Lower Black River Ecological Restoration Master Plan

December 2009

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Gregory A. Rhinehalt, PWS, was a senior ecologist at URS, and the original project manager for this Ecological Restoration Master Plan.

Greg tragically passed away on November 21, 2008.

This plan is dedicated to his memory.

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Ecological Restoration Master Plan

The vision and goals of the Lower Black River Ecological Restoration Master Plan were defined by a team of local, state and federal representatives.who share the common realization that restoring the ecological health of the lower Black River is critical to the economic recovery of Lorain. This Ecological Restoration Master Plan defines specific actions to help restore ecological function, and thereby help stimulate economic development, in the lower portion of the Black River, in the city of Lorain, Ohio (See *Figure 1.1* for a regional location map).

The plan is intended to:

- Capitalize on the success reached so far in cleaning up the Black River.
- Take advantage of the recent awareness of the need to restore the Great Lakes Areas of Concern to ecological health, and the recent funds being made available for potential projects.
- Make the best use of vacant un under-used properties in order to recover the ecological health and economic vitality of the City of Lorain.

The City of Lorain has always relied on the Black River. Originally the river provided the transportation link needed to bring raw materials to, and ship finished products from, this growing industrial center. While the role of heavy industry in Lorain's economy has decreased, the river is still seen as the vital "backbone" of the city. Restoring ecological health and vitality to this central artery is a key to the long-term survival of the city. Habitat has been lost in the stream and along the banks, and the residents of Lorain have become detached from their river.

The overall goal is to develop an Ecological Restoration Master Plan for the Lower Black River that improves, preserves and restores fishery health, aquatic and riparian habitat, and adjacent terrestrial habitats in a way that is consistent with the community's vision for the area, including social and cultural interaction, recreational access and use, and development and public infrastructure.

The mouth of the Black River.

The project area for this Ecological Restoration Master Plan begins near the mouth of the Black River, and extends to the 31st Street Bridge in the City of Lorain. This plan proposes 41 actions broken up into 12 action categories:

Group A, Restoration Actions

These are actions that involve the creation of new habitat, or the major restoration of areas where habitat has been lost.

Action A1: *Install fish shelves to create new fish habitat at feasible locations.* ***Five proposed locations, totaling 7,717 feet, at a total estimated cost of $1,402,800.***

Action A2: *Slag pile remediation, to remove slag deposited along the banks of the river.* ***Three proposed locations, totaling 6,422 feet, at a total estimated cost of $3,211,000.***

Action A3: *Wetland restoration and construction, to restore and create new wetlands for habitat and water quality.* ***Three proposed locations, totaling 74.7 acres, at a total estimated cost of $4,812,000.***

Action A4: *Stream Bank stabilization, to restore native vegetation to streambanks in order to restore habitat and prevent erosion.* ***Thirteen proposed locations, totaling 11,980 feet of stream bank, at a total estimated cost of $1,497,500.***

Action A5: *Slag pile stabilization, to remove and restore the largest concentration of deposited slag in the area, downstream of the confluence of French Creek and the Black River.* ***One proposed location, totaling up to 105 acres, at a total estimated cost of $4,775,000.***

Action A6: *Bulkhead habitat creation, to alter existing bulkheads where possible to restore habitat in the industrial and urban areas of the river.* ***Approximately 7,900 feet of steel bulkhead surrounds the Former Pellet Terminal, total estimated costs for this experimental technique is at a total estimated cost of $11,844,000.***

Group B, Enhancement Actions

These are actions that enhance existing habitats and systems. They tend to involve less earthmoving and other heavy construction than the restoration actions.

Action B1: *Invasive species removal, to remove the non-native plants that have begun to dominate portions of the river banks and lake shoreline.* ***Four proposed locations, totaling 20.5 acres, at a total estimated cost of $205,000.***

Action B2: *Plant submerged aquatic species and other flora to increase diversity in nearshore areas.* ***One proposed location, totaling 12.2 acres, at a total estimated cost of $124,440.***

Action B3: *On an experimental basis, Install floating wetlands and fish baskets on a trial basis, to increase habitat diversity in difficult areas.* ***Four proposed locations, at a total estimated cost of $305,000. Note that the members of the Advisory Committee strongly recommend that this category of actions be viewed as experimental, and that proponents of actions in this category be encouraged to seek their own funding.***

Group C, Protection Actions

These are actions that protect remnant higher quality natural areas and ecologically restored sites.

Action C1: *Conservation easement acquisition and wetland purchase, to protect the "best of what is left".* ***Six proposed locations, totaling 73.5 acres of protection at a total estimated cost of $1,100,250.***

Action C2: *Best management practices for developers, a compendium of actions that the City of Lorain should require for*

all development within the project area, particularly within the Riparian Setback, in order to protect the investment made by completing the actions in this plan.

Action C3: *Suggested regulatory protections that the city should implement in order to protect the investment made by completing the actions in this plan*

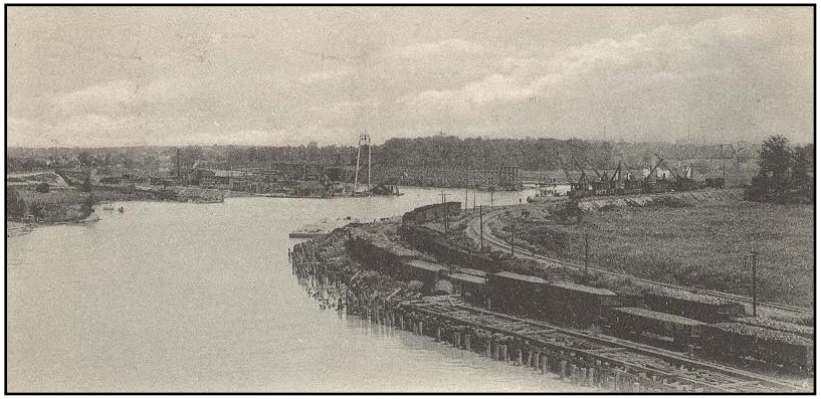
The actions described in the plan were selected in order to help achieve the restoration of ecological function in the Lower Black River. Economic and societal factors have been forcing fundamental changes in Lorain; the industrial base on which the city was built has deteriorated, jobs have been lost and businesses have moved away. All parties involved in development of the plan firmly believe that ecological restoration and economic recovery are inextricably linked. Building on the successes achieved so far in cleaning up the river, this plan is another important step in recovery. Economic recovery will of course depend on factors well beyond the scope of this plan, but the ecological restoration should provide a vital new impetus to help stimulate appropriate growth and development in the river corridor. Completing the actions described in this plan will have direct economic effects. There are real costs associated with untreated urban runoff. This plan outlines steps to help ensure that runoff volumes are decreased, and that pollutants common to urban run off are removed and treated. Around the country it has been demonstrated that property values are enhanced by the presence of intact natural areas and green space in communities. Undertaking and completing these restoration efforts will send an important message to the business community, by showing the City of Lorain's commitment to its future.

Further, this plan is intended to serve as a tool to help guide decisions made within the river corridor. The plan includes a list of suggested Best Management Practices (BMPs), assembled here and presented to ensure that new development along the river, which is not only acknowledged but actually encouraged by participants in the planning process, does not contribute to further degradation of water quality. The plan can be used to help determine how to guide development to appropriate sites, and away from the currently few high quality systems that remain. It is the desire of all participants in the planning process that Lorain will use the plan in the future as a yardstick of sorts with which to assess the potential effects of any proposed actions along the river on the ecology of the river.

The Lorain Utilities Department and the Lorain Port Authority are the local "champions" of this plan, and the local groups that are accepting the responsibility for carrying out the actions and meeting the goals and objectives outlined here. The project has enjoyed the support of the current city administration. Upon completion of the Plan, the city will seek the endorsement of the Lorain City Council.

This plan lists no specific timeframes in which the actions should be accomplished. As a practical matter, these actions will be undertaken as funds are identified to pay for them. The plan should be reviewed by the city, the Black River RAP, Ohio EPA and U.S. EPA every five years, to review progress and examine priorities for the coming period.

The long history of industrial, agricultural and urban uses to which the Black River was subjected has left its mark. Like most rivers that flow through or near the industrial heartland of the US, the Black River has been subjected to a variety of uses. Rivers were suppliers of water, agents of commerce but ultimately unfortunate receptors of and conduits for wastes.



The Black River was highly industrialized in the 1940s.

Our values and perceptions have changed over the years. We now realize that healthy ecosystems are keys to our well-being, both ecologically and economically. The pendulum has swung and we now realize that unconstrained use of natural systems is clearly not sustainable, and that economic growth and the preservation, restoration and enhancement of our natural surroundings are not mutually exclusive. Truly, we have come to know that healthy economies and a healthy populace depend upon healthy environments.

The city of Lorain, through which the lower portion of the Black River flows, is a living example of people coming to this realization, and acting on it. The city sees the Black River as its *"Main Street"* and as a key to its rebirth. Former abandoned industrial areas are alive today with new residential and commercial activity, and a thriving trail system is bringing citizens to the banks of their river for leisure and recreation. A tour boat sponsored by the Lorain Port Authority takes residents and visitors for a new look at their river. Much progress has been made. Contact advisories have been lifted; the status of one of the 10 Beneficial Use Impairments has been upgraded. Herons, eagles and other birds fly over the river, and live along its banks.

This plan is another vital step in the recovery of the Lower Black River. It represents the work of multiple federal, state and local agencies, and most importantly the government and citizens of Lorain, Ohio. It is a stakeholder driven, collaborative effort to develop a concise set of guidelines for the future ecological restoration of the river.

The Black River is making great progress in its restoration due to a new commitment to environmental restoration along its shores.

The Master Plan

Lower Black River
Lorain, Ohio
Ecological Restoration Master Plan

1. MASTER PLAN PROCESS

Overall Purpose

This Ecological Restoration Master Plan is intended to define specific actions to help restore ecological function, and thereby help stimulate economic development, in the lower portion of the Black River, in the City of Lorain, Ohio (See *Figure 1.1* for a regional location map).

The vision and goals of the Lower Black River Ecological Restoration Master Plan were defined by a team of local, state and federal (U.S. EPA) representatives. A series of workshops have provided opportunities for stakeholder input into the master planning process (Appendix B)

The major partners in developing this plan, the United States Environmental Protection Agency (U.S. EPA), Ohio Environmental Protection Agency (Ohio EPA), the Black River Remedial Action Plan (RAP) Coordinating Committee and the City of Lorain, all realize that restoring the ecological health of the Lower Black River is critical to the economic recovery of Lorain. A series of events have occurred that all point to this being a crucial time to plan and begin restoration activities in this urban river corridor.

First, there have been successes in cleaning up the Black River. Sediment contamination, a legacy of the industrial past of the lower portion of the Black River, has largely been eliminated. This and other improvements in the health of the river in response to remedial actions shows the resilience of river system when remedial actions are offered. There is a clear opportunity to continue the recovery by improving habitat in and along the river.

Second, there is an increased awareness of the importance of the Great Lakes, and a new commitment to restoring the health of the world's largest group of inland lakes. Federal and state agencies are poised to commit time, energy and money to restoring ecosystem health in this inland fresh water resource. This Restoration Master Plan contains a wide variety of restoration actions, and can be used as a guidebook for those involved in applying for and using the funds provided for this needed restoration work.

Third, events over the last few decades have led to an industrial decline in Lorain. While this decline has certainly had wide ranging economic consequences for the city and its residents, the loss of large heavy industries has opened land for new development and for potential restoration activities. The city took action to acquire a great deal of property along the river, property on which ecological restoration activities could and should be cited along with appropriate new development. Economic drivers are in fact forcing a change in how land near the river will be used in the future.

The City of Lorain has always relied on the Black River. Originally the river provided the transportation link needed to bring raw materials to, and ship finished products from, this growing industrial center. While the role of heavy industry in Lorain's economy has decreased, the river is still seen as the vital "backbone" of the city. Restoring ecological health and vitality to this central artery is a key to the long-term survival of the city.

In addition to proposing specific restoration actions, this plan is intended to serve as a tool to help guide decisions made within the river corridor. The plan includes a list of suggested Best Management Practices (BMPs), assembled here and presented to ensure that new development along the river, which is not only acknowledged but actually encouraged by participants in the planning process, does not contribute to further degradation of water

quality. Further, the plan can be used to help determine how to guide development to appropriate sites, and away from the few high quality systems that currently remain. It is the desire of all participants in the planning process that Lorain will use the plan in the future as a yardstick of sorts with which to assess the potential effects of any proposed actions along the river on the ecology of the river. Future land use plans developed in Lorain should take into account the actions and guidance offered in this document.

The Lorain Utilities Department and the Lorain Port Authority are the local "champions" of this plan, and the local groups that are accepting the responsibility for carrying out the actions and meeting the goals and objectives outlined here. The project has enjoyed the support of the current city administration. Upon completion of the plan, the city will seek the endorsement of the Lorain City Council.

Technical Criteria

A major intention of this plan is to address and offer corrective measures for those Beneficial Use Impairments related to aquatic and adjacent terrestrial habitat that led to listing the Black River as an Area of Concern. These two terms, Area of Concern (AOC) and Beneficial Use Impairment (BUI), will be used throughout this plan. AOCs are defined by the U.S.-Canada Great Lakes Water Quality Agreement as "geographic areas that fail to meet the general or specific objectives of the agreement where such failure has caused or is likely to cause impairment of beneficial use of the area's ability to support aquatic life." Great Lakes AOCs are severely degraded geographic areas within the Great Lakes Basin. The U.S. and Canadian governments have identified 43 such areas; 26 in U.S. waters and 17 in Canadian waters (five are shared between U.S. and Canada on connecting river systems). One major purpose of this Plan is to further the U.S. EPA goal of de-listing this AOC.

U.S. EPA lists 14 beneficial uses provided by surface waters like the Black River. Of those 14 uses, the following 10 were originally listed as impaired in the Black River:

- Restrictions on fish and wildlife consumption.
- Eutrophication or undesirable algae.
- Restrictions on drinking water consumption, or taste and odor.
- Degradation of fish and wildlife populations.
- Beach closings.
- Fish tumors or other deformities (in recovery as of 2004).
- Degradation of aesthetics.
- Degradation of benthos.
- Restriction on dredging activities.
- Loss of fish and wildlife habitat.

In 1984, concern over pollution loads in the river, and the resulting damage to fish and other aquatic populations, led to the listing of the Lower Black River as an AOC by the International Joint Commission (IJC). Removal of the contaminated sediments in the Lower Black River began in 1989 and was completed in 1990. The Black River RAP was formed in 1991. Shortly after the RAP was formed, the RAP Coordinating Committee expanded the AOC delineation to include the entire watershed, making the Black River one of the few AOC's that encompasses an entire watershed.

The Ohio EPA and others continued to study the river and intensive biological surveys were conducted in 1992 and 1997. Every two years, the state publishes an Integrated Water Quality Monitoring and Assessment Report, summarizing the general conditions of the waters of the state and listing those waters that are not attaining water quality standards. The biennial reports listed the Black River as impaired over much of its length for aquatic life beneficial uses and for fish tissues. The impaired status of the aquatic life uses led

to the development of a Total Maximum Daily Load (TMDL) for the Black River. A TMDL is developed to identify the total pollutant load that a water body can receive and still attain its listed water quality standards. The Black River TMDL was approved in August of 2008. The TMDL specifically recommends:

- Reductions in phosphorus and nitrogen discharges, and general nutrient loading reductions form livestock;
- Addressing effluent from home sewage treatment systems;
- Reductions in sediment loads in the river;
- Reductions in the amount of fertilizer run-off from urban areas;
- Reductions in the volume of stormwater discharged from urban areas.

The hard work carried out by the Black River RAP, the city and Lorain County, and a wide variety of other agencies and public groups, has resulted in improvements in the health of the Black River. In 2004, the Ohio Department of Health lifted the contact advisory. Also in 2004, the U.S. EPA and IJC re-designated the Fish Tumors and Other Deformities use impairment status from Impaired to In Recovery, a major achievement for a river once known as the "river of fish tumors". In Recovery status is essentially an interim designation that recognizes substantial efforts have been completed, recovery of the beneficial use has started and natural processes should complete the restoration. No additional effort is planned but further monitoring is required to determine if the recovery continues or if further actions will be needed. In this instance, the incidence of fish tumors had declined sufficiently to justify the change to In Recovery. Ohio EPA is planning to conduct the follow-up monitoring. The follow-up monitoring is expected to reveal continued improvement to the resident fish populations. If sufficient improvement is documented, the impairment will be removed.

