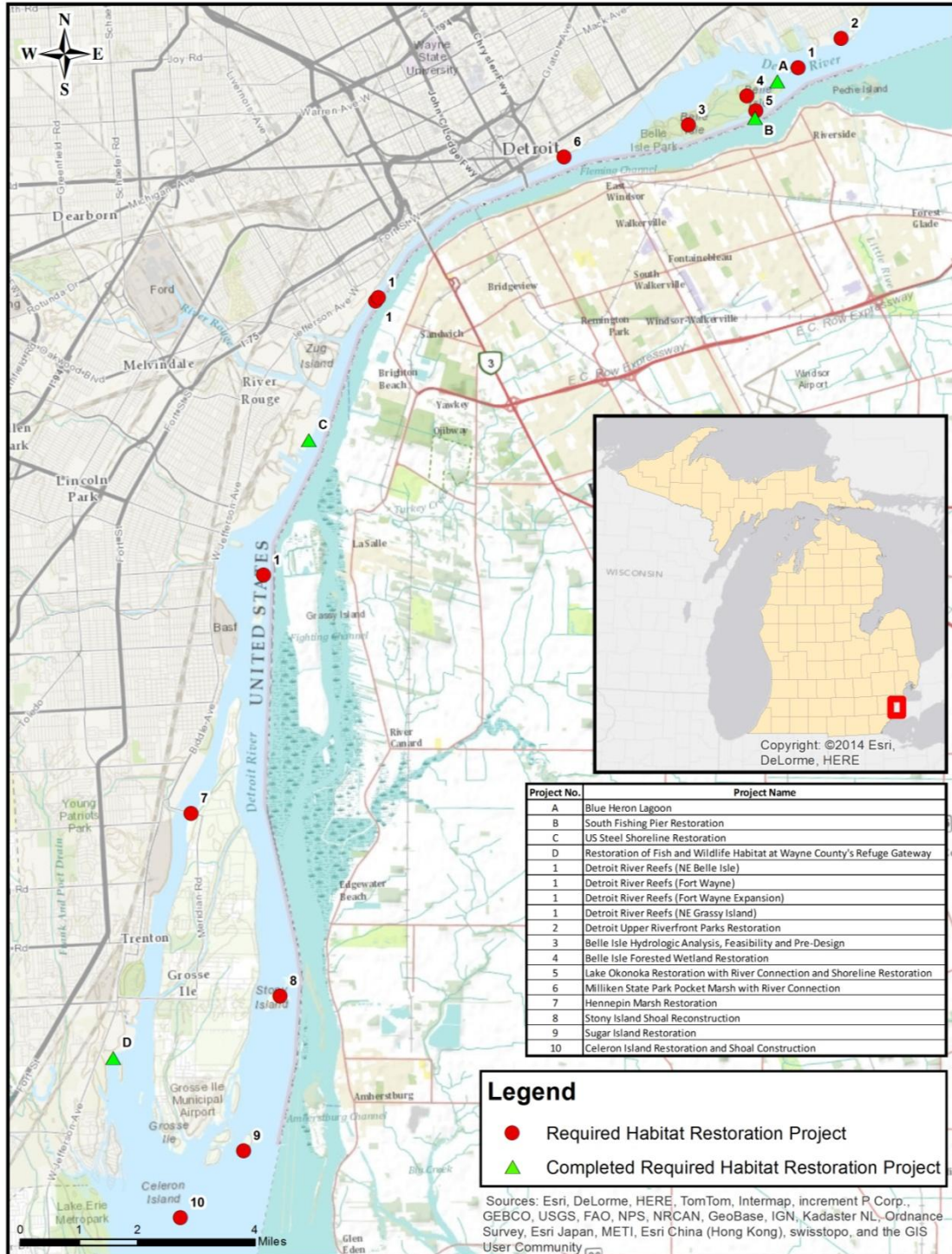
Started	Completed	Project Title	Description	Location	Lead	Cost
2008	2009	Turkey Creek Native Plant Demonstration Garden	Garden to highlight the variety, beauty and versatility of native wildflower and grasses that can be planted in this region. The goal was to show homeowners how to create a beautiful garden using native plant species.	Small garden off recreational trail in LaSalle near Morton Ave. and Matchette Ave.	Essex Region Conservation Authority and Friends of Turkey Creek	Paid through program below
2008	ongoing	Native Tree, Shrub & Wildflower Plantings	Community and school tree plantings are coordinated by local groups with support from ERCA and funding from the DRCC. Between April 2008 and March 2013, 12,127 trees, shrubs and wildflowers were planted in the Detroit River watershed with support from approx. 5,397 volunteers!	Throughout watershed	Essex Region conservation Authority	\$15,000 annually
2009	2010	LaSalle Riverfront Park Shoreline Habitat Restoration	Restoration of approx. 550 meters of Detroit River shoreline in the Town of LaSalle, next to Gil Maure Park. The completed works feature an undulating shoreline incorporating a variety of rock types and sizes, as well as a large offshore sheltering island. The project improves habitat for Detroit River fishes and protects the shoreline from erosion.	Lasalle (foot of Laurier Road); immediately downstream of the Sturgeon Spawning Reef	Essex Region Conservation Authority and Town of LaSalle	TBD
2010	2011	Windsor Riverfront Shoreline Fish Habitat Restoration	Project used various techniques to soften 550 meters of Detroit River shoreline directly upstream of the Windsor Riverfront Retention Treatment Basin, improving fish habitat while also protecting the shoreline from erosion.	Adjacent to the RTB along the Detroit River in Windsor	Essex Region Conservation Authority and City of Windsor	TBD
2011	2012	Detroit River Shoreline Assessment	This project examined the condition of the 52 km Detroit River Canadian Shoreline (mainland). Information was analyzed and mapped to identify and prioritize areas for shoreline restoration or enhancement.	Detroit River Canadian Shoreline	Essex Region Conservation Authority	TBD
2011	2012	Canard River Park Shoreline Restoration	Project to restore 200 m of shoreline at the River Canard Park, co-owned by the Town of LaSalle and the Town of Amherstburg, to improve fish habitat and protect the shoreline from erosion. Also included a walking trail lined with native wildflowers, two large viewing platforms and a fishing platform to enhance visitor experience.	Canard River Park	Essex Region Conservation Authority, towns of Lasalle and Amherstburg	TBD
2012	2013	Detroit River Shoreline Options Guide	A public-friendly, visually-appealing guide was developed to encourage riverfront landowners to consider fish-friendly shoreline erosion protection techniques. A decision matrix was also developed to help various representatives (e.g., contractors, technical staff) choose the best shoreline solution based on specific site characteristics and needs.	Detroit River Shoreline	Essex Region Conservation Authority and Environment Canada	\$30,000
2012	2013	GLIER Native Plant Garden	With help from the local community, staff and students at the University of Windsor's GLIER planted a native wildflower garden at the front entrance of their building to demonstrate their commitment to protecting the local environment by reducing the need to mow and water.	2990 Riverside Drive West (GLIER)	Great Lakes Institute for Environmental Research	Paid through ongoing native plant program above
2013	2014	Shoreline Fish Habitat Restoration at Lafarge Inc.	This project restores and enhances a 315 m shoreline at a major industrial site along the Detroit River.	Lafarge (west Windsor)	Windsor Port Authority and Lafarge, Inc.	\$430,000
2013	2013	Expansion of the Lake Sturgeon Spawning Reef	Building on the success of the spawning reef constructed in 2008, this project created an additional 1.25 acres of spawning habitat at the bottom of the Detroit River adjacent to the existing one completed in 2008 at Fighting Island.	Detroit River (between Fighting Island and LaSalle)	Essex Region Conservation Authority	\$320,500

\*\*Note: Although most projects only list one or two lead organizations, many of the projects could not have been completed without the support of numerous stakeholders. Projects completed prior to 2008 are listed in the Detroit River Canadian Remedial Action Plan Stage 2 Report (Green et al. 2010).