It is important to note that impairment of the river occurred over time, its restoration will take time as well. This document is intended to be a "living plan," one that can be revised and updated as restoration activities are undertaken and natural system responses are documented. This adaptive process will also need to take into account revisions to goals and objectives, the identification of new or increased threats and available resources.

This Ecological Restoration Master Plan is not intended to return the Lower Black River to a pristine, pre-European settlement condition.

Rather, this plan was designed to incorporate the economic needs of the city with the environmental needs of the Black River system.

Throughout the development of the plan, the restoration of the local economy was recognized as essential but if the redevelopment occurs without a concern for the environmental condition of the river, the river will never be restored and could become more degraded.

Specific Components of the Master Plan

This plan recommends a cohesive collection of individual restoration projects. Each individual project includes estimated costs and expected outcomes of the restoration and identifies appropriate agencies and organizations to implement the restoration. It also provides a timeline of the restoration process, and includes a

process to measure the success of the restoration actions, including measurable benchmarks. Specific components of the plan include:

- Statements of vision, goals and measurable objectives.
- Descriptions and discussion illustrating ecological restoration initiatives consistent with the conservation goals of restoring habitat in the Black River AOC.
- Descriptions and locations of potential reference ecosystems along with information used to develop a 'reference state.'
- Regulatory permitting requirements.
- An implementation and funding strategy for the restoration process, aimed at allowing self-generating ecological processes to resume.
- A description of the ecological and institutional strategies that will be required for the long-term protection and management of the restored ecosystem.
- A framework for performance standards, each with suitable monitoring protocols, by which the project can be evaluated within the trajectory selected as most desirable for its long-term ecological goals and objectives.
- A framework for ensuring that stakeholders are involved in the continued development and management of the restoration initiatives.
- Planning level cost estimates for final design, implementation, and management.

Project Area

The Black River generally flows north through northeast Ohio to Lake Erie. The river lies west of Cleveland and east of Sandusky, Ohio and is one of a series of watersheds that drain to Lake Erie (*Figure 1.1*). A review of the existing conditions along the river, and the history of the area that led to those conditions, is presented in Appendix A.

The project area begins at the breakwall and extends upstream to the 31st Street Bridge *(Figure 1.2),* all within the City of Lorain. The project area extends landward from the river bank to encompass those properties that abut the Lower Black River. Historically, the project area and the City of Lorain functioned as a major manufacturing center in the Great Lakes region. Lorain was a major industrial city whose landscape was dominated by steel mills, rail hubs, and a busy industrial port. The past 30 years have led to a dramatic decline in shipbuilding, auto assembly, and other major manufacturing industries in the area.

There are approximately 1,800 acres of land in the project area. Almost one-third of that total (576 acres) is publicly owned. Roughly 58 percent of the acreage is owned by companies engaged in steelmaking, handling steelmaking by-products, or other heavy industries.

The plan divides the Lower Black River into three distinct sections, based upon physical and land development characteristics along the river *(Figure 1.2).* These sections, referred to in this plan as Sections 1, 2 and 3, were used to differentiate the existing conditions along the river, and to begin to identify potential solutions to the problems identified.

Figures 1.3 through *1.5* show the locations of various outfalls and intakes along the river. These are classified as effluent outfalls (those which discharge treated water), non-contact cooling water (those which discharge cooling water that does not come in direct contact with industrial processes), and stormwater (discharges of rainwater collected from impervious surfaces). Effluent outfalls are closely regulated by the Ohio EPA. Stormwater outfalls, frankly, are not. The city needs to be aware of the effects on water quality caused by stormwater discharges to the river. Appendix C contains many ideas useful for treating urban stormwater.

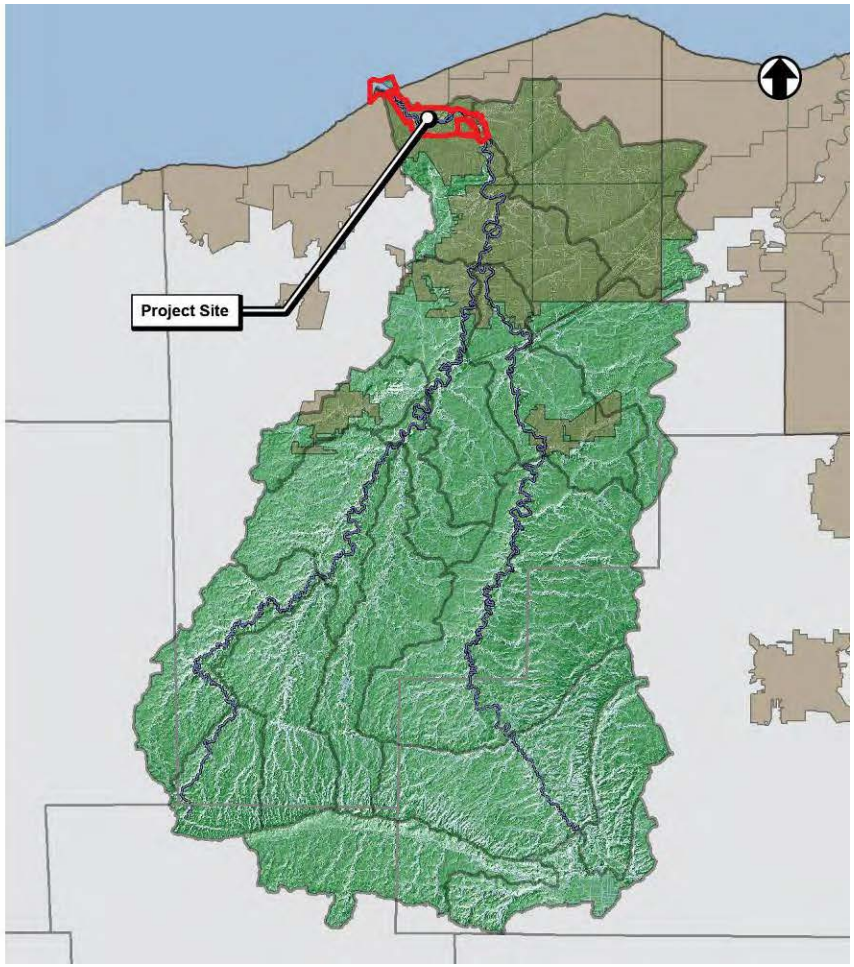


Figure 1.1 Regional Setting for the Project.

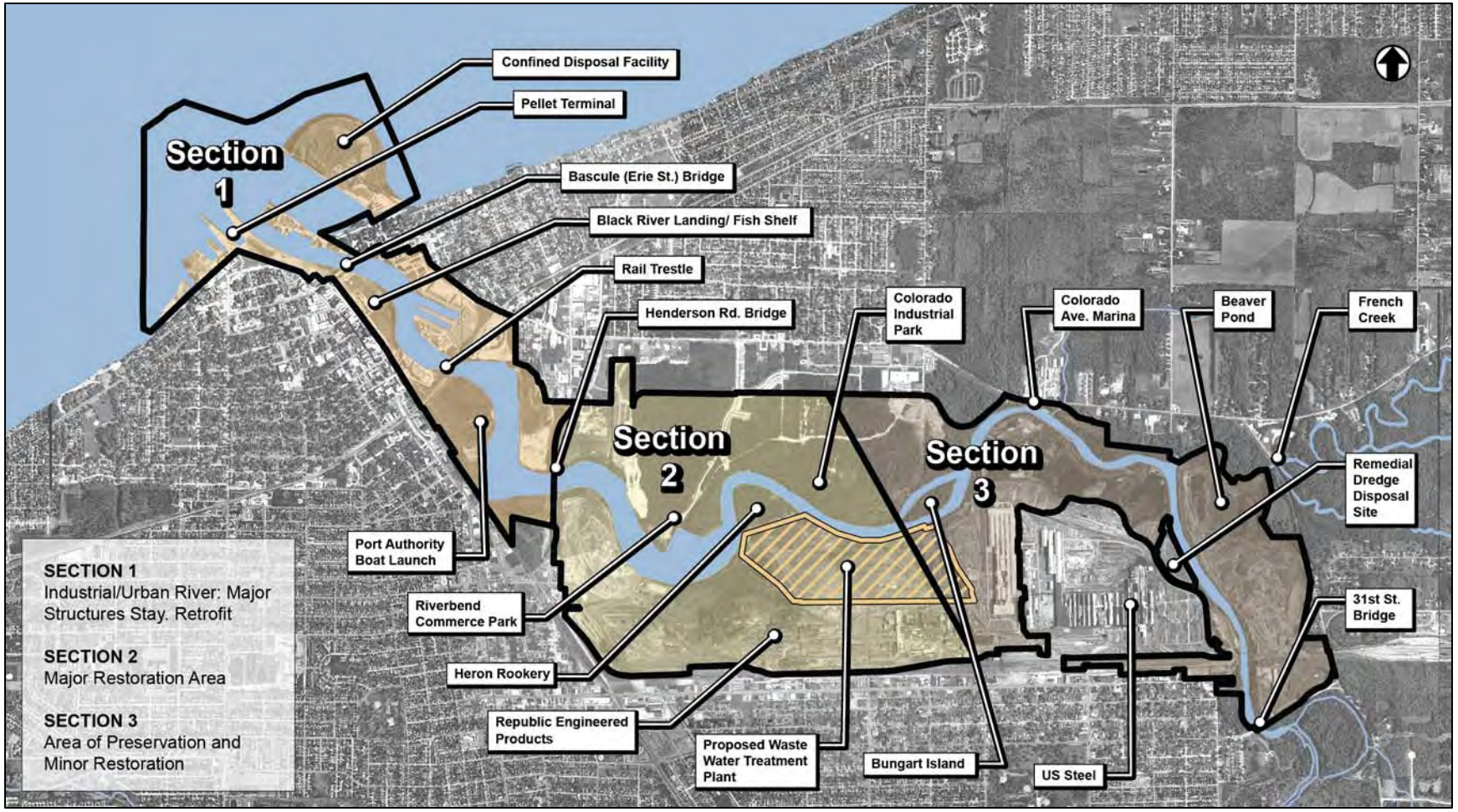


Figure 1.2 – Project Area Sections.

Section 1 of the project area *(Figure 1.3)* extends from the breakwall to the Henderson Road Bridge, and is an industrial/urban river characterized by banks made up of bulkheads and revetments. More than half of the shoreline length is occupied by steel or concrete walls. Hard structures will remain in this area, so restoration in this section will entail using available technologies to enhance and restore ecological functions where possible. Slightly more than ¼ of the riverbank is in a semi-natural, recovering state (one where little hard structure exists but where human modifications have altered the shore and its plant community) or high quality natural state. These few high quality areas are logical high priority preservation candidates.

Table 1.1. Shoreline Summary - Section 1

Shoreline Type	Percent of Shoreline
Steel/Concrete Vertical Walls	64
Modified Rip Rap Shore	8
Semi Natural Recovering Shore	8
High Quality Natural Shore	20

A major constraint on any restoration effort in Section 1 is the presence and maintenance of the Black River ship channel. Federal ship channels are simply "untouchable", requiring an act of Congress to alter or encroach on one. This section has some economically sound businesses, such as the Terminal Ready-Mix cement operation located downstream of the Norfolk and Western rail bridge. This firm needs a link to the river in order to continue to receive its raw materials by ship. Public and private investments have been made in this area, including the Port Authority's Black River Landing site, and Spitzer's Great Lakes Ltd. Harborwalk, a marina-based condominium community. Any restoration activities in this section of the river must take into account these and other existing developments.

The Bascule (Erie Street) Bridge lies near the mouth of the Black River in Section 1.

Figure 1.3 - Shoreline Existing Conditions Section 1.

Section 2 of the project area *(Figure 1.4)* extends from the Henderson Road Bridge to the west end of Bungart Island, and is characterized by existing and abandoned industrial areas, slag piles, and areas where economic recovery efforts and development have been underway. Only 19 percent of the bank is occupied by hard structure in this section. Just over half of the bank length is modified by rip-rap, large rocks often used to armor shorelines. Less than one-third of the bank length in Section 2 is in semi-natural or high quality natural cover.

Section 2 is dominated by past and current industrial activities.

A large proportion of the land in Section 2 is publicly held. The City of Lorain owns most of the north shore, and has a large holding in part of the former Republic Steel site on the south shore (Note that while the Black River generally flows from south to north, for almost half its length in the project area, and all of the length in Section 2, it flows from east to west, and thus the banks are on the north and south sides here.). A new wastewater treatment plant for the city is proposed along the south bank in Section 2. Some commercial development has occurred in the Colorado Industrial Park and the Riverbend Commerce Park on the north shore, and some of this development has included the construction of riparian wetlands along the river, beginning the process of restoration along this bank. Other major constraints in Section 2 include the bulk-headed docks at the Republic Steel site, and the ship channel, which ends just upstream of the Turning Basin. This section is home to large slag piles associated with the steelmaking operations along the river. Section 2 is an area of maximum restoration, and also the area where the greatest appropriate new development may occur.

Table 1.2. Shoreline Summary - Section 2

Shoreline Type	Percent of Shoreline
Steel/Concrete Vertical Walls	19
Modified Rip Rap Shore	51
Semi Natural Recovering Shore	18
High Quality Natural Shore	12

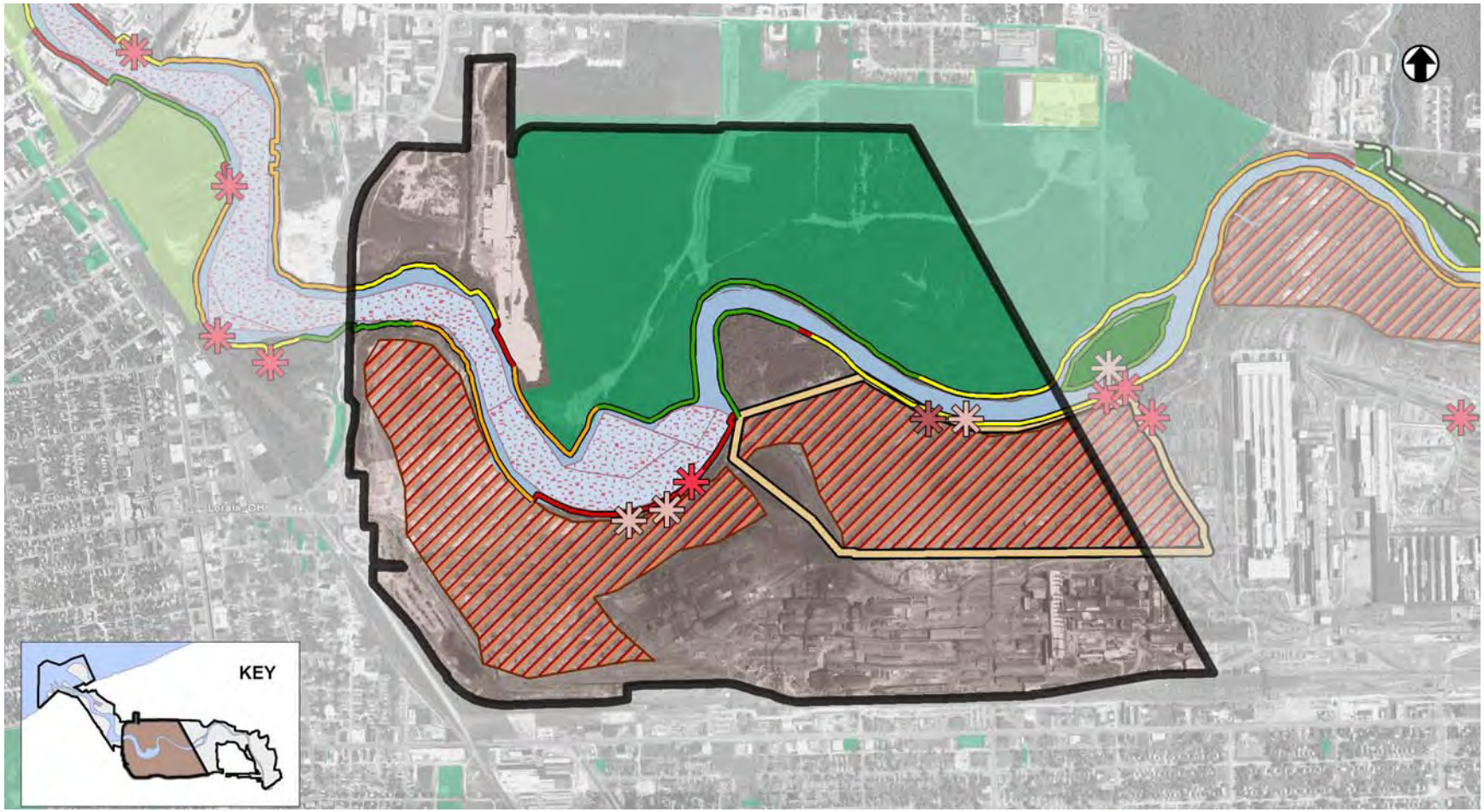


Figure 1.4 - Shoreline Existing Conditions Section 2.