## 7.0 SITE INDEX

The following is a list of the restoration projects recommended by the Technical Committee and summarized in this section. Projects are generally numbered from upstream to downstream, not in order of importance. Figure 2 shows the location of each project.

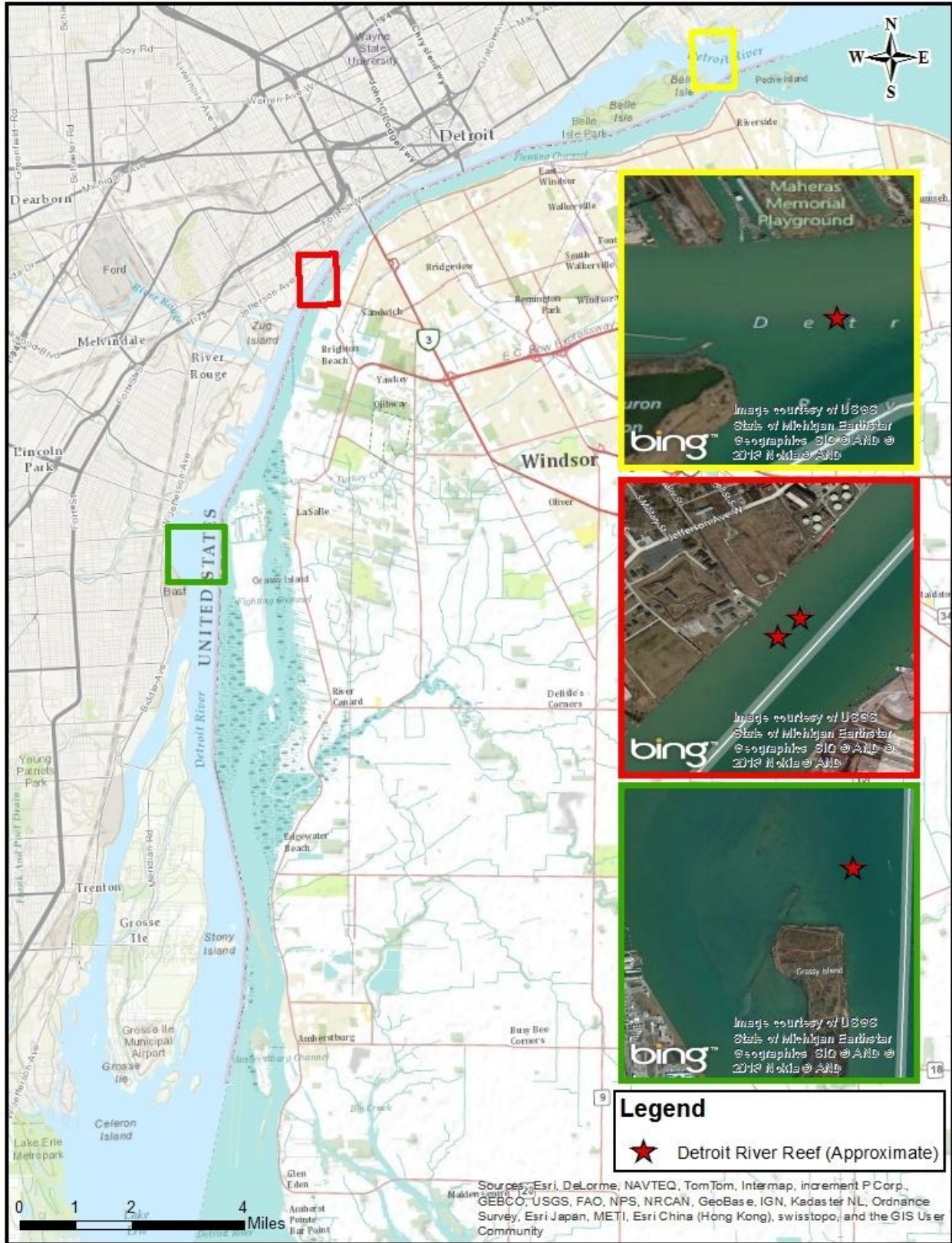
Figure 2 – Habitat Restoration Projects Required for BUI Removal in the Detroit River AOC





# #1 DETROIT RIVER REEFS

Figure 3 – Project Location Map – Detroit River Reefs



## #1 DETROIT RIVER REEFS

### 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 Refuge, 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.

## #1 DETROIT RIVER REEFS

**Justification as target site** – The Detroit River is a binational 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 is partially due to large-scale dredging activities in the AOC that removed critical habitat for lithophilic spawners. Impacts on fish and wildlife populations 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.

**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.



## #1 DETROIT RIVER REEFS

### **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 MDEQ and US Army Corps of Engineers (USACE) to fill or place structures within the Detroit 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 Rivers. 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 USFWS, 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).



## #1 DETROIT RIVER REEFS

### Timetable (design, permitting, construction, monitoring):

Project Activities	Year 1				Year 2				Year 3			
	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	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	
● 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:** The Detroit River PAC will work with USGS, USFWS and other 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.

## #2 DETROIT UPPER RIVERFRONT PARKS RESTORATION

Figure 4 – Project Location Map – Detroit Upper Riverfront Parks Restoration



## #2 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 into the Detroit River (see photo).

**Brief site background** – All three sites are located at the headwaters 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. 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, restore the aquatic and shoreline habitats and enhance fishing opportunities.

**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 in order to restore and enhance approximately 1800 linear feet of shoreline and establish approximately 8 acres of wetland habitat.

### Actions –

- Remove approximately 600 LF of existing riprap shoreline, and restore the shoreline with native wetland edge and spawning shelves
- Improve approximately 1,000 LF of existing soft shoreline, and modify approximately 1 acre of upland into wetland habitat
- Remove approximately 200 LF (total) of steel seawall at two locations
- Create approximately 7 acres of wetlands and shallow and deep water habitats
- Create turtle nesting areas, snake hibernacula, mudpuppy structure, and large woody material for both fish habitat and reptile basking structures, where feasible

**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 a minimum of one season prior to restoration and no less than two seasons following restoration. Assessments should emphasize habitat use, spatial distribution, and presence of various life stages, reproductive success, and overall population size.