Section 3 *(Figure 1.5)* extends from the west end of Bungart Island to the end of the project area at the 31st Street Bridge. Steel and concrete walls occupy only 2 percent of the bank length. Approximately 74 percent of the bank is in a semi-natural or high quality state.

Table 1.3. Shoreline Summary - Section 3

Shoreline Type	Percent of Shoreline
Steel/Concrete Vertical Walls	2
Modified Rip Rap Shore	24
Semi Natural Recovering Shore	50
High Quality Natural Shore	24

A large portion of this section is owned and managed by Lorain County Metro Parks. These lands form the basis of an opportunity for additional preservation and restoration efforts in this section. Other large tracts are privately held, and on some of these are large slag piles.

There are other important land uses and features in Section 3. U.S. Steel has a facility near this portion of the river. The property does not extend to the river bank, thus it is not included within the study area boundary. However, it is clear that the presence of this large industrial facility can have potential effects on water quality. Further, the disposal site for the poly-aromatic hydrocarbon (PAH) contaminated soils is located in this area.

We consider this Section to be one where actions will focus on preservation, restoration where needed, and appropriate development.

Bungart Island, a higher quality natural area, lies at the west end of Section 3.

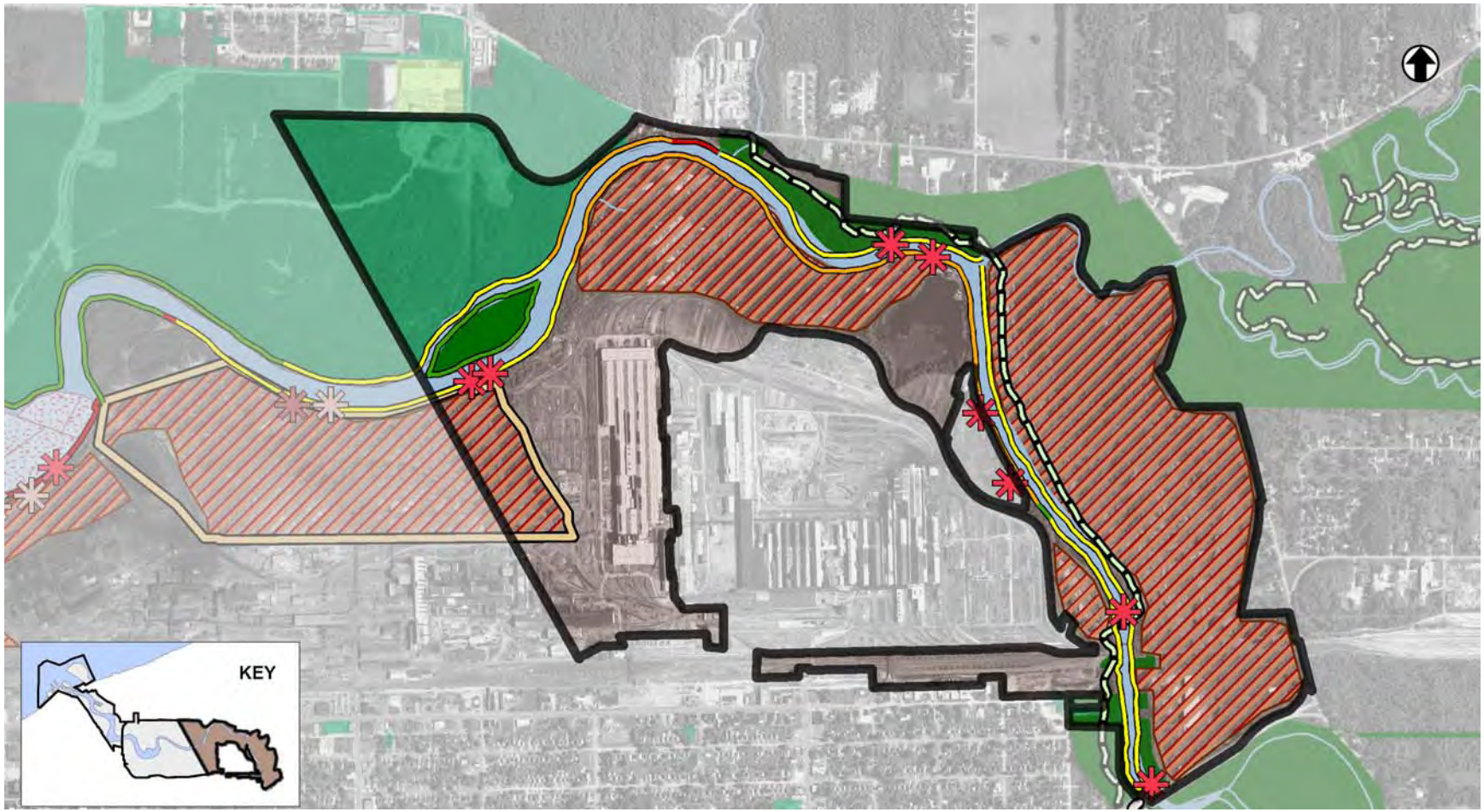


Figure 1.5 - Shoreline existing conditions Section 3.

Stakeholder Collaboration

The planning approach taken here is aimed toward the eventual adoption and shepherding of the plan by the City of Lorain, in cooperation with the U.S. EPA, the Black River RAP and other agencies. As such, it was critical to first develop an Advisory Committee that would help develop the plan, and work in partnership with the city to adopt, implement and manage the ecological restoration initiatives presented here. The Advisory Committee consisted of representatives from the U.S. EPA, Ohio EPA and other state and local agencies, staff from the City of Lorain, and URS Corporation. Committee participants included:

- City of Lorain:
  - Corey Timko, Director, Utilities Department
  - Jan Mackert, Planner, Community Development Department
  - Rick Novak, Director, Lorain Port Authority
- U.S. EPA
  - Karen Rodriguez, U.S. EPA, Great Lakes National Program Office
  - Danielle Green, U.S. EPA, Great Lakes National Program Office
  - Anne Marie Vincent, Black River RAP Federal Liaison, U.S. EPA - Cleveland Office
- Ohio EPA
  - Ted Conlin, Black River RAP State Coordinator
  - Scott Winkler, Water Quality Specialist
- NOACA
  - Andy Vidra, Environmental Planner
  - Mary Wells, Environmental Planner
- Cleveland State/Countryside Initiative
  - Kirby Date, Program Coordinator
- Lorain County Community Development Department
  - Dan Gouch, Black River Watershed Coordinator
- Ohio Department of Natural Resources
  - Phil Hillman, Fish Management Supervisor, Division of Wildllife
- Ohio Sea Grant
  - Dave Kelch, Extension Specialist
- Stein, Inc. Ohio
  - Jim Conlon, Vice President
- Falbo Construction/Terminal Ready-Mix
  - John Falbo, President

To date, four meetings have been held with the advisory committee. In addition, staff preparing the plan held meetings with city leaders and with individual property owners. A more detailed description of the stakeholder involvement process appears in Appendices B and C.

Establishing a Vision

The common vision shared by the participants in developing the plan is a Black River that continues to revive and thrive, and a community that renews itself and thrives along with its river. It is the common goal of all participants that the Black River will no longer be known as the “river of fish tumors”, and that through its restoration, Lorain will no longer be seen as a “rust belt” city located along a degraded urban river.

The participants identified these qualities that a healthy Lower Black River would exhibit:

- Potential ecosystem threats are eliminated or reduced.
- Self-sustaining natural communities are present.
- High quality, sensitive systems are protected.
- Development is channeled to those parcels where it is the most appropriate.
- Appropriate areas for mitigation are created in the corridor.

- Characteristic assemblages of native species and communities found in the reference ecosystems are present.
- Native species are maximized, invasive species are removed wherever possible.
- New development along the corridor incorporates Best Management Practices (BMPs) to ensure that restoration activities remain successful. BMPs are retrofitted onto existing developed sites.
- Habitat diversity is maximized.
- Educational and volunteering opportunities are integrated.
- A flexible restoration plan that allows the integration of new ideas and stakeholders over time.

These guiding principles were used to set the goals and objectives for restoration; to determine appropriate restoration actions, define restoration "targets" and to serve as benchmarks for determining the success of restoration actions articulated in this plan.

Restoration Goals

The overall goal is to develop an Ecological Restoration Master Plan for the Lower Black River that improves, preserves and restores fishery health, aquatic and riparian habitat, and adjacent terrestrial habitats in a way that is consistent with the community's vision for the area, including social and cultural interaction, recreational access and use, and development and public infrastructure. To accomplish this, four specific goals were developed:

- **Goal 1 - On Public Property, Restore, Enhance and Protect Ecological Habitats.**

Restoring the ecological landscape is crucial to capturing those ecological functions that lie at the heart of restoration of the Lower Black River. Cleanup, restoration, enhancement and creation of natural landscapes along the river are the major steps involved in restoring the ecological health of the system. There is substantial public property in the project area, meaning that the city can quickly undertake projects to accomplish restoration without acquisition of property or easement rights.

- **Goal 2 - On Private Property, Restore, Enhance and Protect Ecological Habitats.**

Restoring the ecological landscape on the many acres of private land along the river is crucial to restoring the health of the river. A cleaner, healthier river and riverfront will lead to healthier ecosystems and enhanced property values. Restoration, enhancement and protection actions can be designed to meet both the ecological and economic goals and business needs of the private landowners.

- **Goal 3 - Ensure the Sustainability of the Plan Through Best Management Practices, Easements and Education.**

Long term protection is required to sustain the areas restored, enhanced and preserved under this plan. Further, there are logical steps that should be taken to ensure that run-off from existing and new developments along the river do not degrade the improvements called for in this plan. Another key to sustaining the restored ecosystem functions will be an effective program to monitor these areas after restoration activities. Finally, public education and understanding are keys to this effort. Public education efforts have begun with the Advisory Committee meetings, meetings with public officials and the Black River RAP, a presentation to the Board of the Lorain Port Authority, and an open presentation to City Council. Public education will continue as the plan is adopted and implemented by the city and Port Authority.

- **Goal 4 - Implement the Ecological Restoration Plan in a way that Complements the City of Lorain's Economic Development Objectives for Property Adjacent to the Lower Black River.**

A cleaner, healthier Black River will become a community asset that attracts people to the city and encourages the development of new recreational resources, which in turn will help retain and attract high quality, sustainable, industrial, commercial, mixed use and residential development on select properties adjacent to the river and throughout the city. Achievement of this goal will result in an enhanced quality of life for all residents in the greater Lorain community and it will increase revenues from both property and income taxes within the City of Lorain.

These laudable goals are not necessarily easy to quantify. As such, there are challenges in developing definitive, measurable targets for restoration.

One quantitative mean of measuring success is to utilize the Qualitative Habitat Evaluation Index (QHEI) developed by Ohio EPA as a method to assess habitat in Ohio streams (Ohio EPA, 1999a; 1999b; 1990; 1989a; 1989b; 1987a; 1987b; Rankin, 1989). A modification of this method, designed to make it more suitable for use along lake shores and in the lower portions of large rivers like the Black River, was developed and provides a useful tool to assess the ecological condition of the banks, and to set targets for restoration. The Lake/Lacustuary Qualitative Habitat Evaluation Index (LQHEI) assesses habitat components including substrate type and quality, cover, shoreline morphology, quality of the riparian zone and degree of bank erosion, presence and quality of aquatic vegetation, presence and density of invasive species, and bottom slope and depth (Ohio EPA, no date). Each component is rated numerically. Table 1.4 shows the LQHEI scores and component measures for each streambank segment evaluated along the river. Scores for the segments are shown on *Figures 1.6* through *1.8.*

The LQHEI is designed as a tool to rate the habitat quality of portions of shorelines. It can also serve as a guide to direct restoration efforts toward those activities that are most likely to result in improved habitat values. The components that are evaluated to calculate an LQHEI score include:

Substrate: This is the material that forms the bottom of the river. The highest score is given to substrates dominated by boulders (boulders are defined as rocks greater than 256 millimeters (approximately 10 inches) diameter). These larger rocks and slabs provide places for small fish to escape predators, and provide crevices for egg masses. Lowest substrate scores are assigned to areas with silty or mucky bottoms. Additional points are assigned for the origin and quality of the substrate. A maximum of 20 points are possible for the substrate component.

Cover Types: This measure further defines the bottom condition by describing and rating any additional features that may provide fish habitat. The highest scores are given to areas that have natural offshore sandbars or submerged aquatic vegetation. The amount of cover is also rated. A maximum of 20 points are possible for the Cover Types measure.

Slope: Measured as the angle from the shoreline to the bottom (slopes between 25 and 45 degrees rate the highest). A maximum of six points are possible for the slope measure.

Depth: Average depth is measured at five places along the reach being rated. Depths from two to four meters rate the highest. A maximum of four points are possible for this measure.

Shoreline morphology: This component rates features of the shoreline including sinuosity (a moderate sinuosity is best), development (good development indicates a mix of deeper and shallower areas), the extent of modification, and shoreline stability. A maximum of 20 points are possible for this measure.

Riparian Zone and Bank Erosion: This component rates the width and quality of the riparian zone. Highest scores are assigned to riparian zones wider than 50 meters (roughly 164 feet) occupied by forest, wetland or open lake, that show little or no signs of erosion. A maximum of 10 points are possible.

Aquatic Vegetation Quality: This component rates populations of desirable aquatic vegetation, scored as 0 (absent or uncommon), 1 (few), 5 (common) or abundant (3). Points are subtracted for the presence of populations of the invasive exotic species that are of little benefit to wildlife, and which tend to overcome native plants. A maximum of 30 points are possible for this measure.

Figures 1.6 through *1.8* show the LQHEI scores along the entire project area. The highest habitat score (62) was achieved at the wetland at the Henderson Road Bridge. The lowest score (11) was found at the sheet pile wall at the mouth of the river. The LQHEI scores not only give us an idea of the quality of aquatic habitat throughout the site, they also serve to point out areas where habitat can be improved. Further, by examining the component scores, we can identify specific activities that will improve habitat in particular locations.

The overall numeric goal for this Ecological Restoration Master Plan, and the target established by the RAP for the ecological restoration, is to raise the average LQHEI score for the project area to at least 55, a 15.6 point increase over the current average score for the project area.

The health of the fish population in the Black River has greatly improved through cleanup efforts begun in the 1980s..