**Projected costs:** TOTAL \$5M

### Timetable (design, permitting, construction, monitoring):

- Design – 12 months
- Permitting – 6 months
- Pre-Construction Monitoring – 12 months

## #2 DETROIT UPPER RIVERFRONT PARKS RESTORATION

- Construction – 12 months
- Post Construction Monitoring – 2 years

**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.



### #3 BELLE ISLE HYDROLOGIC ANALYSIS, FEASIBILITY AND PRE-DESIGN

Figure 5 – Project Location Map – Belle Isle Hydrologic Analysis, Feasibility and Pre-Design



### #3 BELLE ISLE HYDROLOGIC ANALYSIS, FEASIBILITY AND PRE-DESIGN

#### Project description:

**Project location** – Belle Isle, Detroit, Michigan.

**Brief site background** – The waterways on Belle Isle include three lakes, a lagoon, and over two miles of canals totaling 106 acres of open surface water. Historically, these waterways were connected to the Detroit River providing aeration and circulation for fish habitat. In the 1950s, the waterways were closed off from the river creating stagnant conditions and eliminating the ability for fish to migrate into the canal and lake system. Pumps were installed to circulate the water within Belle Isle, but were costly to maintain and operate; therefore currently function only on a limited basis.

The canal system routes throughout the entirety of the island, and into the wet-mesic flatwoods community type which has been rated according to the Heritage Methodology as a G2G3 S2 that is “vulnerable to imperiled globally and imperiled within the state” as well as through Lake Okonoka, a linear-shaped lake with several forested islands providing a diversity of terrestrial and aquatic habitat.

Manipulation of the waterways throughout the island have contributed to the degradation of the wet-mesic flatwoods community and Lake Okonoka, which have been identified for future restoration as part of this plan. Prior to designing restoration of the Belle Isle Forested Wetland and Lake Okonoka, a hydrologic study has been identified as a primary need.

**Habitat to be addressed** – hydrological review of lake, wetland, canal and river hydrology of Belle Isle.

**Justification as target site** – A comprehensive study of the hydrology of Belle Isle is a necessary component of the Lake Okonoka and Belle Isle Forested Wetland Habitat Projects. A thorough understanding of the hydrology of the entire island, including influences from the Detroit River, groundwater, and the canal system, as well as the historical manipulation of water on the island is a prerequisite for designing successful habitat restoration projects.

Understanding the hydrology of the island will allow for future restoration enhancements such as the following:

- Restored hydrology that supports enhancement of the entire 200-acre wet-mesic flatwoods community;
- Vast improvements to the hydrologic function and water quality of the Blue Heron Lagoon and Lake Okonoka by re-establishing a flow-through current from the Detroit River within both water bodies;
- Restored fish passage into and through Lake Okonoka;
- Adding to Blue Heron Lagoon’s 41 acres of fish nursery, the Blue Heron Lagoon/Okonoka/South Shore system will total 86 acres of habitat permanently on-line with the River. This is 45 acres of additional fish nursery;
- The addition of 65 acres of remaining internal waterways to the flow-through system;
- Enhanced 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;
- Improved habitat for freshwater mussel species, many of which are rare, threatened or endangered, including the Northern Riffleshell, Hickorynut, Purple Wartyback, Rainbow and the Round Pigtoe;

**Property owner (Responsible entities):** Belle Isle is owned by the City of Detroit and managed by the State of Michigan through a lease. Possible additional partners include the Friends of the Detroit River, Detroit Recreation Department, MDNR and Belle Isle Conservancy.



### #3 BELLE ISLE HYDROLOGIC ANALYSIS, FEASIBILITY AND PRE-DESIGN

#### Project purpose:

**Goal** – A thorough understanding of the waterways of Belle Isle in order to effectively design the habitat restoration projects in the Belle Isle forested wetland and Lake Okonoka.

**Objective** – Gather existing documents and conduct field reconnaissance to fully understand the hydrologic function of Belle Isle's internal waterway system. Conduct analysis and make recommendations pertaining to a variety of potential habitat enhancement concepts.

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

#### **Task 1: Existing Document Review, Data Gathering and Field Reconnaissance:**

- *Review existing documents.* Numerous studies have been prepared over the past 20 years that pertain to the canals, lakes and flora and fauna found on Belle Isle. These documents will be reviewed and quantified based on their relevance to this Task's deliverables. These documents will be supplemented with newly generated data where gaps prevent the ability to quantify applicable information.
- *Supplement existing bathymetric surveys* of the Isle's lake and canal system where gaps prevent the ability to understand the influences of these surface water features on Lake Okonoka and the wet-mesic flatwoods. Map bathymetry of canals, Lake Okonoka, and Lake Muskoday. Determine average, maximum, and minimum water depths to be expected if these were reconnected to the Detroit River.
- *Supplement existing topographic surveys* where gaps prevent determining sub-watershed boundaries, drainage patterns, critical high points and low points and full understanding of surface water flows. Locate, map and compile all surface drains, ditches and underground drainage (tiles) on the island. Determine the condition and functionality of each drain. Identify the location and condition of all storm water drains/pipes and sewage lines, manholes pumps etc. Determine roadway, parking lots, lawns and other areas that are prone to seasonal and rain event flooding.
- *Delineate wetlands and approximate boundaries of vernal pools* in the forested wetland for development of water balance modeling, minor drainage alterations such as filling or cutting ditches and adding culvert pipes to improve connectivity between pools while abandoning tiles where possible. Rely on existing data to verify approximate locations of wetland boundaries and update these boundaries and GPS locations.

#### **Task 2: Analysis Documentation:**

- *Determine impact of canals on the forest hydrology.* Determine if the canals function as a sump, or if the clay layer prevents this. Determine the impact of increasing the depth of the canals.
- *Determine impact to the forest if Lake Okonoka is connected to the Detroit River.* Include evaluation of the surface drain/ditch entering the canal between the pedestrian bridge and Lake Okonoka.
- *Determine the impact of abandoned roads and trails* on the forest surface water hydrology. Determine the impact on hydrology if they are removed, culverts installed or roads reduced to trails.
- *Determine the impact on the forest hydrology if fill and roadbeds are removed* from where roads are covered with fill. Investigate the possibility of restoring vernal pools that may have been destroyed.
- *Investigate relationships of forest vegetation with surface water and groundwater.* Determine if the trees tap into a groundwater source or if they are primarily influenced by surface water.
- *Investigate blocking or unblocking drains.* Determine the hydrological impact of blocking each of the mapped surface drains or known buried drain tiles. Conversely, determine the impact of unblocking any currently blocked drains.
- *Determine if the canals currently function to drain upland developed areas* to reduce flooding/ponding. Evaluate this potential given current design and pump capabilities.

### #3 BELLE ISLE HYDROLOGIC ANALYSIS, FEASIBILITY AND PRE-DESIGN

- *Investigate the feasibility of flooding or drawing down Lake Okonoka* via water control structures installed at the current inlet and outlet and at a future River connection. Investigate the potential of flooding enough to control invasive plants, or drawing down enough to create mudflats for shorebirds. Investigate impact on recreation (fishing/boating) opportunities and impact on fish nursery function.
- *Investigate removing woody debris in the canals.* Include evaluation of the large number of downed ash trees. Determine the impact on water flow within the canals, lakes, and adjacent upland areas if this material is removed. Evaluate the potential of leaving or positioning large woody debris in the canals for aquatic habitat while still allowing a channel for canoes and kayaks to easily pass.
- *Investigate impact on the current water control structure* at the terminus of the canal system as a result of the “Lake Okonoka project” – include potential impacts to the pump system / operation. Validate the assumption that with Okonoka “off line” less water will be needed to pump into the canals.

**\*\*Note:** Any study or action plan should be mindful of and dovetail with hydrologic restoration plans for the entire island, and include recreational needs. Beyond the flatwoods storm water drainage/management, recreational use (boating, fishing, access) should be considered.

#### **Indicators & Monitoring**

**Projected costs:** \$140,000

#### **Timetable (design, permitting, construction, monitoring):**

- Gathering Available and Existing Data: 3 months
- Field study for Additional Data Collection: 3 months
- Analysis and documentation: 6 months
- Total: 9 months

**Public involvement:** The MDNR and 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.



# #4 BELLE ISLE FORESTED WETLAND RESTORATION

Figure 6 – Project Location Map – Belle Isle Forested Wetland Restoration



## #4 BELLE ISLE FORESTED WETLAND RESTORATION

### Project description:

**Project location** – Belle Isle, Detroit (see photo)

**Brief site background** – Belle Isle supports a large forested wetland complex (classified as wet-mesic flatwood community by the Michigan Natural Features Inventory (MNFI)) on the east half of the island. The large forested wetland complex drains via a canal system to the Detroit River. In addition to the canals, roads, surface and sub-surface drains and fill material have 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 turfgrass, marsh, and open water habitats. Historic browsing 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. According to MNFI, flatwoods can have abundant vernal pools that serve as breeding ponds for aquatic invertebrates and amphibians. Flatwoods provide “habitat for cavity nesters, canopy-dwelling species, and interior forest obligates, including neotropical migrant birds such as black-throated green warbler (*Dendroica virens*), scarlet tanager (*Piranga olivacea*), and ovenbird (*Seiurus aurocapillus*)”. Multiple amphibian and reptile species are also associated with this community type including Blanding’s Turtles (*Emydoidea blandingii*), Spotted Turtle (*Clemmy gutatta*), Small-mouthed Salamanders (*Ambystoma texanum*), and other vernal pool dependent wildlife. After the loss of key species such as native ash (*Fraxinus* spp.) and native elm (*Ulmus* spp.) trees due to the Emerald Ash Borer and Dutch Elm disease, respectively, it will not be possible to restore a completely intact wet mesic flatwood community. However, the primary goal of the project is to have as many representative constituent species as possible in the appropriate relative frequencies.

Severe problems with noxious weeds and sedimentation have been common since the closing of canal connections to the Detroit River in the 1950s. Amenities such as ice-skating and canoeing that were once popular are no longer featured. The Belle Isle Master Plan of 2005 recommends replacing roads with picnic areas, fishing, walkways and natural edges so that they complement their surroundings and are environmentally responsive. Automobile traffic cutting through the forest should be reduced without completely eliminating the experience. Alternative modes of access, such as bicycle trails, should be integrated into the wooded environment and should be connected to the overall bicycle and pedestrian systems planned for the island. The plan also calls for the creation of interpretive systems and nature trails that tell the story of the forest, stimulating educational use and visitor interest for all ages.

**Habitat to be addressed** – wet-mesic flatwood community

**Justification as target site** – Belle Isle is a critical habitat for a variety of rare and sensitive species including Shumard oak, pumpkin ash, Butler’s garter snake, and Blanding’s turtle. At approximately 200 acres, the complex is one of the largest in the Detroit River watershed and is strategically located - 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 S2 that is “vulnerable to imperiled globally and imperiled within the state.” This ecosystem has been degraded over time; for example, by including manipulation of hydrology through construction of a canal system. The Floristic Quality Assessment performed by Conservation Design Forum (BIC,ECC contracted) recorded a comparatively low number of native species in the most diverse area of the forest. 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. Restoration emphasizing amphibians and reptiles has been under represented in the Detroit River but is necessary to support strong healthy functioning ecosystems. Belle Isle historically supported a

## #4 BELLE ISLE FORESTED WETLAND RESTORATION

diverse community of amphibians and reptiles and presumably aquatic macroinvertebrates (Harding 1997, Holman 2012, Mifsud 2004, Mifsud 2013). 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):** Owned by City of Detroit and managed by State of Michigan through a lease. Possible project management partners include the Friends of the Detroit River, Detroit Recreation Department, and Belle Isle Conservancy.

### **Project purpose:**

**Goal** – Enhance the existing forest to establish representative species characteristic of the wet mesic flatwoods natural community/ecosystem and Belle Isle’s natural heritage to provide habitat for fish and wildlife populations such as bird, aquatic macroinvertebrate, amphibian and reptile species.

### **Objectives –**

- Restore approximately 200 acres of wet-mesic flatwoods complex and adjacent habitat.
- Restore hydrology/topography that supports restoration of the entire wet-mesic flatwoods community.
- Ensure that conditions are present that are capable of supporting native species such as aquatic macroinvertebrates, amphibians, and reptiles.
- The restoration will support migratory and resident bird habitat and food resources within the wetland complex.
- The restoration will support understory herbaceous plant community within wet-mesic flatwoods restoration area that preserves the unique genetic character of the natural community.
- Reduce habitat fragmentation and restore connectivity to adjacent natural areas.
- Reduce road related mortality with an emphasis on reptile and amphibian communities.
- Reduce populations of invasive species and subsidized predators to levels appropriate for the flatwoods community.
- Ensure long-term control of invasive species and subsidized predators.
- Integrate public education, outreach and training to support the objectives of the project.

### **Actions –**

- Conduct hydrologic analysis to evaluate and guide restoration targets including a map of all anthropogenic alterations to hydrology including, dikes, culverts, sumps, ditches, tiles, fill, etc.\*\*
- In the project area, implement the Ecological Management Plan being developed by the Belle Isle Conservancy’s Environmental Conservation Committee once it is finalized and approved by MDNR, Parks and Recreation Department (PRD) and others as appropriate.
- Establish up to 20 acres of deeper and more semi-permanent vernal pools within fill areas and/or existing road bed within the project area that supports successful reproduction of rare and sensitive amphibian and reptile indicator species.
- Construct wildlife barrier fencing and wildlife culverts to address road mortality on Lakeside Dr., the road that connects the forested wetland project area to Blue Heron Lagoon.
- Incorporate additional features such as amphibian and turtle nesting areas, basking logs, snake hibernacula etc. throughout the project area, where feasible.
- Remove Central Ave. from east of Vista Ave to Lakeside Dr. and restore to wet-mesic flatwoods, if feasible.
- Convert Oakway Trail and Woodside Dr. to hike/bike trails and restrict vehicular access to emergency vehicles only with breakaway gates, if feasible. Incorporate interpretive signage.



## #4 BELLE ISLE FORESTED WETLAND RESTORATION

- Remove/block ditches that presently drain some interior areas of the forest, if feasible based on the hydrologic study and community restoration goals.
- Remove roadbeds and fill material from former Tanglewood Rd. and Wildwood Pass.
- Enhance/restore/create watercourses that pass through the wetland complex such as a fringe of marsh and wet prairie along Nashua Canal and Sylvan creek opposite the forest.
- Characterize the soil, including salinity, along roadbeds and drainage paths within the project area.
- Incorporate native fruit bearing shrubs (i.e. Maple-leaved Arrow-wood, Spicebush, etc) using local genotypes associated with wet-mesic flatwood community along edge of woods and when appropriate in the interior to provide food and cover for resident and migratory birds.
- Map invasive trees, shrubs and herbaceous plants by means of MDNR, PRD's protocol, develop an invasive plant removal implementation plan and remove invasive plants using best known practices and adaptive management according to the Ecological Management Plan, when it is approved. Prioritize by threat (extent, immediacy, impact) and opportunity. Integrate amphibian and reptile BMPs.
- Work with appropriate agencies for control and long-term management of subsidized predators.
- Remove excessive coarse woody structure, primarily recently fallen ash trees, from the canals that pass through the woods to enhance fish passage. Retain sufficient coarse woody structure for fish habitat, basking logs for turtles etc.