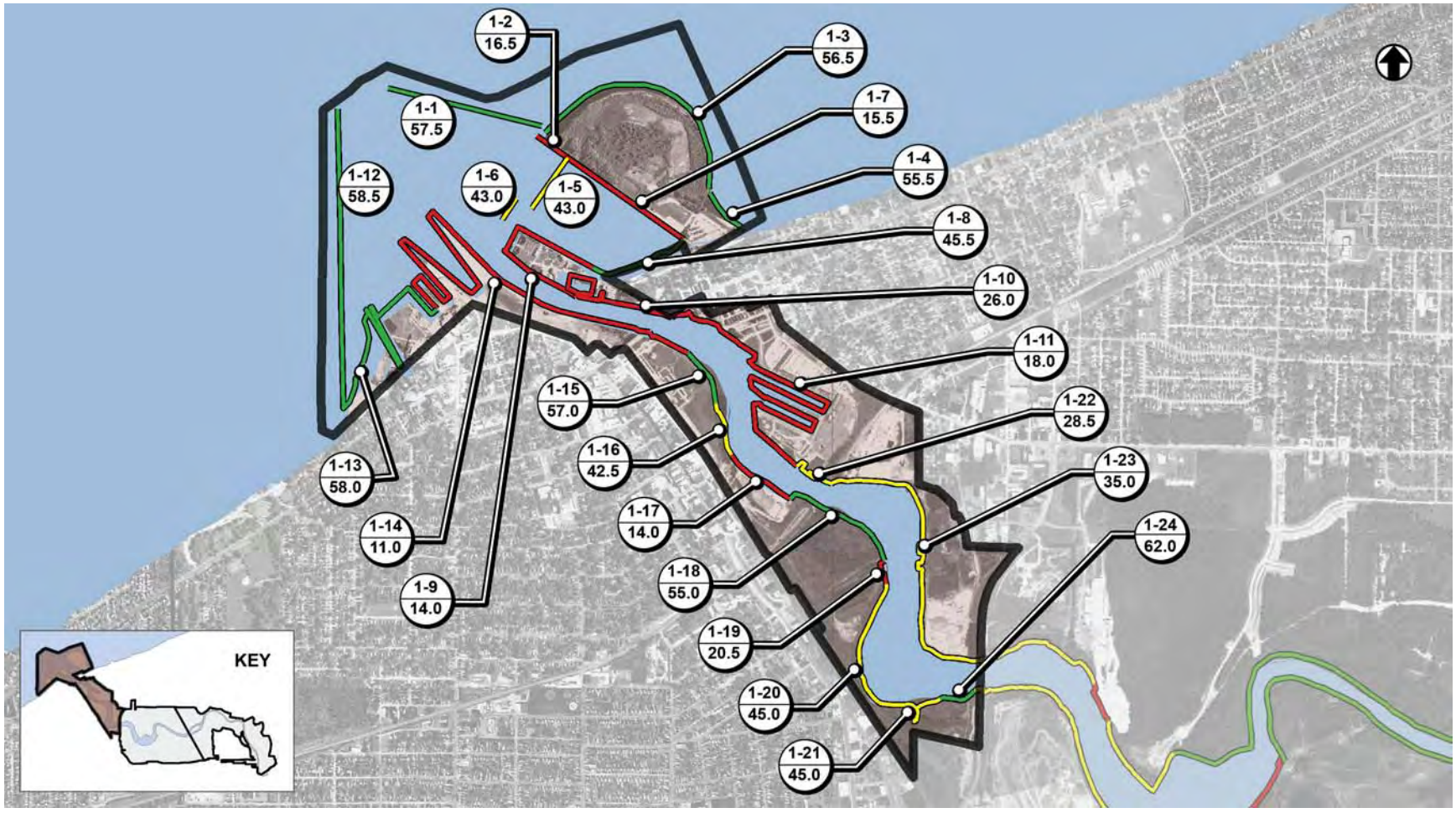


Figure 1.6 – LQHEI Scores for Section 1. **(Each site is labeled with a site code (dashed number on top) and the LQHEI score. Site codes are keyed to Table 1.4).**

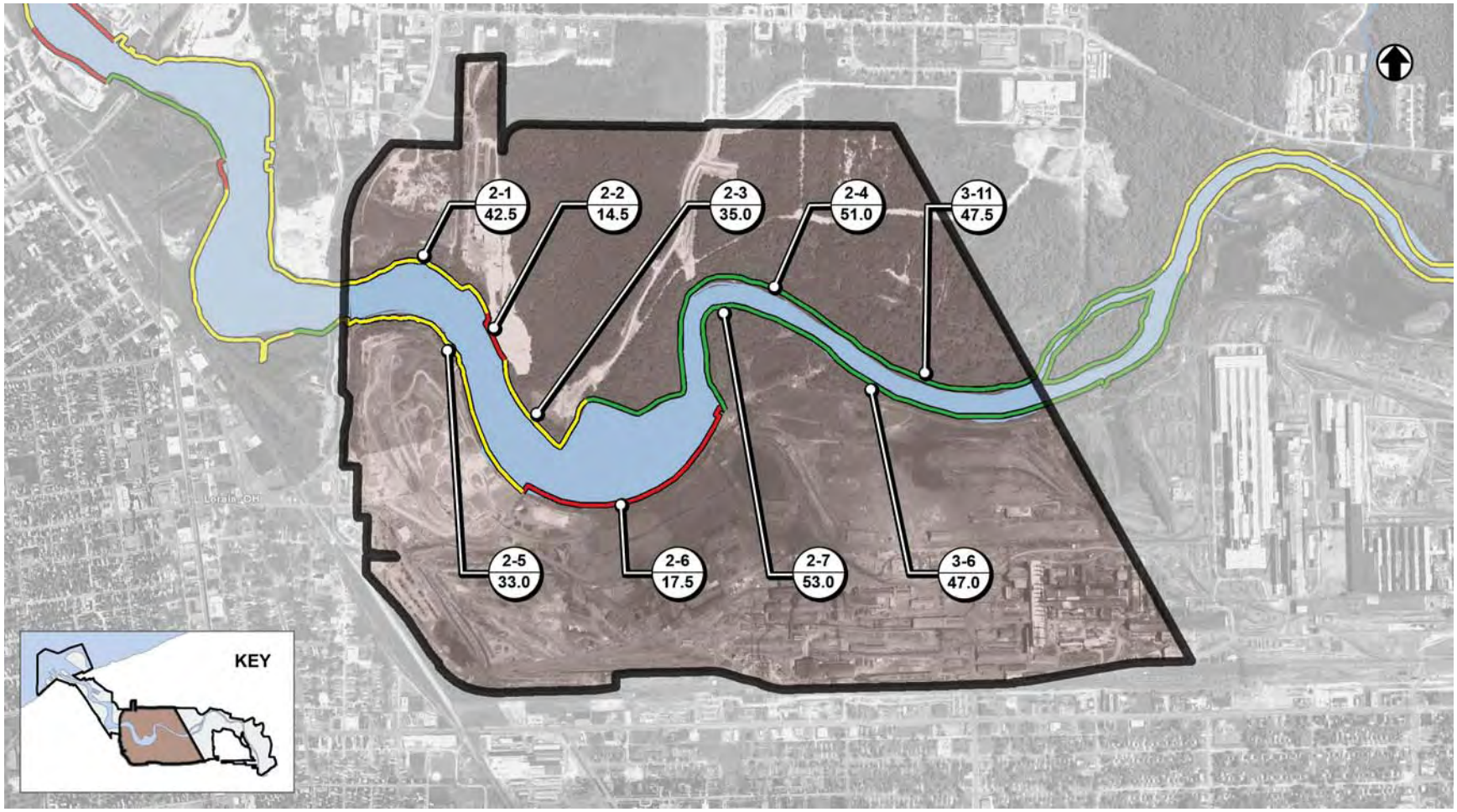


Figure 1.7 – LQHEI Scores for Section 2. (Each site is labeled with a site code (dashed number on top) and the LQHEI score. Site codes are keyed to Table 1.4).

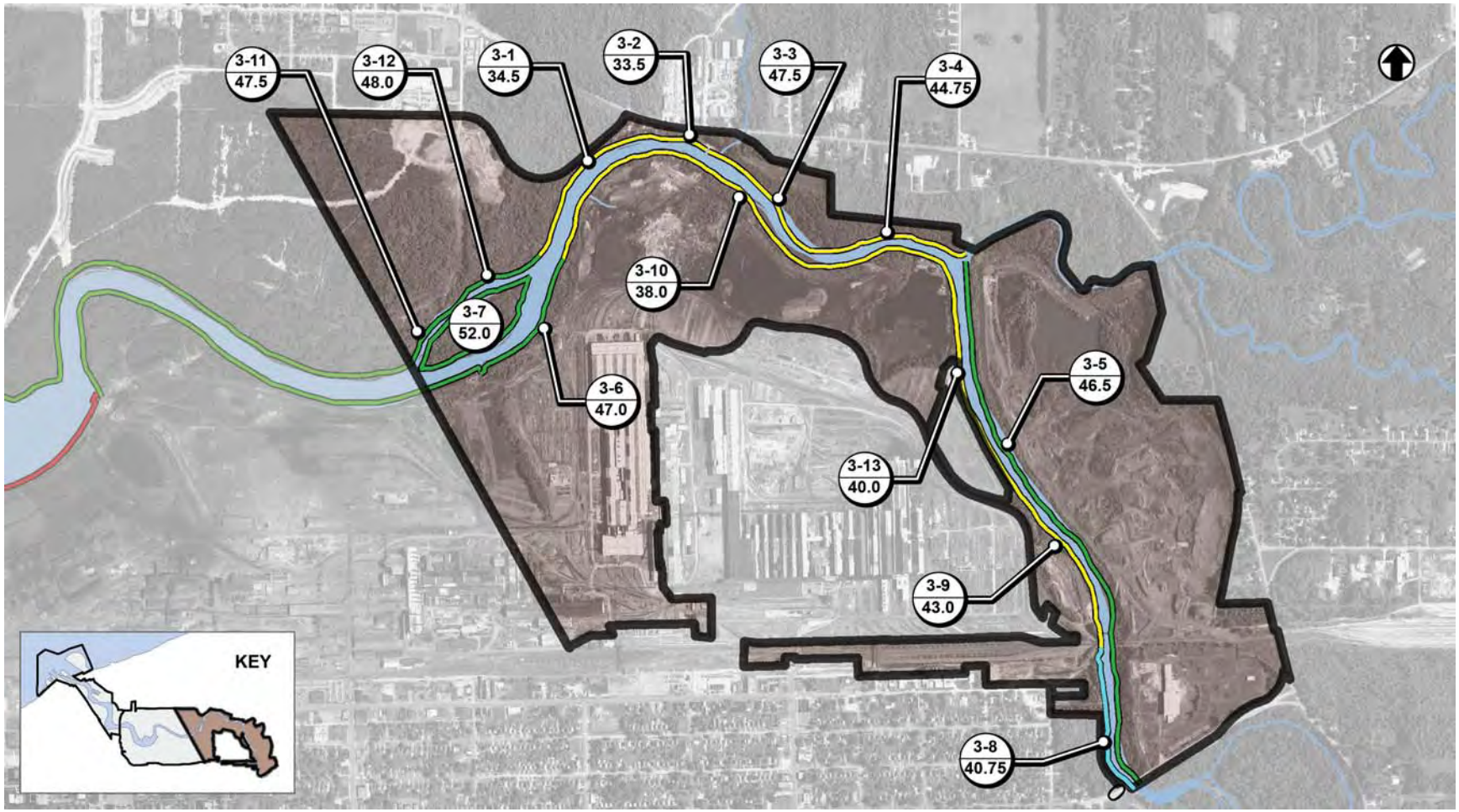


Figure 1.8 – LQHEI Scores for Section 3.
(Each site is labeled with a site code (dashed number on top) and the LQHEI score. Site codes are keyed to Table 1.4).

Table 1.4. LQHEI Scores for Segments of the Lower Black River. *Tan shading indicates areas with the LQHEI scores in the highest third (> 45), blue indicates sites with scores in the middle third (45-28) and no shading for the lowest third (<28). Site codes are used to identify stream bank reaches on Figures 1.6 through 1.8.*

Site Code	Site	LQHEI score	Substrate	Cover	Slope	Depth	Shoreline	Riparian zone	Vegetation
	Possible score	**110**	**20**	**20**	**6**	**4**	**20**	**10**	**30**
	SECTION I								
1-1	Breakwater East (center)	57.5	20	11	2	3.5	11	10	0
1-2	Bulkhead at Confined Disposal Facility (CDF)	16.5	1	1	0	3.5	1	10	0
1-3	Lake side CDF Shoreline	56.5	19	11	2	3	12	9.5	0
1-4	Beach, South Edge of CDF	55.5	15	13	1	2	17	7.5	0
1-5	Inner Breakwater	43	11	10	2	3	7	10	0
1-6	Detached Breakwater	43	11	10	2	3	7	10	0
1-7	Small Boat Marina	15.5	1	1	0	3.5	4	6	0
1-8	West of Jackalopes	45.5	10	11.5	3	2.5	11	7.5	0
1-9	Peninsula at River Mouth	14	1	1	0	2	4	6	0
1-10	East Shore Erie Street Bridge	26	10	2	0	2	6	6	0
1-11	Erie Street Bridge to RR trestle	18	0	2	0	4	6	6	0
1-12	West Breakwater	58.5	19	18	1	2.5	12	6	0
1-13	Sand Accumulation Area between Power Plant and Breakwater	58	15	18	0	1	17	6	1
1-14	Sheet Pilings at Mouth of River	11	0	2	0	2	4	3	0
1-15	Fish Shelf at Black River Landing	57	17	12	2	2	15	9	0
1-16	Upstream of Black River Landing	42.5	6	11	3	3	14	5.5	0
1-17	Upstream of Rail Trestle	14	0	2	0	2	4	6	0
1-18	Downstream of Port Authority Boat Ramp	55	7	14	3	3	18	10	0
1-19	Boat Ramp and Upstream	20.5	0	5	0	4	4	7.5	0
1-20	Downstream of Cattail Stand	45	8	11	3	2	12	9	0
1-21	Downstream of Henderson Rd. Bridge	45	7	10	0	1	17	10	0
1-22	Henderson Rd. Bridge and Downstream	28.5	9	5	0	2	9.5	3	0
1-23	Upstream of Rail Trestle	35	13	7	0	2	10.5	2.5	0
1-24	Wetland at Henderson Rd. Bridge	62	19	11	3	3	16	10	0
	Average Score for Section 1	**37.4**	**8.7**	**8.2**	**1.0**	**2.5**	**9.7**	**7.2**	**0.0**

Table 1.4, continued. LQHEI Scores for Segments of the Lower Black River. *Tan shading indicates areas with the LQHEI scores in the highest third (> 45), blue indicates sites with scores in the middle third (45-28) and no shading for the lowest third (<28). Asterisks show those items where the component score was less than ½ the possible total, and indicate areas where improvements could be made. Site codes are used to identify stream bank reaches on Figures 1.6 through 1.8.*

Site Code	Site	LQHEI score	Substrate	Cover	Slope	Depth	Shoreline	Riparian zone	Vegetation
	Possible score	**110**	**20**	**20**	**6**	**4**	**20**	**10**	**30**
SECTION 2									
2-1	Upstream of Henderson Rd. Bridge	42.5	6	13	1	1	16.5	10	5
2-2	Gypsum Site	14.5	0	2	0	2	4	6.5	0
2-3	Colorado Industrial Park	35	6	9	1	2	11	6	0
2-4	Upstream of the Turning Basin	51	6	14	0	2	19	10	0
2-5	Upstream of Henderson Bridge, Downstream of Steel Plant Dock	33	3	10	2	3	12	3	0
2-6	Steel Plant dock	17.5	3	2	0	1	5	6.5	0
2-7	Upstream of Steel Plant Dock	53	6	13	3	2	19	10	0
	Average Score for Section 2	**38.6**	**6.1**	**9.3**	**1.3**	**2.0**	**12.8**	**7.8**	**0.6**
SECTION 3									
3-1	Downstream of the Colorado Ave. Marina	34.5	3	6	0	2	15	8.5	0
3-2	Colorado Ave. Marina	33.5	11	5	3	3	7	4.5	0
3-3	Upstream of Colorado Ave. Marina	47.5	6	10	1	2	19	9.5	0
3-4	Downstream of French Creek	44.75	3	11	1	2	19	8.75	0
3-5	Downstream 31st street Bridge to French Creek	46.5	6	13	0	2	20	5.5	0
3-6	Adjacent to Bungart Island	47	3	11	2	3	20	8	0
3-7	Bungart Island	52	6	13	1	2	20	10	0
3-8	Downstream of 31st Street Bridge	40.75	3	8	1	1	19	8.75	0
3-9	West shore Downstream of the Bike Path Trail	43	6	10	3	2	18	4	0
3-10	Slag area Upstream Colorado Ave. pond marina	38	6	10	2	3	12	5	0
3-11	East Floodplain and Area Adjacent to Bungart Island	47.5	6	12	0	2	19	8.5	0
3-12	Adjacent to Bungart Island	48	6	11	0	2	19	10	-2
3-13	Shale Cliff Downstream of Rail trestle	40	13	7	0	2	10.5	2.5	0
	Average Score for Section 3	**43.3**	**6.0**	**9.8**	**1.1**	**2.2**	**16.7**	**7.2**	**-0.2**
	Average Score for the Project Area	**39.4**	**7.4**	**8.9**	**1.1**	**2.3**	**12.3**	**7.3**	**0.1**

Technical Methods Used to Identify and Prioritize Actions

After setting goals, the next step was to identify actions that would be undertaken to achieve the goals. We used the LQHEI scores to identify areas of relatively good habitat, and areas that should be preserved. We used the LQHEI to identify those areas with rather low scores, indicating areas where improvements could be made. Finally, we used the LQHEI component scores to help identify actions that could be undertaken in order to improve habitat at specific sites.

- **Identify areas of exceptional habitat:** These areas are defined as those which have LQHEI values greater than 60, or those that were documented by Ohio EPA to have aquatic life scores in the exceptional range, or those that have a successfully reproducing assemblage of organisms unique to the study area. While improvements might still be possible, these exceptional areas are identified as preservation sites as they represent the best in the Lower Black River. Two areas, the current Fish Shelf at the Black River Landing site, and the wetland at the Henderson Road Bridge, will serve as reference condition sites against which other restored sites can be compared. A third site, the Heron Rookery is also included.