**\*\*Note:** Any study or action plan should be mindful of and dovetail with hydrologic restoration plans for the entire island, and include recreational needs. Beyond the flatwoods storm water drainage/management, recreational use (boating, fishing, access) should be considered.

**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 a 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 DEQ is evaluating the potential for a pilot program to monitor vernal pools.

**Projected costs:** \$4M

**Timetable (design, permitting, construction, monitoring):**

- Feasibility, Pre-Design Monitoring and Design – 12 months
- Permitting – 6 months
- Construction – 18 months
- Monitoring – 2 to 5 years post construction

**Public involvement:** The unique nature and interest in Belle Isle makes it a desirable place for community involvement. The Detroit Recreation Department and MDNR, PRD typically solicit public input during the planning and permitting stages of major projects. Volunteers from the Belle Isle Conservancy and other local groups can assist with invasive species removal and control, habitat creation and placement, and community outreach, and participate in organized volunteer monitoring events, and stewardship.

# #5 LAKE OKONOKA RESTORATION WITH RIVER CONNECTION AND SHORELINE RESTORATION

Figure 7 – Project Location Map – Lake Okonoka Restoration with River Connection and Shoreline Restoration



## #5 LAKE OKONOKA RESTORATION WITH RIVER CONNECTION AND SHORELINE RESTORATION

### Project description:

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

**Brief site background** – Lake Okonoka is a linear-shaped lake with several forested islands that provides a diversity of terrestrial and aquatic habitats. Based on survey data compiled in the late 1990s, most of the lake is shallow water (approximately 4-5 feet deep) with deeper pools and limited open water. It is part of the Isle's canal and lake system that is hydrologically maintained and controlled by a pump system that utilizes river water to artificially control the water levels for aesthetic, recreation and habitat functions. The canals and lakes are artificially controlled at an elevation higher than the Detroit River, and its hydrology is regulated through a system of pumps and 2 overflow structures located at opposite ends of the Isle. One such structure exists at the east end of Lake Okonoka adjacent to Lakeside Drive (JJR 1996). At this location, a stop-log structure provides the opportunity to manipulate water levels in the canals and Lake prior to its discharge into Blue Heron lagoon via a large diameter culvert pipe below Lakeside Drive, which is now hydrologically connected with the Detroit River. During periods of exceptionally high river levels or certain seiche events, the river and Blue Heron Lagoon water levels can top this overflow structure, which in turn backs up water in the lakes and canals. When this occurs, the functions of the pumps are reversed to remove water from the lakes and canals to prevent flooding in lower elevations of the Isle.

The near-south shoreline of Belle Isle between the South Fishing Pier and Vista Drive can be described as “calm” water due to the shoreline being depressed from the remainder of the south shoreline. In this location, the shipping channel is its greatest distance from the shoreline, and currents are significantly slower than the remainder of the Detroit River. This creates a backwater effect where currents often are observed moving upriver. However, wave action from pleasure vessels and freighters is great in this area and the shoreline is heavily stabilized with coarse riprap and broken concrete in response to this condition. Throughout this location (based on field observations), large aquatic beds appear to exist, suggesting that its potential for a high quality fish nursery is great with the introduction of breakwater structures that will serve to abate the pleasure craft and freighter wave action that contribute to excessive turbulence and degraded habitat for juvenile fish species. The waters off Belle Isle once supported 17 or so species of fresh water mussels including several rare species. The mussel fauna has been decimated due to the introduction and establishment of the invasive zebra mussel.

The Belle Isle Master Plan of 2005 recommends improving the quality and quantity of recreational experiences on the lakes and canals while protecting and enhancing the natural environment allowing for the trails to become an active part of the Belle Isle experience.

**Habitat to be addressed** – lake, emergent wetland and shoreline

**Justification as target site** – The proposed habitat enhancements to Lake Okonoka and a portion of the Detroit River shoreline will expand upon the connectivity created by the Blue Heron Lagoon and South Fishing Pier Restoration projects 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 44 acres of fish nursery to the 41 acre Blue Heron Lagoon/Lake Okonoka system, bringing a total of 85 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.



## #5 LAKE OKONOKA RESTORATION WITH RIVER CONNECTION AND SHORELINE RESTORATION

**Property owner (Responsible entities):** Owned by the City of Detroit and managed by the State of Michigan through a lease. Possible project management partners include the Friends of the Detroit River, Detroit Recreation Department, Michigan DNR 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 44 acres.

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

- Conduct hydrologic analysis to evaluate and guide restoration targets including a map of all anthropogenic alterations to hydrology including dikes, culverts, sumps, ditches, tiles, fill, etc.\*\*
- Bathymetric survey to determine locations where dredging of Lake Okonoka soils will be required and verify proposed flow-through pipe elevations,
- Sample and test soil to determine soil disposal requirements and to fulfill permit requirements,
- Replace the existing stop log structure with open-flowing crossing structure(s) (box culverts, bottomless arched culvert pipes, or bridges) connecting Blue Heron Lagoon with Lake Okonoka below Lakeside Drive. Crossing(s) shall be sized to maximize fish and wildlife passage and flow-through current.
- Perform minor excavation at the outlet of Blue Heron Lagoon and Lake Okonoka to improve this connectivity.
- Locate and construct similar enhanced crossing structure(s) (box culverts, culvert pipes, or bridges) 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 that project are anticipated.
- Dredge soil 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.
- Possibly restore aquatic plants to portions of the lake if necessary due to dredging impacts.
- Where possible, create turtle nesting areas, terrestrial basking structures, snake hibernacula, and large woody material for both fish habitat and reptile basking structures.
- Add 18 acres of nursery habitat within a 250 - 450 feet wide by 3000 feet long reach of the Detroit River that parallels the south shoreline of Belle Isle between the Great Lakes Museum and the South Fishing Pier for larval fish species by:
  - Conducting a bathymetric survey to determine most suitable locations for the outer limits of the breakwater structures.
  - Constructing a series of staggered breakwater structures that provide fish passage in numerous locations while significantly reducing the impacts due to wave action from pleasure crafts and freighters.
  - Adding new water control structure at canal – Lake Okonoka connection to maintain canal water levels suitable for fish passage and recreational boating access, if feasible.
  - And, if necessary, adding aquatic plant beds that would infill any significant gaps in the vegetative cover on the river bottom.

**\*\*Note:** Any study or action plan should be mindful of and dovetail with hydrologic restoration plans for the entire island, and include recreational needs. Beyond the flatwoods storm water drainage/management, recreational use (boating, fishing, access) should be considered.

## #5 LAKE OKONOKA RESTORATION WITH RIVER CONNECTION AND SHORELINE RESTORATION

**Indicators & Monitoring:** Pre and post construction monitoring of fish, amphibian, reptile, bird and other wildlife use should be incorporated into the overall project to assess its success. Monitoring should be conducted for a minimum of one season prior to restoration and no less than two seasons following restoration completion with potential of up to five years total to accurately assess community composition and system function. Other possibilities for volunteer monitoring include existing student groups such as the Stream Team, National Wildlife Federation's Earth Tomorrow program or new programs for youth within the Detroit Recreation Department and/or the Belle Isle Nature Zoo.