- **Identify areas of relatively good habitat:** These are defined as areas with LQHEI scores between 45 and 60, and are highlighted in tan in Table 1.4. Note that improvements are still possible for sites in this category, but compared to other reaches of the river these scored comparatively high.

- **Identify those areas with very low scores:** These are areas that had LQHEI scores less than 28, and are not highlighted in Table 1.4. Some of these sites can be improved, but improvement opportunities may be limited by land uses.

- **Identify those measures that could be relatively easily improved at specific sites:** *Table 1.4* shows that scores for the substrate, cover and vegetation measures all average less than half the possible score. Of these three measures, substrate and vegetation are the two that are the most easily manipulated and improved. Cover may be improved as well, but in general changes to the other two metrics are more easily achieved.

It is not practicable to attempt to improve the scores for all measures on a river segment as large as the lower portions of the Black River. For example, changing shoreline morphology could certainly raise scores, but would in general require substantial engineering and earth moving. Some improvements can be made in altering the character of portions of the riparian zone of the Black River, but it's neither possible nor in this case desirable to return the entire stretch to native plant cover. Such an approach would not meet the city's economic goals.

It is possible to see rather substantial increases in scores with improvements to the substrate and vegetation measures in particular. The mean scores for both of these measures were less than half the maximum possible, so there is much room for improvement, particularly in the vegetation measures. Appropriate rock and other inert material could be used to augment bottom substrates. Other projects, such as the artificial reef constructed north of Cleveland's 9th Street Pier, have successfully used concrete rubble to create bottom habitat. Clearly, any materials used to augment the substrates must be inert and must not be sources of potential pollutants. Under state and federal water quality laws, nothing that has the potential to cause pollution can be discharged to a river. According to regulations, prior to placement of any substance in the river, materials used for substrate enhancements must be thoroughly tested to ensure no discharge of pollutants occurs.

The potential success of any planting efforts within the Black River channel will be hampered by the turbidity often exhibited in the water. Just over half of the entire watershed acreage is in row crops or pastures. The current agricultural practices, combined with erodible soils in the watershed, and with the addition of nutrients all along the length of the river, lead to a rather large sediment load, increased algal growth and other factors that increase turbidity in the mainstem of the river. Control of many of these factors, particularly of the sediment and nutrient loading, will require control of inputs at the sources, in the agricultural regions and growing suburban areas upstream of the study area for this plan.

Linking Ecological and Economic Restoration.

The Lower Black River has, until recently, functioned as a shipping conduit for local industry. The dramatic decline in heavy industry in the City of Lorain that began in the 1980s represents both a challenge and an opportunity. The obvious challenge is the city's need to reinvent itself, not so much by abandoning its industrial heritage, but by diversifying its local economy by attracting employers who base their location decisions less on historical principles of economic geography and more on the availability of a skilled, well educated labor force, low taxes, good schools, and a multitude of characteristics that can be lumped into the "quality of life" category. Clearly, an ecologically restored Black River is a key ingredient in the recipe to restore the economic health and overall quality of life in the City of Lorain.

There are a number of studies that document the positive economic impacts of ecological restoration actions in river dependent and coastal communities. Case histories describing activities and success in nine of these communities are included in Appendix D. While remedial actions in these communities focused primarily on the removal of contaminated sediments, circumstances varied, and included the remediation of brownfield sites adjacent to rivers and harbors, as well as habitat restoration activities that all contributed to significant water quality improvements. In general, there was a positive correlation between cleanup and restoration activities and the economic health of the surrounding communities. When examining the results of several of the studies of Great Lakes communities, it is possible to compare benefits that either have occurred or are projected to occur with opportunities in the City of Lorain. The changes seen as a result of the investment made in a major harbor restoration in Waukegan Illinois, illustrates the potential benefits that may occur in the City of Lorain and surrounding communities as a result of ecological restoration activities on the Lower Black River.

Waukegan Illinois is a city of over 87,000, (Lorain's population for

The revitalization of Waukegan's downtown is tied to the restoration of its lake front environments.

2000 was listed at 68,000) 40 miles north of downtown Chicago. Like Lorain, Waukegan was once the home of industries supporting thousands of jobs on a lakefront with a strong 19th and 20th century industrial legacy. With only a small fraction of the industrial jobs remaining, the Waukegan's downtown retail core declined, office tenants left its downtown in large numbers, and downtown housing and hotel space fell into disrepair. While there are a number of positive

attributes associated with Waukegan's location in a dynamic, rapidly growing North Shore county, the pattern of urban decline resulting from the shift away from an industrially based economy closely mirrors that of Lorain.

Today in Waukegan, a positive outlook is emerging, tied directly to a $2.6 million clean up of contaminated sediments in the harbor and the adoption in 2003, of a master plan entitled *A 21st Century Vision for Waukegan's Downtown and Waterfront*. This outlook is supported by studies conducted by the Northeast-Midwest Institute and the University of Illinois found that property values in Waukegan could increase by as much as $53,000 per home as a result of a $2.6 million cleanup of contaminated sediments in Waukegan Harbor.

This is not to suggest that comparable increases would necessarily result from the ecological restoration of the Lower Black River, however it does suggest that similar positive outcomes are possible. With a healthier Lower Black River ecosystem, the public's perception (both locally and regionally) of the city, its lake and river fronts, will continue to improve. This change in perception is a first critical step in advancing a group of existing redevelopment plans. Lorain's vision for its future is already reflected in its existing plans which include:

- The Black River/Lorain Harbor Shoreline Master Plan, which calls for the mixed use redevelopment of the city-owned, 26 acre former Lorain Pellet Terminal site at the mouth of the Black River.
- Plans for new mixed use development consisting of housing, restaurants, and retail/commercial development on vacant Port Authority owned land just upstream of Black River Landing.
- The Lower Black River Master Plan for 400 acres of riverfront property owned by the City of Lorain, which includes the unique Colorado Industrial Park with integrated wetlands.

Existing development likely to recognize economic benefits from the ecological restoration of the Lower Black River include:

- Recent private sector investment in Harborwalk, a residential community for boat owners located on the site of the old American Shipbuilding (AmShip) boat yards near the mouth of the Black River.
- Retail and commercial activity along Broadway Avenue in downtown Lorain, particularly those properties that can be linked, through improved pedestrian linkages, to the river front and Black River Landing.
- The preservation and renovation of residential properties in the historic Charleston Village neighborhood located just south of the lake shore and west of City Hall.

While there are examples of similarly sized cities that have begun economic recovery in part as a result of ecological restoration efforts, it is difficult to predict in any reliable, quantitative way the economic effects that follow ecological restoration in urban settings. In the 1980's researchers such as Dennis King at the University of Maryland began studies aimed at assessing the economic value of services provided by natural ecosystems and communities. In general, these studies defined the economic value of natural systems by calculating the cost of providing a structural replacement designed to provide a specific ecological function. For example, one of the functions wetlands provide is flood storage. One might calculate the flood storage capacity of wetlands in an urban setting, and then express the "value" of those wetlands, for that function, in terms of the cost required to construct detention basins or similar infrastructure to provide that same level of flood storage. Local, state and federal governments can then see economic benefits, in terms of cost reductions, by preserving or restoring natural systems that provide functions and values that would otherwise need to be provided by traditional infrastructure.

Some other costs are fairly well documented. Fishcenich (2001) indicated non-point source discharges can cost urban taxpayers between $2,000 and $35,000 per acre of impervious cover. They also show figures for installing erosion and sedimentation control ($800 to $1,500 per cleared acre). These costs arise from the environmental impacts associated with clearing and paving land. Providing areas for natural infiltration, and maintaining natural buffers along stream channels, provides these services without the added costs associated with engineered solutions.

Various studies have shown that the presence of land in a natural state enhances property values. Mahan *et al* (2000), in a study of the value of urban wetlands in Portland, Oregon, showed a correlation between the size of nearby wetlands and home values, such that value of the homes close to wetlands rose $24.00 for each one acre increase in the size of the nearest wetland. Further, they found that home values increased by $436 for each reduction of 1,000 feet in distance between a house and the closest wetland.

Erosion from agricultural areas and urban areas experiencing clearing and excavating deposits sediment, nutrient and pollutants into waterways. The total estimated cost across the U.S. of the effects of erosion and sedimentation runs approximately $63 billion per year (Collins *et al*, 2005). Pimentel *et al* (1995) showed that every dollar spent on erosion control techniques generates savings of $7.54 in avoided costs associated with solving problems caused by sedimentation.

Many studies have established a link between changes in water quality and property values. For communities around the Chesapeake Bay, home values increased 1.5% for every reduction of 100 fecal coliform cells per 100 milliliters of water (Leggett and Bockstael, 2000). Conversely, decreased water quality can lower property values. Poor *et al* (2007) found that home values dropped an average of $1,086 for every 1 milligram per liter increase in total suspended solids (particles responsible for increased turbidity in water), and $17,642 for each 1 milligram per liter increase in dissolved inorganic nitrogen, a plant nutrient that pollutes waterways and often leads to rampant growth of undesirable algae.

Nearby wetlands and other restored natural areas can increase urban property values.

No comparable figures are available for the City of Lorain, but clearly residents and businesses have experienced lowered property values that are due at least in part to the decreases in water quality in the Black River.

Predicting the future economic gain realized from the investment of money in urban ecological restoration is less well understood than determining the present value of the functions provided by urban

ecosystems, though some trends are emerging. In a 1995 study the U.S. EPA found that across the U.S., developers could charge an average premium of $10,000 for house lots that were located next to stormwater management ponds that incorporated wetlands or other natural features. The effects of greenways, greenbelts, trails and other natural lands on urban property values are well established. Some examples include:

- Boulder, Colorado: Housing prices decrease an average of $4.20 per foot of distance from a greenbelt, up to a distance of 3,200 feet from the greenbelt.
- Salem, Oregon: Urban land adjacent to a greenbelt was worth $1,200 more per acre than urban land 1,000 feet or more away from the greenbelt.
- Durham, North Carolina: The market value of homes decreased by $5.51 for each foot of distance between the home and the Eno River Open Space Corridor.

The decline in property values in Lorain in general, and the Black River corridor in particular, is due to a number of factors, and no single solution will lead to the recovery of these values. Still, there is every reason to believe that restoration of ecological systems along the Black River in Lorain would lead to improvements similar to those discussed above.

So far, we've looked at the economic benefits of restoration in terms of reductions in costs of services provide by natural systems compared to the structural analogs most cities use to provide services like flood storage. We've also looked at the positive effect that nearby natural features can have on property values. In addition to these economic benefits, there are obvious direct benefits that would accrue to the city and region through the enhancement of recreational resources and eco-tourism.

Great Blue Herons, Bald Eagles, waterfowl and other birds are found even in urban areas of the Black River.

Collins *et al* (2005) published a widely cited study of the benefits seen after restoring two streams in Preston County West Virginia. They calculated the increased recreational value associated with restoring aquatic life and scenic character attributes of the streams at between $12 and $16 per household per month. In Ohio, an estimated $700 million is spent each year on sport fishing, with fully one-third of that value spent in the Lake Erie region. It seems obvious that restoring a viable fishery in the Black River and nearby Lake Erie would provide a boost to the local economy.

The Lake Erie shoreline and Black River corridor in Lorain is well known to local birders. A U.S. Fish and Wildlife Service (USFWS)

study shows over 47 million US citizens partook in bird watching activities in 2006. Total expenditures for all wildlife observation related recreational activities, including birding, were over $45 billion dollars in 2006. Some local figures are just as staggering. USFWS estimates that some 50,000 birders visit the Ottawa National Wildlife Refuge and associated marshes each year. Combined, these visitors spent a total of $3.5 million in 2006, $3.2 million of that was spent by non-residents.

Since 2004, when the documented decrease in fish tumors pointed towards the beginnings of restoration of aquatic health in the Black River, tourism in and around the corridor has slowly begun to increase. Kayak and Canoe rentals at from the Port Authority's boat launch at have increased over during the past two seasons. Increased numbers of passengers have traveled up the river on eco-tours sponsored by the Port Authority. It is reasonable to assume that a healthy river and riparian ecosystem will attract recreational uses that would not have been imaginable during the peak of industrial activity in the middle of the 20th Century. In the near future projects being undertaken by Lorain Metroparks will bring recreational visitors to the river's waters at the proposed canoe launch facility and to the lake front through recreational enhancements at the diked disposal site adjacent to Spitzer Marina.

Lorain County Metro Park's trail provides important access to the Black River and its banks for residents and visitors.

While an ecologically restored Lower Black River will continue to support industrial uses, it is anticipated that as corporate commitments to sustainable operating practices increase, low impact industrial development practices will also become more prevalent, and a better balance between recreational, industrial and residential uses will be achieved.

Taken together, all of these trends are supportable and will contribute to undeniable increases in the quality of life for the Citizens of Lorain and all of the surrounding communities in the Lower Black River Watershed. Again, this improved quality of life is the main ingredient in returning economic well being to community.

2. MASTER PLAN ACTIONS

Recommended Restoration Actions

Actions were selected that would lead to increases primarily in the scoring of substrate and vegetation components of the LQHEI. We developed three broad groups, and 12 categories of actions to be undertaken for this plan. These are:

Group A, Restoration Actions

These are actions that involve the creation of new habitat, or the major restoration of areas where habitat has been lost.

Action A1: *Install fish shelves to create fish habitat at feasible locations*
Action A2: *Slag pile remediation*
Action A3: *Wetland restoration and construction*
Action A4: *Stream bank stabilization*
Action A5: *Slag pile stabilization*
Action A6: *Bulkhead habitat*

Group B, Enhancement Actions

These are actions that enhance existing habitats and systems. They tend to involve less earthmoving and other heavy construction than the restoration actions.

Action B1: *Invasive species removal*
Action B2: *Plant submerged aquatic species and other flora*
Action B3: *Install floating wetlands and fish baskets on a trial basis*

Group C, Protection Actions

These are actions that protect remnant higher quality natural areas and ecologically restored sites.

Action C1: *Conservation easement acquisition and wetland purchase*
Action C2: *Best management practices for developers*
Action C3: *Suggested regulatory protections*

Each action is described in detail on the pages that follow. Locations of proposed actions are shown in *Figures 2.4* through *2.6.* The individual locations for actions are listed on the following pages in a preferred order, an order which reflects the ecological importance of the action at that location. First, we began by predicting LQHEI scores that could be attained at the completion of each action. These scores represent the targets for each restoration action. We compared the existing LQHEI scores for the river reach along which each action is proposed, to the predicted LQHEI score for the action. In order to give priority to those actions which had the greatest difference between existing and predicted LQHEI scores, and therefore presumably have the greatest local ecological impact, we assigned simple weighting factors. We weighted (multiplied) the predicted LQHEI score of any action that resulted in a predicted LQHEI above 60 by a factor of 1.50. Those actions that resulted in predicted LQHEI sores above 55 but below 60 were weighted with a factor of 1.25. Those actions that result in predicted LQHEI scores that were higher than the existing score for the reach where the action is located, but were lower than 55, were weighted by a factor of 1.1. Finally, any action that served to protect any of the remaining high quality habitats in the project area was weighted by a factor of 1.75. This system clearly gives the greatest weight to those actions that preserve and improve the existing high quality habitats; logically any restoration plan should begin with first protecting the best of what is left in the area. The actions are summarized in *Table 2.1*.

Descriptions of the Actions

Action A1: Install Fish Shelves to Create Fish Habitat at Feasible Locations.

Applicable River Sections: 1

Goals Addressed: 1, 2, 4

Procedure: This procedure involves installing rock or clean concrete rubble to create shallow fish habitat at feasible locations (*Figure 2.1*). The minimum effective size appears to be on the order of 20 feet long by 20 feet wide. Water depths should be six to eight feet. The shelves can be constructed of readily available rubble; large piles of concrete rubble are available at the east end of the Republic Steel site. It is vitally important to note that no material can be deposited in waters of the state of Ohio or U.S. without the appropriate permits, and that under no circumstances should any material that could contribute pollutants to the water be used. Emergent and submerged aquatic vegetation can be planted in the shelf, and on the slopes above the shelf, though the success of plantings along the Black River may be limited due to the general turbid conditions in the river.

Reference Condition: Approximately 800 feet of aquatic fish shelf now exist just south of Black River Station. Ohio EPA monitoring has documented dramatic increases in fish populations and diversity to "near exceptional" status. Fish populations on new fish shelves will be compared to populations on this existing shelf.

Project Sites: A total of 7,014 feet of potential shoreline sites, located on both private and public property, are illustrated on *Figures 2.1* through *2.3* and include:

- A1-1: 1,155 feet, near Henderson Rd. Bridge, $231,000. Predicted LQHEI: 57
- A1-2: 436 feet, north of Trestle. $87,200. Predicted LQHEI: 57
- A1-3: 60 feet, south of the Bascule (Erie Street) Bridge, $12,000. Predicted LQHEI: 57
- A1-4: 3,463 feet, at the CDF, $692,600, predicted LQHEI: 59.5.
- A1-5: 1,900 feet, at the proposed wastewater treatment plant site, $380,000. Predicted LQHEI: 51

Estimated Construction Costs: $100 to $250 per lineal foot. Costs are largely driven by the availability of suitable material. If suitable rubble, free from contamination and dense enough to not float away is available close by and at no cost, lower unit costs would apply. Costs would likely be higher for construction of additional fish habitat along the CDF wall.

Total Estimated Construction Costs: $12,000 to $1,402,800

Permitting Requirements: Nationwide Permit, # 27, Aquatic Habitat Restoration, Establishment and Enhancement Activities, submerged lands permit within Lake Erie Coastal Zone Management Area.

Implementation Requirements: Complete site designs, acquire material for the shelves, acquire appropriate permits and seek project funding. While the general design for the shelf located at the Black River Landing will serve as a template and guide, site specific designs would be required for each proposed fish shelf. Site A1-3 will require attention to the potential impact of ship traffic, specifically potential disturbances from bow thrusters. Along the CDF, the proposed "shelf" should be constructed using additional armor stone and clean concrete rubble, sloping away from the current sides of the CDF. Smaller stone (small boulder to large cobble sized) could also be placed at the toe of the new slope, to provide spawning habitat. Note that these projects could serve as mitigation for projects in the Black River Watershed that require stream mitigation. If sufficient permit demand exists, the 6,987 feet of aquatic fish habitat shelf and associated stream side restoration could form a sizable stream mitigation bank.

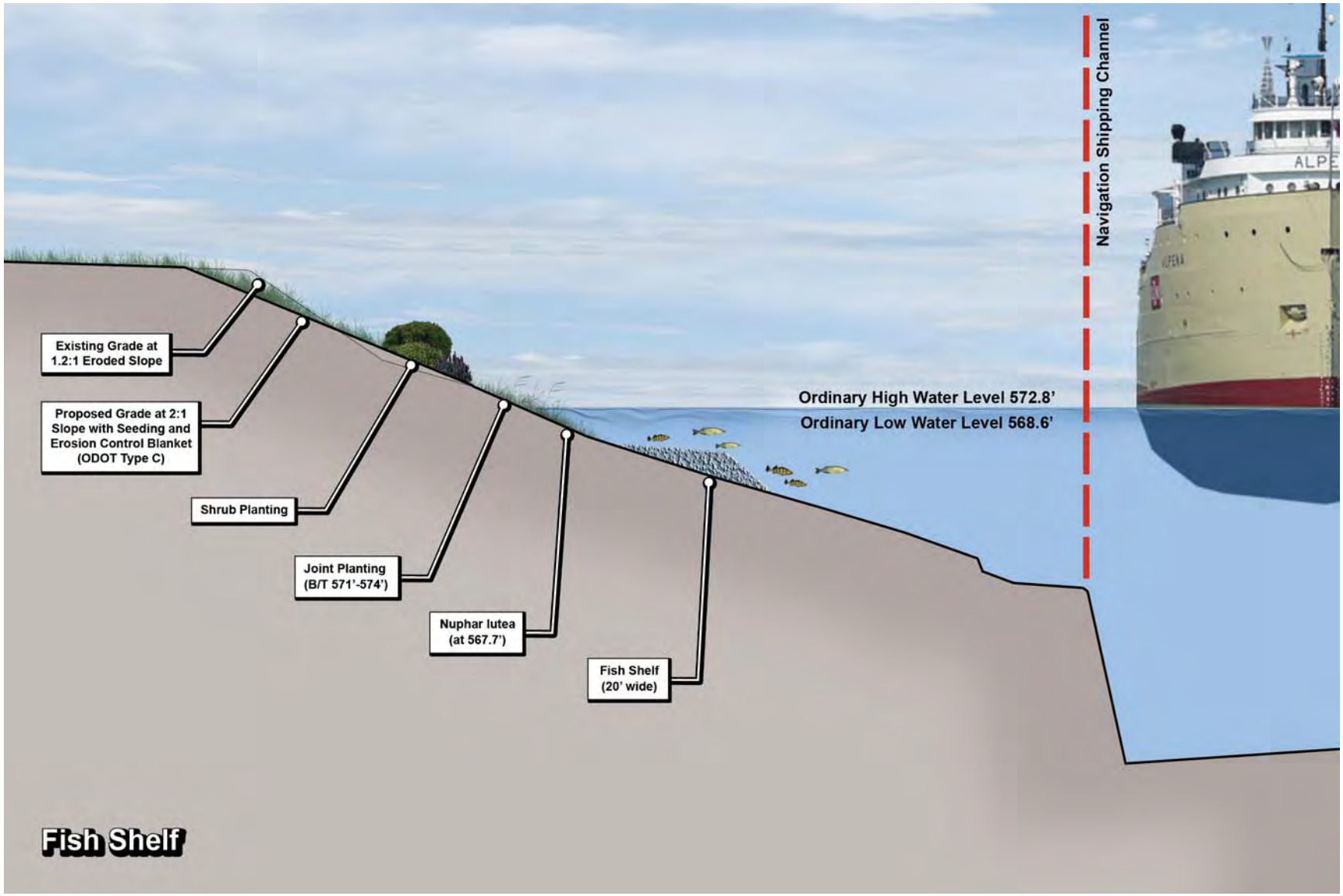


Figure 2.1 Cross section for the Black River aquatic shelf located at the Black River Landing site.

Action A2: Slag Pile Remediation

Applicable River Sections: 2, 3

Goals Addressed: 1, 2, 4

Procedure: Slag, a by-product of the steel making process that is essentially a limestone-based rock, has been deposited over large areas along the Lower Black River. In some areas this material extends to the water's edge and covers the original riparian area. This action is designed to remove the slag within an area extending up to 100 feet from the water's edge. The removed slag could be sold as a construction material, or moved and safely stockpiled for later use on the same property. After the slag has been removed, appropriate, clean soil should be placed and graded, and a native plant community established. Restoration to a forested condition is most desirable, though in cases where the removal of slag extends close enough to the normal elevation of the river to potentially support wetland hydrology, construction of riparian wetlands in these areas would be highly desirable. The end result is a 100 foot wide swath of native riparian vegetation, replacing the generally barren areas the slag now creates.

Reference Condition: Lorain County Metro Park's French Creek Reservation offers a very good reference area. Most banks in the Park are stable and have intact riparian communities. Other intact areas include the riparian zone upstream of the Colorado Avenue Marina, the shoreline of Bungart Island, and shorelines parallel to the Island.

Project Sites: A total of 6,422 feet of stream bank covered in slag deposits could be repaired, stabilized and re-vegetated.

- A2-1: 759 feet, at the proposed wastewater treatment plant site, $379,500. Predicted LQHEI: 59
- A2-2: 4,660 feet, along the Stein site at the southern end of the project area, $2,330,000. Predicted LQHEI: 51.5.
- A2-3: 1,003 feet, at Stein property, downstream of the proposed wastewater treatment plant site, $501,500. Predicted LQHEI: 41

Estimated Construction Costs: $500 per lineal foot. The cost assumes that the excavated material will not be trucked off site, but would be deposited elsewhere on the same site. Costs also account for re-planting the riparian zone.

Total Estimated Construction Costs: $379,500 to $3,211,000.

Permitting Requirements: Nationwide Permit, # 27, Aquatic Habitat Restoration, Establishment and Enhancement Activities, may be required if the work extends below the Ordinary High Water Mark. Submerged lands permit within Lake Erie Coastal Zone Management Area for work below the water line.

Implementation Requirements: Permits, Funding. Note that riparian restoration can be used as mitigation for projects in the Black River Watershed. A partial list of species suitable for riparian restoration appears on page 36. These species would be suitable for planting in areas where slag is removed from the river banks.

Slag piles at the river's edge.

Action A3: Wetland Restoration and Construction

Applicable River Sections: All

Goals Addressed: 1, 2, 4

Procedure: The benefits associated with wetland restoration are widely known. Wetlands perform a vast array of ecological functions, such as nitrogen processing and biomass accumulation. These functions lead to societal benefits that most recognize as values, including providing wildlife habitat and filtering water. Many wetlands have been removed over the long history of occupation in and around the project area. This action would help reverse that trend. Restoration can be accomplished by restoring hydrology to drained or otherwise altered wetlands, removing invasive species, and establishing native plant cover. Constructing wetlands where none exist now requires data on hydrology and soils; the wetland ecologist designing the constructed wetland must be sure that sufficient water can be supplied, for an appropriate length of time, to establish and maintain a healthy wetland plant community.

Reference Condition: Appropriate reference sites are at Old Woman Creek and Sheldon's Marsh, state nature preserves located near Huron, Ohio. Once restored, the Henderson Road Bridge wetland would serve as a local reference site.

Project Sites: A total of 74.7 acres of wetland restoration would be protected through this action.

- A3-1: 12 acres, at the Henderson Road Bridge wetland, $300,000. Predicted LQHEI: 75
- A3-2: 12.7 acres, at the Colorado Industrial Park site, $762,000. Predicted LQHEI: 61 (*Figure 2.2*).
- A3-3: 50 acres, at the proposed wetland at the mouth of French Creek, $3,750,000. Predicted LQHEI: 56.5

Estimated Costs: Restoration costs for A3-1 were estimated as $25,000 per acre. Wetland creation at A3-2 was estimated at $60,000 per acre. Estimated costs for A3-3 are $75,000 per acre, due to the need to remove slag and other materials, and the greater amount of site preparation required. These costs include the design and construction of the wetlands.

Total Estimated Construction Costs: $300,000 to $4,812,000.

Permitting Requirements: A Section 404/401permit would be required for restoration activities at the Henderson Road Bridge wetland. The two wetland construction sites, A3-2 and A3-3, would require permits only if grading activities occurred below the Ordinary High Water Mark of the Black River, or if a grading impact occurred on another water of the U.S.

Implementation Requirements: Acquisition of the two privately owned properties would be required prior to construction. Design work, through final construction drawings, would be required. Funding could clearly come through applicants in need of mitigation for activities in the Black River watershed. Grant programs for wetland restoration or creation are also available.

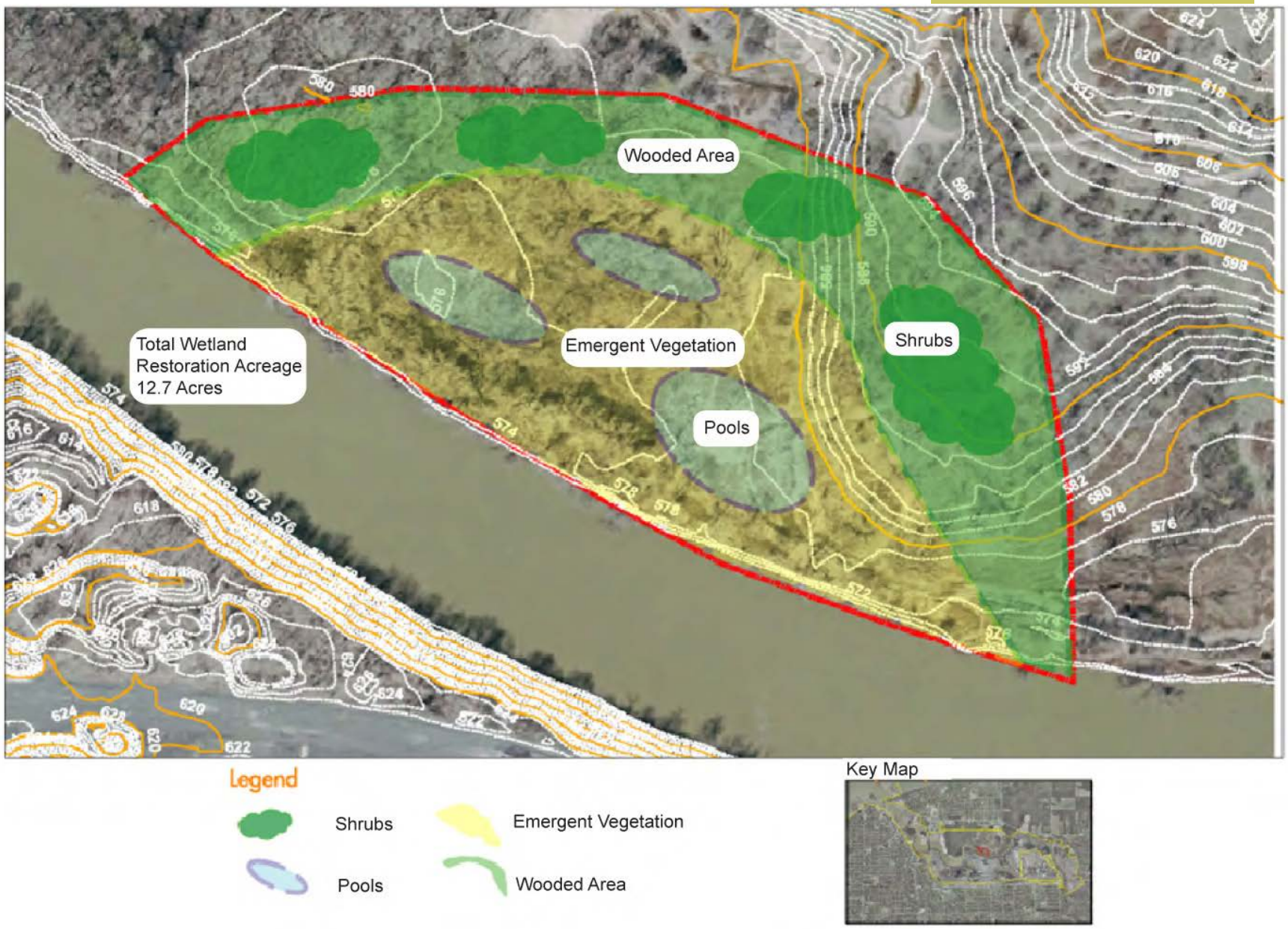


Figure 2.2 Conceptual Design for Wetland A3-2

A successful constructed wetland.

The list below contains species that are appropriate for planting in wetlands. It is by no means exhaustive, but is representative of species that have been commonly planted in constructed and restored wetlands in the Lorain area. Scientific names are followed by common names. Note that common names for most plants, particularly sedges (members of the genus *Carex*), are highly variable. The common name is followed by the wetland status, from Reed (1988). Reed's (1988) document contains a designation indicating the frequency with which species are found in wetlands. OBL indicates plants that almost always occur in wetlands. FACW indicates plants that are found in wetlands roughly 75% of the time they are seen in the field. Species listed as FAC have an equal chance of occurring in both uplands and wetlands.

- *Alnus serrulata*, Alder (OBL)
- *Bidens cernua*, Nodding bur marigold (OBL)
- *Caltha palustris*, Marsh marigold (OBL)
- *Carex vulpinoidea*, Fox sedge (OBL)
- *Carex lacustris,* Lakeside sedge (OBL)
- *Carex stricta*, Tussock sedge (OBL)
- *Carex baileyi,* Bailey's sedge (OBL)
- *Carex comosa*, Bristly sedge (OBL)
- *Carex lurida*, Lurid sedge (OBL)
- *Cephalanthus occidentalis*, Buttonbush (OBL)
- *Cornus amomum,* Silky dogwood (FACW)
- *Eleocharis obtusa,* Blunt spikerush (OBL)
- *Eupatorium maculatum*, Spotted Joe pye weed (FACW)
- *Eupatorium perfoliatum*, Boneset (OBL)
- *Glyceria septentrionalis*, American manna grass (OBL)
- *Juncus effusus*, Soft rush (FACW+)
- *Leersia oryzoides,* Rice cutgrass (OBL)
- *Penthorum sedoides*, Ditch stonecrop (OBL)
- *Rumex verticillatus*, Swamp dock (OBL)
- *Scirpus (Schoenoplectus) acutus*, Hard-stemmed bulrush (OBL)
- *Scirpus atrovirens,* Green bulrush (OBL)
- *Scirpus cyperinus*, Wool grass (FACW+)
- *Scirpus polyphyllus*, Many-leaved bulrush (OBL)
- *Scirpus validus*, Soft stem bulrush (OBL)
- *Solidago patula*, Rough-leaved goldenrod (OBL)
- *Verbena hastata*, Blue vervain (FACW+)
- *Viburnum dentatum*, Arrowood (FAC)

Wetland plants can be seeded, or planted as bare root or potted stock. Seeding is often the least expensive way to restore plants. Survival rates may be slightly higher for bare root and potted stock, but the individual plants are more expensive than seeds, and planting costs are higher. If applied as seed, a rate of 15 pounds per acre is generally appropriate. If planting will occur using bare root or potted stock, the general recommendation is to plant on two or three foot centers. Soils should be tested to determine the need for fertilizers.