**Projected costs:** \$3.6 million

**Timetable (design, permitting, construction, monitoring):**

- Design and permitting: 1 year
- Construction and restoration: 1 year
- Monitoring: Minimum of 1 year pre-construction and 2 years post-construction

**Public involvement:** The MDNR 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 Okonoka 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.

**Figure 8 – Conceptual Design – Lake Okonoka River Connection**



Lake Okonoka Restoration & River Connection

Belle Isle  
Detroit, Michigan



## #5 LAKE OKONOKA RESTORATION WITH RIVER CONNECTION AND SHORELINE RESTORATION

Figure 9 – Conceptual Design – Shoreline Restoration As Part of Lake Okonoka River Connection



South Shoreline Habitat Restoration

Belle Isle  
Detroit, Michigan

# #6 MILLIKEN STATE PARK POCKET MARSH WITH RIVER CONNECTION

Figure 10 – Project Location Map – Milliken State Park Pocket Marsh with River Connection



## #6 MILLIKEN STATE PARK POCKET MARSH WITH RIVER CONNECTION

### Project description:

**Project location** – Milliken State Park - North side of the Detroit River main channel downstream of Belle Isle. The restoration area 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 Gentry Park pocket marsh (similar to the one proposed here) found juvenile muskellunge were using that site. 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 shallow water depths and a gentle current. The recessed shoreline would be naturalized to enhance this feature and breakwaters 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 riverbank. 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 refuge 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, native mussel habitat, 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.



## #6 MILLIKEN STATE PARK POCKET MARSH WITH RIVER CONNECTION

### 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.
- 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 and amphibian habitat and nesting areas on the shoreline and nearshore habitat.
- 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 a breakwater between main river channel and off-channel open water area with large riprap and/or boulders.
- Construct turtle nesting areas, snake hibernacula, mudpuppy structures, and large woody material for both fish habitat and reptile basking 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:** Pre and post monitoring of use of the new habitat by fish, amphibians, reptiles, birds, and other animals. Monitoring should be conducted for a minimum of one season prior to restoration and no less than two seasons following restoration completion with potential for up to five years total to accurately assess community composition and system function. 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. Park 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 – 12 months
- Construction – 12 months
- 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.

# #7 HENNEPIN MARSH RESTORATION

Figure 11 – Project Location Map – Hennepin Marsh Restoration



## #7 HENNEPIN MARSH RESTORATION

### Project Description:

**Project location** – Hennepin Marsh 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 (see map). The North Hennepin Marsh project area consists of a 106-acre wetland and emergent shoreline located above the Toll Bridge and is denoted as the upper site on the map. The South Hennepin Marsh project area, denoted as the lower site on the map, includes about 48 acres of coastal wetlands, emergent shoreline, upland hardwood forests and contains three barrier islands.

**Brief site background** – North Hennepin Marsh is a shallow wetland area that once contained large stands of native cattail. Being on a narrow and very busy waterway, this wetland has suffered a great loss of its natural emergent vegetation due to wave action, ship surges and hardened shorelines as a result of past human use. 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. The shoreline area is almost completely dominated by invasive Phragmites.

The South Hennepin Marsh is 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 North Hennepin Marsh, this site also has a phragmites problem along its shoreline. But, unlike the north 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, emergent shoreline and upland hardwood forests with vernal ponds.

**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, reptiles and shorebirds.

**Property owner (Responsible entities):** The upper site property owners include the BASF Corporation, the Township of Grosse Ile, and the Grosse Ile Nature and Land Conservancy. The lower site below the Toll Bridge also has several property owners. Although there are a number of landowners of the lower 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 property owners of selected sites, MDNR, and USACE.

### Project purpose:

**Goals** – Protect and enhance the existing submergent wetlands and create additional emergent shoreline.

### Objectives –

- **Protect existing habitat and provide an area for the regeneration of lost emergent wetlands by adding a protective shoal to North Hennepin Marsh and rebuilding protective barrier islands in South Hennepin Marsh**
- Eliminate negative impacts of invasive Phragmites.
- Ensure long-term protection and management of undeveloped acreage of upland forests and coastal wetlands.
- Improve movement and connectivity between aquatic and terrestrial habitats.
- Improve habitat for turtles, mudpuppies and fish.



## #7 HENNEPIN MARSH RESTORATION

**Actions** – The actions taken will be determined by the final engineering design, but may include:

- Construct shoal(s) parallel to the North Hennepin Marsh, and the reconstruction of approximately 500' of barrier islands in the South Hennepin Marsh area
- Remove invasive Phragmites and possibly replant native vegetation within the construction zone.
- Determine the feasibility of purchasing up to 37 acres of wetland and forested upland/wetland mosaic.
- Include the incorporation of small stone/gravel in riprap areas to facilitate better movement and connectivity between aquatic and terrestrial habitats.
- Add turtle nesting beaches with southern exposures, the addition of branches in shallow water to provide nesting structure for amphibians, and logs in shoal areas to allow for reptile basking and cover for fish.
- Add limestone sheet rock 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 for a minimum of one year as well as post-construction for a minimum of two years. 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 completion of approximately 1,500 feet of dike using marine construction methods and is estimated to cost approximately \$2.6 million. This figure 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 37 acres of upland woods, emergent shoreline, coastal wetland, and barrier islands is estimated to be approximately \$1.5 million. The total cost for the entire project is expected to be up to \$4.25 million.

**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) which is currently under negotiation by Township of Grosse Ile. 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 – 4 years (including a 1 year period of ecological stabilization post-construction)

**Public Involvement:** This project with its proposed off shore shoal 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 removal and emergent reconstruction portions of the project using local NGOs and conservation groups like the Grosse Ile Open Space Committee and Grosse Ile Nature and Land Conservancy.