Only species native to northeast Ohio should be used. Outstanding references for native species for Ohio include the *Plant Communities of Ohio* (Anderson, 1982) and *The vascular flora of the glaciated Allegheny Plateau region of Ohio.* (Andreas, 1989).

Action A4: Stream Bank Stabilization

Applicable River Sections: All

Goals Addressed: 1, 2, 4

Procedure: This action will create stable slopes at sites where erosion has caused banks to slump and fail. It will restore natural vegetation communities along the banks and in the adjacent shallows in the River. A total of 11,980 feet of stream bank could be repaired, stabilized and re-vegetated. Substrate can be improved at these sites by depositing boulder and cobble sized pieces of concrete or pieces of weathered slag at the toe of the bank slope.

Reference Condition: Lorain County Metro Park's French Creek Reservation offers a very good reference area. Most banks in the Park are stable and have intact riparian communities. Other intact areas include the riparian zone upstream of the Colorado Avenue Marina, the shoreline of Bungart Island, and shorelines parallel to the Island.

Project Sites: A total of 11,980 feet of stream bank could be repaired, stabilized and re-vegetated.

- A4-1: 257 feet, near the heron rookery, $32,125. Predicted LQHEI: 58
- A4-2: 408 feet, at the Riverbend Commerce Park, $51,000. Predicted LQHEI: 61
- A4-3: 1,357 feet, upstream of the southern rail trestle, $169,625. Predicted LQHEI: 53
- A4-4: 1,491 feet, downstream of Republic Steel docks, $186,375. Predicted LQHEI: 54
- A4-5: 717 feet, at the proposed wastewater treatment plant site, $89,625. Predicted LQHEI: 54
- A4-6: 1,859 feet, at the proposed wastewater treatment plant site, $232,375. Predicted LQHEI: 54
- A4-7: 1,232 feet, upstream of the southern rail trestle, $154,000. Predicted LQHEI: 52
- A4-8: 262 feet, downstream of the junction of French Creek and the Black River, $32,750. Predicted LQHEI: 51
- A4-9: 700 feet, at the downstream end of the Black River Station, $87,500. Predicted LQHEI: 50
- A4-10: 833 feet, opposite from and downstream of the mouth of French Creek, $104,125. Predicted LQHEI: 49.
- A4-11: 1,174 feet, at Stein property, downstream of the proposed wastewater treatment plant site, $146,750. Predicted LQHEI: 48
- A4-12: 1,156 feet, at the Republic Steel site, $144,500. Predicted LQHEI: 43
- A4-13: 534 feet, at opposite the mouth of French Creek, $66,750. Predicted LQHEI: 41

Estimated Construction Costs: $125 per lineal foot. This includes minor excavation with material deposited on-site, grading, and planting with native species.

Total Estimated Construction Costs: $32,125 to $1,497,500.

Permitting Requirements: Nationwide Permit, # 27, Aquatic Habitat Restoration, Establishment and Enhancement Activities may be required if the work extends below the Ordinary High Water Mark. Submerged lands permit within Lake Erie Coastal Zone Management Area for work below the water line.

Implementation Requirements: Permits, Funding. Note that stream bank stabilization can be used as mitigation for projects in the Black River Watershed.

The list below contains species that are appropriate for planting in riparian areas. As with the wetland planting list on page 34, It is by no means exhaustive, but is representative of species that have been commonly planted in restored riparian areas in the Lorain area. Scientific names are followed by common names.

Trees:

- *Acer negundo, Box elder*
- *Acer rubrum, Red maple*
- *Acer saccharinum, Silver maple*
- *Juglans nigra, Black walnut*
- *Platanus occidentalis, American sycamore*
- *Quercus palustris, Pin oak*
- *Salix nigra, Black willow*

Shrubs:

- *Alnus serrulata, Alder*
- *Amelanchier laevis, Shad bush*
- *Cornus racemosa, Gray dogwood*
- *Viburnum acerifolium, Maple-leaved viburnum*
- *Salix interior, Sandbar willow*
- *Salix lucida, Shining willow*
- *Salix purpurea, Pussy willow*

Herbs:

- *Asclepius incarnata, Swamp milkweed*
- *Arisaema triphyllum, Jack in the pulpit*
- *Bidens cernua, Nodding bur marigold*
- *Eupatorium perfoliatum, Boneset*
- *Glyceria septentrionalis, American manna grass*
- *Juncus effusus, Soft rush*
- *Scirpus cyperinus, Wool grass*
- *Solidago patula, Rough-leaved goldenrod*
- *Verbena hastata, Blue vervain*
- *Panicum virgatum, Witch grass*
- *Elymus virginicus, Virginia wild rye*

An intact riparian zone in the project area.

Trees and shrubs can be purchased and planted as bare root or potted stock. Bare root trees are cheaper, but generally have greater post-planting mortality rates than potted stock. Some shrubs, particularly members of the genera *Salix* (willows) and *Cornus* (dogwoods), will grow quite readily from cuttings taken from live specimens. The number needed to fill an area can be calculated assuming planting on five foot centers.

Herbs can be seeded or planted from bare root or potted stock. If seeded, recommended rates are generally 15 pounds per acre. In addition, a temporary cover crop of seed oats (*Avena sativa*) should be added to the mixture at a rate of 30 pounds per acre. The seed oats will provide temporary cover until the intended native mix germinates and is established, and does not produce the purported allelopathic effects associated with annual rye and other cover crops.

Action A5: Slag Pile Stabilization

Applicable River Sections: 3

Goals Addressed: 2, 4

Procedure: Similar to Action A2, but occurring over a much larger area. This action will not be possible without close cooperation with the Stein Corporation, the owner of the property. The slag on the site is a marketable material, and the owner is currently selling slag and looking for other buyers. As the slag is removed, opportunities for restoration of the site will emerge. Revegetation in this area with a native plant community will provide habitat and reduce runoff into the Black River. A mix of upland plant communities would be desirable to provide additional cover type diversity in the Project Area.

Reference Condition: Lorain County Metro Park's French Creek Reservation offers a very good reference area. Most banks in the Reservation are stable and have intact riparian communities. Other intact areas include the riparian zone upstream of the Colorado Avenue Marina, the shoreline of Bungart Island, and shorelines parallel to the Island.

Project Sites: At site A5-1, a minimum of 40 acres could be restored to provide a substantial block of habitat. Up to 105 acres of mostly upland restoration might be possible. Work along the stream banks could raise the LQHEI score in this area from 46.5 to 58.5.

Estimated Construction Costs: $45,500 per acre. The cost assumes most of the slag on the site would have been removed through selling to customers. Costs include replacing topsoil and developing a stable upland plant community on the site. Costs do not include acquisition of the property.

Total Estimated Construction Costs: $1,820,000 to $4,775,000

Permitting Requirements: Nationwide Permit, # 27, Aquatic Habitat Restoration, Establishment and Enhancement Activities may be required if the work extends below the Ordinary High Water Mark. Submerged lands permit within Lake Erie Coastal Zone Management Area for work below the water line.

Implementation Requirements: Landowner approval and permits, funding. Note that riparian restoration through slag removal, stabilization and planting can be used as mitigation for projects in the Black River Watershed. Also, any movement of significant volumes of slag likely requires a three to four year lead time, most of which would be taken up by identifying projects that could use the material, and moving the slag to the site where it will be used.

Slag piles at the river's edge.

Action A6: Bulkhead Habitat

Applicable River Sections: 1

Goals Addressed: 1, 3, 4

Procedure: Steel bulkheads in the project area offer virtually no shoreline habitat; all the bulkheaded areas had quite low LQHEI scores. Creating habitat along the bulkheads would involve cutting the existing bulkheads three to four feet below the water line, and stepping them back approximately 20 feet, in essence creating a fish shelf below the top of the bulkhead. A new bulkhead, or more natural shore constructed of armor stone or other suitable rocky material, could be installed at the landward side of the 20 foot wide area now exposed to water. The substrate in the submerged area should be boulder and cobble sized rock. Planting the newly created flooded portion with submerged aquatic vegetation would be desirable, though the success of plantings may be limited by the generally turbid water conditions. As an experimental technique, this is one where signage and public access and explanation may be particularly instructive and beneficial (*Figure 2.3)*

A bulkhead near the mouth of the river.

Reference Condition: This approach has been proposed for the Cuyahoga River in Cleveland, but to our knowledge has not been implemented. The existing fish shelf at the Black River Landing should serve as a suitable reference for fish habitat.

Project Sites: Approximately 7,896 feet of steel bulkhead surrounds the former pellet terminal, a facility that no longer serves as a bulk transfer site A6-1. Any bulkheaded area along Section 1 of the project area could potentially be an appropriate site. The predicted LQHEI for this site is 57.

Estimated Construction Costs: Could be as high as $1,500 per foot, and would include potentially substantial engineering and design costs.

Total Estimated Construction Costs: $11,844,000

Permitting Requirements: Nationwide Permit, # 27, Aquatic Habitat Restoration, Establishment and Enhancement Activities may be required if the work extends below the Ordinary High Water Mark. Submerged lands permit within Lake Erie Coastal Zone Management Area for work below the water line. A Section 10 Permit is required for work in navigable waterways.

Implementation Requirements: The structure and integrity of any bulkhead would need to be investigated. Bulkheads are typically tied back and anchored to the shore, often to deadmen (concrete blocks) buried in the ground to provide stabilizing mass. A minimum opening of four to six feet should allow for easy fish passage into and out of the restored habitat area. The minimum effective size is probably on the order of 20 feet by 20 feet. Water depths of one to two feet would provide habitat and refuge for some larval fish species. Depths much greater than two feet would preclude submerged aquatic vegetation.

Creating vegetated strips along the top of either retrofitted bulkhead habitat areas or along the existing bulkheads would provide needed shade to the river areas immediately adjacent to the bulkhead, and

help to "green up" the overall riverside area. A belt of 20 to 50 feet wide could provide enough room for two to three tree canopy diameters along the landward side of the bulkhead, and therefore provide an important waterside green space for Lorain.

The list below contains species that are appropriate for planting in riparian areas. As with the wetland planting list on page 34, it is by no means exhaustive, but is representative of species that have been commonly planted in restored riparian areas in the Lorain area. Scientific names are followed by common names.

Trees:

- *Acer negundo*, Box elder
- *Acer rubrum*, Red maple
- *Acer saccharinum*, Silver maple
- *Juglans nigra*, Black walnut
- *Platanus occidentalis*, American sycamore
- *Quercus palustris*, Pin oak
- *Salix nigra,* Black willow

Shrubs:

- *Alnus serrulata, Alder*
- *Amelanchier laevis, Shad bush*
- *Cercis canadensis, Redbud*
- *Cornus racemosa, Gray dogwood*
- *Cornus florida, Flowering dogwood*
- *Viburnum acerifolium, Maple-leaved viburnum*

In addition to the trees and shrubs, native grasses and any of the local, commercially available, upland meadow seed mixes would provide diversity of species, forms and colors.

- *Appropriate submerged or floating aquatic species include:*
- *Potamogeton nodosus, Floating-leaved pondweed*
- *Potamogeton foliosus, Leafy pondweed*
- *Vallisneria americana, Water celery*

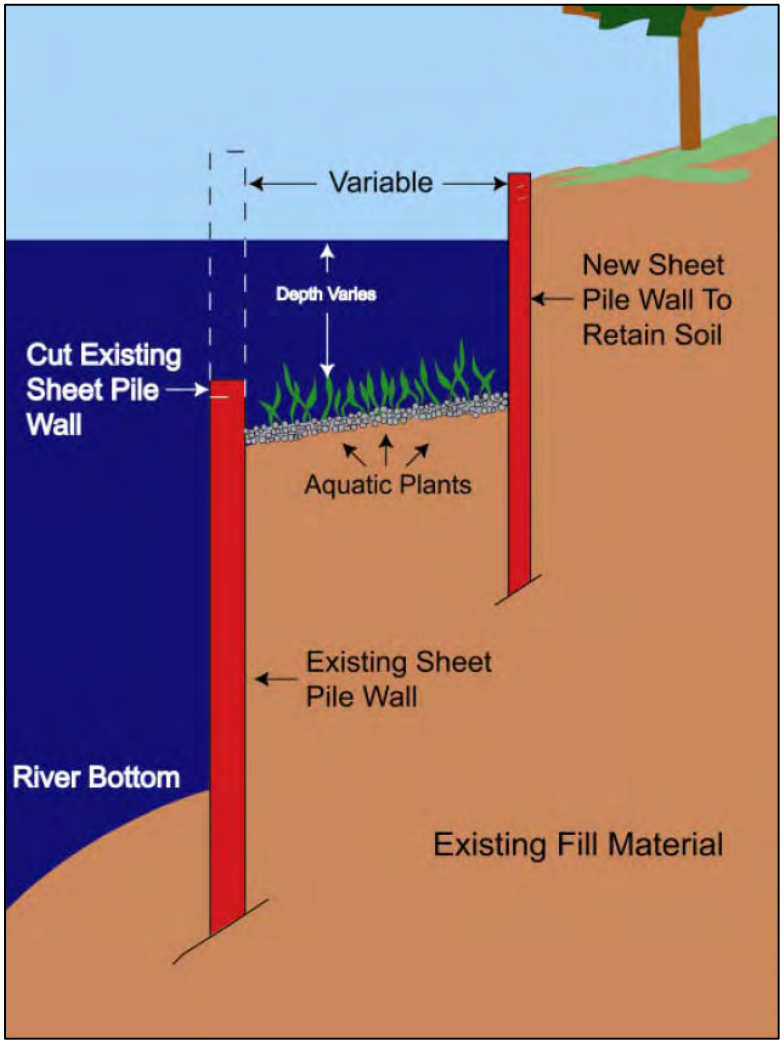


Figure 2.3 The Bulkhead Habitat Concept.

Action B1: Invasive Species Removal

Applicable River Sections: All

Goals Addressed: 1, 2, 4

Procedure: Several invasive plant species are found along the Project Area. The most common wetland and aquatic invasives are purple loosestrife, common reed and narrow-leaved cattail. European buckthorn is a non-native invasive shrub commonly found in the area. Careful, controlled application of appropriately labeled herbicides, the potential use of bio-control agents (particularly for purple loosestrife) or construction measures to eradicate invasive vegetation species such as purple loosestrife, and common reed, should be undertaken. We assume that two years of treatment may be required at most sites.

Reference Condition: Invasive species eradication has recently been conducted at the East and West Floodplain Restoration sites of the former Landfill property. As the eradication progresses, these communities should serve as reference sites indicating the extent to which invasives can be removed. Additional reference sites are at Old Woman Creek and Sheldon's Marsh, state nature preserves located near Huron, Ohio.

Project Sites: A total of 20.5 acres should be treated to remove invasive non-native plants.

- B1-1: 5.87 acres, at the Henderson Road Bridge wetland, $58,700. Predicted LQHEI: 75
- B1-2: 11.42 acres, at the proposed wetland restoration site at the Commerce Park site, $114,200. Predicted LQHEI: 61
- B1-3: 1.86 acres, at Bungart Island, $18,600. Predicted LQHEI: 57
- B1-4: 1.35 acres, west of the former Pellet Terminal docks, $13,500. Predicted LQHEI: 59

Implementation Timeline: All four areas should be treated at the early stages of implementing this plan. Most areas will likely require treatment for more than one year. Most of these areas will be sites of other activities, and removal of the invasive species will be a key to the success of subsequent actions.

Estimated Costs: $10,000 per acre.

Total Estimated Construction Costs: $13,500 to $205,000.

Permitting Requirements: Permits may be required for the use of herbicides near water.

Implementation Requirements: Funding. Note that efforts to eradicate invasive species from existing wetlands may be used as mitigation efforts for projects in the Black River watershed.

Common reed, an invasive plant found along the river.

Control of invasive species was a topic of much discussion among the advisory committee. Some felt that given the extent of the invasive plant problem, attempts at control were likely to be futile. Some believed that individual restoration efforts must be preceded by the local control of invasive species. Some felt that biocontrol agents should be employed, rather than chemical means.