## #7 HENNEPIN MARSH RESTORATION

Figure 12 – Aerial Photograph of Upper Hennepin Project Site – looking southeast



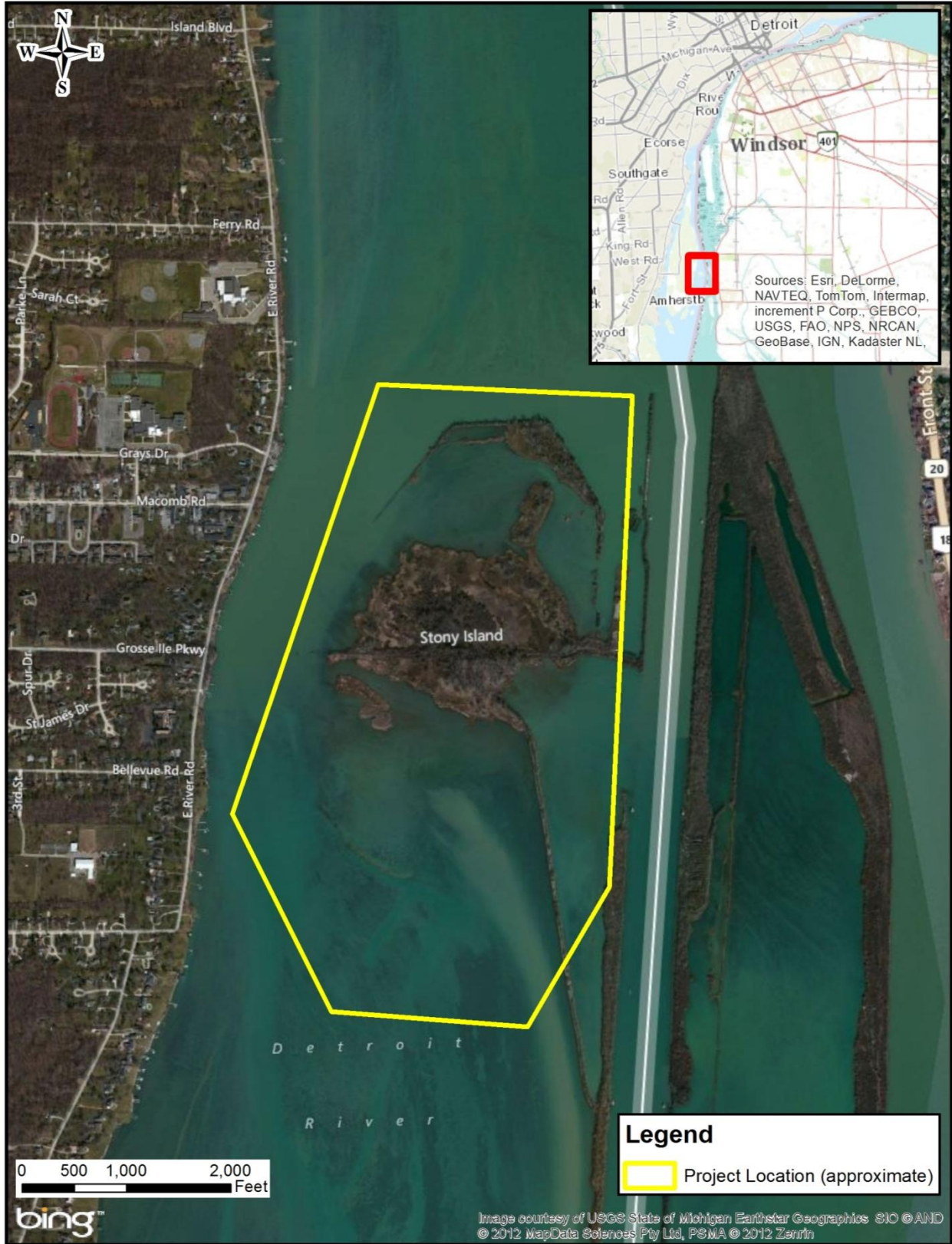
Figure 13 – Aerial Photograph of Lower Hennepin Marsh Project Site – looking west





# #8 STONY ISLAND SHOAL RESTORATION

Figure 14 – Project Location Map – Stony Island Shoal Restoration



## #8 STONY ISLAND SHOAL RESTORATION

### Project description:

**Project location** – Stony Island is a large uninhabited 52-acre island in the Lower Detroit River, located in the Township of Grosse Ile.

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

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 river's largest Great Blue Heron rookery, containing over 200 active nests.

**Habitat to be addressed** – coastal wetlands with emergent and submergent vegetation

**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 island's old bridge crossing) and extends off of the island approximately 1,250 feet in a curve linear direction to the southeast. Reconstruction of these shoals would provide desirable protection to Stony Island.

This project, with its offshore 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 Pointe Mouillee 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 the island from further degradation of existing valuable wetland habitat, and provide an environment for the natural regeneration of additional wetland habitat to occur over time.

**Objectives** – To protect and enhance the Stony Island wetlands and emergent areas by the reconstruction of eroded shoals. 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 approximately 750 feet of shoal/dikes around the western side of the upper bay and approximately 1,250 feet on the southwest side of the lower bay of the island
- 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
- Addition of logs to shoal areas for reptile basking and cover for fish and the addition of branches in shallow water to provide nesting structure for amphibians

## #8 STONY ISLAND SHOAL RESTORATION

- Installation of limestone sheet rock for mudpuppy habitat including lace structure to encourage use and colonization of native aquatic mussel beds
- Incorporation control measures for invasive plants within the construction zone with emphasis around vernal pool and coastal wetlands

**Indicators and Monitoring:** Monitoring should be conducted both prior to construction for a minimum of one year as well as post-construction for a minimum of two years. 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:** 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 received funding from the National Oceanic and Atmospheric Association (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 – 1.5 years (**Funding secured through NOAA GLRI grant 2013**)
- Design and Permitting – 1 year (**Funding secured through NOAA GLRI grant 2013**)
- Construction – 2 years
- Post-Construction Monitoring – to begin 1 year after the completion of construction and last for 2 years

**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 engaged regarding the value of this project through local media outlets and project presentations.

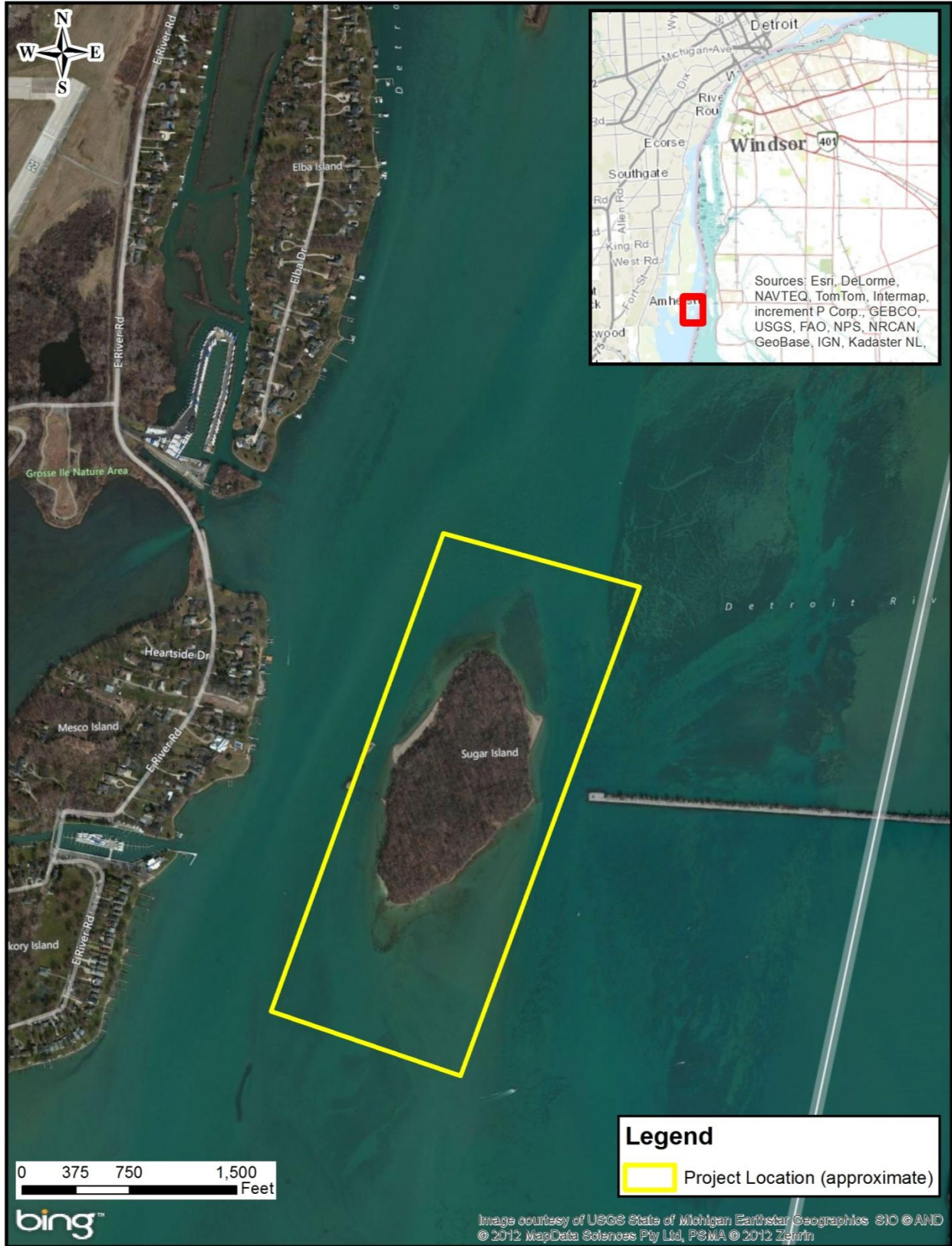
Figure 15 – Aerial Photograph of Stony Island Showing Shoal Reconstruction Areas





# #9 SUGAR ISLAND RESTORATION

Figure 16 – Project Location Map – Sugar Island Restoration



## #9 SUGAR ISLAND RESTORATION

### Project Description:

**Project location:** Sugar Island is a 30-acre island located in Grosse Ile Township, Wayne County, Michigan. It is located at the mouth of the Detroit River about 800 feet (244 m) off the eastern shore of Meso Island in T5S R11E (N 42.0913 W 083.1442). Sugar Island is situated southeast of Grosse Ile Municipal Airport and west of the Livingstone Channel in the Detroit River.

**Brief site background:** Sugar Island was purchased by the USFWS with Great Lakes Restoration Initiative (GLRI) funding for inclusion in the Detroit River International Wildlife Refuge in 2012. This Refuge Hunt Plan was approved in 2012 and hunting was opened on Sugar Island in the fall of 2012. Limited public use of the west beach was opened on Sugar Island from dawn to dusk between Memorial Day and Labor Day.

**Habitat to be addressed:** Because the southern end of Sugar Island faces western Lake Erie, it is exposed to high wind and wave action resulting in erosion. It is estimated that 10% of the island has been lost to such erosion. The USFWS is open to exploring the ecological value and feasibility of armoring the southern shore in some way and simultaneously enhancing fish and wildlife habitat. Such a science-based feasibility study could be undertaken with input from fisheries and wildlife scientists from USGS and USFWS.

**Justification as target site:** The Sugar Island Tract currently serves as an important stopover habitat for migrating raptors and landbirds. The island is also part of a “conservation crescent” surrounding Grosse Ile at the mouth of the Detroit River. Characteristics of the forest approach those of a wet-mesic flatwoods community. The bedrock shoals surrounding Sugar Island serve as potentially important spawning habitat for fish (lake whitefish spawning has been documented in close proximity). Restoration could help extend an important ecological corridor because of its proximity to the Refuge’s Gibraltar Bay Unit, Calf Island Unit, Humbug Marsh Unit, and Lake Erie Metropark Unit.

**Property owners (responsible entities):** The property is owned by USFWS and managed as part of the Detroit River International Wildlife Refuge

### Project purpose:

**Project goals** – Stop further erosion issues on the southern end of the island and enhance fish and wildlife habitat.

**Objectives** – Explore options that stabilize the island and restore habitats, which could include creating an erosion control structure with habitat enhancements of approximately 1,300 feet of shoal along the southern end of the island to preserve and improve fish and wildlife habitat and re-create lost emergent wetlands.

### Actions:

- Conduct an assessment and feasibility study for controlling erosion along the southern shore of Sugar Island and simultaneously enhancing habitat with input from USGS and USFWS. This could include potentially armoring the shoreline, creating rock spawning habitat for selected fishes, and enhancing wetland habitat.
- Based on the assessment, develop preferred habitat enhancement option for Sugar Island.
- Secure funding and implement restoration and habitat enhancement work.

**Indicators and Monitoring:** Pre and post construction monitoring should be conducted for a minimum of two years. Ideally, the site would be allowed to recover from the construction period for one full growing season prior to the collection of post-construction monitoring data. Monitoring shall include: Pre and post construction monitoring of fish, aquatic macro-invertebrates, amphibians, and reptiles.

**Projected costs:** Cost of the construction is based upon the creation of approximately 1,300 feet of shoal using marine construction methods, including items listed under the action section is estimated to be approximately \$2 million.

## #9 SUGAR ISLAND RESTORATION

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

- Feasibility – 18 months;
- Design and Permitting – 12 months
- Construction – 24 months
- Monitoring – 2 years (including a 1 year period of ecological stabilization post-construction).

**Public Involvement:** This project will not only provide great fish and wildlife habitat, but will also provide excellent fishing, hunting, bird watching and boating opportunities for the public. Sugar 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.

Figure 17 – Photograph of the Southwestern Side of Sugar Island





# #10 CELERON ISLAND RESTORATION AND SHOAL CONSTRUCTION

Figure 18 – Project Location Map – Celeron Island Restoration and Shoal Construction





## #10 CELERON ISLAND RESTORATION AND SHOAL CONSTRUCTION

### Project description:

**Project location** – 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.

**Brief site background** – Named after a French Commander, Celeron Island was previously owned by a family who had a summer cottage on its northern end. In the early 1970s, there still existed a road that spanned the perimeter of 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 1970s and again in the early 1990s, 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.

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. The construction of an offshore 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 island's outer shoreline emergent vegetation. Such a shoal would also create additional coastal wetland, fish, reptile and amphibian habitat, provide additional hunting opportunities and provide a protected area for migratory waterfowl and shorebirds to roost.

**Habitat to be addressed** – offshore emergent shoal and vegetation

**Justification as target site** – This project, with its offshore 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 Pointe Mouillee 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 and managed by the MDNR 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 USACE, who have jurisdiction over the bottomlands of the island and that of the surrounding waters.

### Project purpose:

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

**Objectives** – Construction of approximately 3500' of a shoal 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:

- Construction of a barrier dike/shoal(s) around the southeast to southwest side of the island
- 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
- 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 including lace structure to encourage use and colonization of native aquatic mussel beds
- Incorporation of control measures for invasive plants within the construction zone with emphasis around vernal pool and coastal wetlands

## #10 CELERON ISLAND RESTORATION AND SHOAL CONSTRUCTION

**Indicators and Monitoring:** Reconstruction of the shoals will preserve and improve the valuable habitat that currently exists. Monitoring should be conducted both prior to construction (as part of the design phase) for a minimum of one year as well as post-construction for a minimum of two years. 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 received 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 – 1.5 years (**Funding secured through NOAA GLRI grant 2013**)
- Design and Permitting – 1 year (**Funding secured through NOAA GLRI grant 2013**)
- Construction – 2 years
- Post-Construction Monitoring – to begin 1 year after the completion of construction and last for 2 years

**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 engaged regarding the value of this project through local media outlets and project presentations.

**Figure 19 – Aerial Photograph of Celeron Island Restoration Area at southern end of the island**



## **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 during scheduled PAC meetings and informally discussed with the Detroit River AOC coordinator from MDEQ.

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