The most common invasive species in wetlands and the nearshore areas in the project area are *Phragmites australis* (Common reed), *Lythrum salicaria* (Purple loosestrife), *Typha angustifolia* (Narrow-leaved cattail), *Polygonum cuspidatum* (Japanese knotweed) and *Rhamnus cathartica* (European buckthorn). All of these non-native species tend to grow at rather rapid rates, and will crowd out native plants. As the composition and structure of the plant community changes from a native-dominated system, to one dominated by non-native species, ecosystem functions also change. Many of the non-natives are not palatable to native wildlife, and so offer little food value. Some structural cover may be provided for some wildlife by non-native plants, but the lack of food value limits the total habitat available. Some species, such as purple loosestrife, show evidence of the presence of compounds that are toxic to soil invertebrates, offering the possibility of severely restructuring food webs in the systems where these plants dominate. Clearly, if ecosystem functions are to be restored, control of these non-native species is important.

Control can be achieved through a variety of measures. Physically removing plants is one method, but this must be done with care. Pulling purple loosestrife plants after the plants have set seed can scatter thousands of viable seeds throughout the area. *Phragmites* has very deep roots, and the plant reproduces mainly from these structures. Without removing the entire plant, re-sprouting can certainly occur.

Biocontrol agents have become more popular recently. There are several insects that have been used as control agents for purple loosestrife, with rather impressive success in the Pacific Northwest, and rather less success in the east. Researchers have identified species that attack Phragmites, but to date no intentional experimental releases have been carried out. No biocontrol agents are known for narrow-leaved cattail, Japanese knotweed or European buckthorn. Some ecologists and naturalists question the wisdom of using introduced agents to control non-native plants (most of the natural predators for these non-native species are of course not native to North America).

Chemical control is generally considered the most cost effective means of treating most invasive species. Many ecologists and natural areas managers are of course quite sensitive to the use of herbicides around natural areas. The labeled uses and restrictions of the herbicide to be employed must be carefully adhered to. There are application techniques, such as ultra-low volume spray applications, that allow careful application of the appropriate herbicide directly to the target plant. These techniques can greatly limit the chance that desirable vegetation would be affected by the herbicide.

Control of these invasive plants in the project area will likely involve a combination of the techniques discussed above.

Action B2: Plant Submerged Aquatic Species and Other Flora

Applicable River Sections: 1

Goals Addressed: 1, 3

Procedure: Submerged aquatic plants such as water celery (*Vallisneria americana*), pondweeds (*Potamogeton*) and others were once abundant in shallow, protected areas along Lake Erie's shoreline. Rooted emergent species, such as lotus (*Nelumbo lutea*) were also found. As sediment and nutrient levels increased, and subsequently as water clarity decreased, populations of these important plants began to dwindle. These species offer important habitat for fish and other organisms. They also help process nutrients and other pollutants. This action focuses on establishing a healthy population of submerged and emergent wetland plants behind the breakwall in front of the power plant along the lake shore.

Reference Condition: Appropriate reference sites are at Old Woman Creek and Sheldon's Marsh, state nature preserves located near Huron, Ohio. Both are shallow coastal marshes protected by barrier beaches. In this case, the breakwall serves as an analog for the barrier beach.

Project Sites: A total of 12.2 acres of submerged and emergent plantings could be accomplished at this site.

- B2-1: 12.2 acres near the power plant. $124,440. Predicted LQHEI: 62

Estimated Costs: $10,200 per acre. Costs include acquiring bare root and other appropriate plant stock, and planting at a density of approximately 3 foot on center.

Total Estimated Construction Costs: $124,440

Permitting Requirements: Nationwide Permit, # 27, Aquatic Habitat Restoration, Establishment and Enhancement Activities may be required.

Implementation Requirements: Funding could come from mitigation needs or from coastal restoration grants.

Floating aquatic plants add diversity and habitat to deeper areas.

Action B3: Install Floating Wetlands and Fish Baskets on a Trial Basis

Applicable River Sections: 1, 3

Goals Addressed: 1, 2, 3, 4

Procedure: Purchase aquatic fish baskets and install on sheet pile walls. Optimal quantity and spacing of baskets and groupings require further testing. The initial recommendation is to install the baskets in 200' groupings with groupings spaced 400' apart, thereby equaling about 1/3 of the sheet pile length. Purchase and anchor an experimental floating wetland near the downstream end of Bungart Island. The location would be visible from the boat tours the Port Authority currently runs on the river. The wetland would be anchored to the bottom, and removed during the winter. Native emergent and floating-leaved species should be used to populate the wetland. *Note that this action is quite experimental, and that there was substantial discussion regarding the merits of these techniques. They are suggested here only as experimental measures, and because the baskets in particular offer one of the very few solutions for improving habitat, albeit in small pieces, along steel bulkheads.*

Reference Condition: *Both techniques are experimental.* The Cuyahoga RAP used the fish baskets for 1 year, with mixed results. The Cuyahoga sites would serve as a reference. No reference site exists locally for the floating wetland. We recommend a monitoring procedure in which regular visits are made to assess the viability of the technique, and its effects on water quality.

Project Sites: Four sites were selected for these experimental treatments.

- B3-1: 300 fish baskets installed on bulkhead at the harbor entrance, $75,000. Predicted LQHEI: 32
- B3-2: 700 fish baskets installed on bulkhead near the Port Authority boat launch, $175,000. Predicted LQHEI: 32
- B3-3: Floating wetland installed just upstream of Bungart Island, $30,000. Predicted LQHEI: 45
- B3-4: 100 fish baskets installed on bulkhead at the river's mouth. $25,000. Predicted LQHEI: 32

Estimated Costs: $100/square foot for the floating wetland; $250 each for the baskets.

Total Estimated Costs: $25,000 to $305,000.

Permitting Requirements: Nationwide Permit, # 27, Aquatic Habitat Restoration, Establishment and Enhancement Activities may be required.

Implementation Requirements: Funding. Available sources could include habitat restoration grants. The Advisory Committee recommended that these techniques only be implemented if an advocate was found who was willing to secure the funds for the installation and maintenance of the projects.

Fish baskets, an experimental technology, may provide habitat on bulkheads.

Action C1: Conservation Easement Acquisition and Wetland Purchase

Applicable River Sections: All

Goals Addressed: 1, 2, 3

Procedure: Conservation easements are tools used to help protect land in perpetuity. An easement can be used to restrict the use of property for certain purposes, and to protect a property from inappropriate uses. Essentially, one sells or donates the right to certain uses of the property, or portion of property, to a third party, generally with an interest in conserving the land. Easements can also be obtained through property owner donation and acquisition of priority preservation areas can also be obtained through agreeable property owner donation. Ideally, all activities undertaken by this plan should be secured through a conservation easement. Achieving that goal may take quite some time. We present here a plan to secure easements on 3 wetland restoration sites, to protect these sites in perpetuity. The city desires that easements for this project be held by the Lighthouse Foundation, a local trust dedicated to preservation in the Lorain area. Any group accepting and managing the conservation easements recommended by this plan should have the capability to handle the nuances and requirements peculiar to conservation easements. These requirements include an ability to understand the conservation needs of the resource, and to handle potential maintenance issues. Any group accepting conservation easements should have a history of managing natural areas. Easements may be written with some flexibility, allowing some very low impact activities such as appropriate trail construction. All conservation easements need to be written with protecting the resource as the primary goal, any other activities contemplated for these areas must be viewed in light of the main reason for the easement, which is protection of the resource. Examples of groups currently handling conservation easements include county conservation districts, parks departments (such as the Lorain County Metro Parks) and land conservancies such as the Western Reserve Land Conservancy.

Reference Condition: This does not apply to this action.

Project Sites: A total of just over 100 acres of wetland restoration and other conserved lands would be protected through this action.

- C1-1: Purchase the 12 acre wetland at the Henderson Road Bridge. $600,000. Predicted LQHEI: 62.
- C1-2: Secure an easement on 12 acres at the Henderson Bridge wetland. $60,000. Predicted LQHEI: 62.
- C1-3. Secure an easement on the 25 acre Heron Rookery. $125,000. Predicted LQHEI: 53.
- C1-4: Secure an easement on the existing 0.35 acre fish shelf at Black River Landing. $1,750. Predicted LQHEI: 57.
- C1-5: Secure an easement on 12.7 acres at the proposed Colorado Industrial Park wetland. $63,500. Predicted LQHEI: 61.
- C1-6: Secure an easement on 50 acres at the proposed wetland at the mouth of French Creek. $250,000. Predicted LQHEI: 56.5.

Estimated Costs: Easements are estimated at $5,000 per acre. Purchase price for the Henderson Road Bridge Wetland is estimated at $50,000/acre.

Total Estimated Construction Costs: $1,750 to $1,100,250.

Permitting Requirements: None required

Implementation Requirements: An agency must be designated to receive and manage the easements. The city is working with the Lighthouse Foundation to receive and manage these easements associated with this plan. Funding can come from mitigation dollars or grant money associated with the wetland restoration.

Action C2: Best Management Practices for Developers

Applicable River Sections: All (not shown on *Figures 2.4* through *2.6*)

Goals Addressed: 1, 2, 3

Procedure: Completion of the activities in this plan will require considerable investments of time, energy and money, and will result in substantial improvement in the ecological health of the river. In order to maintain that health, it will be necessary to ensure that certain best management practices are put into place. We recommend that the city implement zoning regulations to require that new developments use the best available technologies for managing stormwater runoff. Bioswales, raingardens, permeable pavement and other techniques should be required where appropriate. A toolbox of recommended BMPs appears in Appendix C.

Reference Condition: There are a variety of nearby cities and institutions that have such BMPs installed and operating. Excellent examples of parking lot BMP's may be seen at Kent State University. The Chagrin River Watershed Partners can provide additional local examples.

Project Sites: This action should apply to all new development activities within the project area.

Estimated Costs: Costs vary depending on the specific practice.

Total Estimated Construction Costs: Will depend upon the final number of activities undertaken.

Permitting Requirements: No special permits required, construction activities would be covered under the construction permit issued for the project on which the BMP is being applied.

Implementation Requirements: The City of Lorain will need to take steps to ensure that the BMPs are implemented.

Bioswales are constructed areas filled with permeable soils and native plants, they help control and treat stormwater runoff.

Action C3: Suggested Regulatory Protections

Applicable River Sections: All (Not shown on Figures 2.1 through 2.3)

Goals Addressed: 1, 2, 3

Procedure: Truly protecting the investment made by the projects outlined in this plan will require legal authority. Examples of regulations that will protect the Black River include changes to zoning, setback regulations, and new rules for development that codify requirements for best management practices. Some regulations are currently in place. The city has a strong riparian setback ordinance, and a good ordinance for planned unit developments (PUDs). The city should encourage the use of appropriate BMPs through enacting appropriate development regulations and ordinances. The intent of this plan is not to propose regulations that are so stringent that development is constrained.

Reference Condition: This does not apply to this action.

Project Sites: This action should apply to all sites within the project area.

Implementation Timeline: These regulatory protections will be implemented through the life of the plan.

Estimated Costs: NA

Total Estimated Construction Costs: NA

Permitting Requirements: None required

Implementation Requirements: The city of Lorain will determine those regulations best suited to protect the investment in improving the river's health.

Summary of All Actions

Table 2.1 provides a summary of all the proposed actions. Each action is listed, the section of the river to which it applies, the amount (generally acres or feet) of each action at each location, a unit cost and an estimated cost. Unit costs were derived from standard construction references and URS' experience with these restoration techniques. The locations of the actions are shown in *Figures 2.4* through *2.6*

Table 2.1. Summary of Actions (Site codes are keyed to *Figures 2.4* through *2.6*).									Goals Addressed			
Site Code	Action	Description page	Amount	Unit cost	Total cost	Existing LQHEI	Predicted LQHEI	Ranking points	1	2	3	4
C1-1	Purchase Henderson Road Bridge Wetland	44	12 acres	$50,000/acre	$600,000	62	62	162.75		✓	✓	✓
A3-1	Wetland Restoration Henderson Road Bridge Wetland	32	12 acres	$25,000/acre	$300,000	62	75	144.38		✓		✓
B1-1	Invasive Species Removal Henderson Road Bridge Wetland	40	5.87 acres	$10,000/acre	$58,700	62	75	144.38		✓		✓
C1-2	Easement Acquisition, Henderson Road Bridge Wetland	44	12 acres	$5,000/acre	$60,000	62	62	144.38	✓		✓	✓
A4-1	Streambank Stabilization	35	257 feet	$125/foot	$32,125	53	58	115.94	✓			✓
C1-3	Purchase Easement on the Heron Rookery	44	25 acres	$5,000/acre	$125,000	53	53	115.94	✓		✓	✓
C1-4	Easement Acquisition, Black River Landings	44	0.35 acres	$5,000/acre	$1,750	57	57	99.75	✓		✓	✓
A3-2	Wetland Restoration /Construction, North Shore, Colorado Industrial Park	32	12.7 acres	$60,000/acre	$762,000	51	61	91.5	✓	✓		✓
A4-2	Streambank Stabilization	35	408 feet	$125/foot	$51,000	51	61	91.5	✓			✓
B1-2	Invasive Species Removal,	40	11.42 acres	$10,000/acre	$114,200	51	61	91.5	✓			✓
C1-5	Easement Acquisition, wetland A3-2	44	12.7 acres	$5,000/acre	$63,500	51	61	91.5	✓		✓	✓
B1-3	Invasive Species Removal	40	1.86 acres	$10,000/acre	$18,600	52	57	85.5	✓			✓
B3-1	Fish Baskets and Floating Wetlands	43	300	$250 each	$75,000	52	32	85.5	✓			✓
A3-3	Wetland Restoration/Construction	32	50 acres	$75,000/acre	$3,750,000	46.5	56.5	84.75		✓		✓
C1-6	Easement, wetland A3-3	44	50 acres	$5,000/acre	$250,000	46.5	56.5	84.75	✓		✓	✓
A2-1	Slag Pile Remediation	31	759 feet	$500/foot	$379,500	47	59	73.75	✓			✓
A5-1	Slag Pile Stabilization	37	105 acres	$45,500/acre	$4,777,500	46.5	58.5	73.13		✓		✓
A1-1	Fish Shelves	29	1,155 feet	$200/foot	$231,000	26	57	71.25		✓		✓
A1-2	Fish Shelves	29	436 feet	$200/foot	$87,200	14	57	71.25		✓		✓
A1-3	Fish Shelves	29	60 feet	$200/foot	$12,000	35	57	71.25		✓		✓
A6-1	Bulkhead Habitat	38	7,896 feet	$1,500/foot	$11,844,000	11	57	71.25	✓		✓	✓
B2-1	Submerged Aquatic Plantings	42	12.2 acres	$10,200/acre	$124,440	58	62	68.2	✓			✓

Table 2.1. Summary of Actions (Site codes are keyed to *Figures 2.4* through *2.6*).									Goals Addressed			
Site Code	Action	Description page	Amount	Unit cost	Total cost	Existing LQHEI	Predicted LQHEI	Ranking points	1	2	3	4
A4-3	Streambank Stabilization	35	1,357 feet	$125/foot	$169,625	40.75	53	66.25		✓		✓
A1-4	Fish Shelves	29	3,463 feet	$200/foot	$692,600	56.5	59.5	65.45	✓			✓
B1-4	Invasive Species Removal	40	1.35 acres	$10,000/acre	$13,500	58	59	64.9	✓			✓
A2-2	Slag Pile Remediation	31	4,660 feet	$500/foot	$2,330,000	46.5	51.5	64.38		✓		✓
A4-4	Streambank Stabilization	35	1,491 feet	$125/foot	$186,375	47	54	59.4	✓			✓
A4-5	Streambank Stabilization	35	717 feet	$125/foot	$89,625	47	54	59.4	✓			✓
A4-6	Streambank Stabilization	35	1,859 feet	$125/foot	$232,375	47	54	59.4	✓			✓
A4-7	Streambank Stabilization	35	1,232 feet	$125/foot	$154,000	43	52	57.2		✓		✓
A1-5	Fish Shelves	29	1,900 feet	$200/ foot	$380,000	47	51	56.1		✓		✓
A4-8	Streambank Stabilization	35	262 feet	$125/foot	$32,750	44.75	51	56.1		✓		✓
A4-9	Streambank Stabilization	35	700 feet	$125/foot	$87,500	42.5	50	55	✓			✓
B3-2	Fish Baskets and Floating Wetlands	43	700	$250 each	$175,000	45	32	55	✓			✓
A4-10	Streambank Stabilization	35	833 feet	$125/foot	$104,125	40	49	53.9		✓		✓
A4-11	Streambank Stabilization	35	1,174 feet	$125/foot	$146,750	33	48	52.8		✓		✓
A4-12	Streambank Stabilization	35	1,156 feet	$125/foot	$144,500	38	43	47.3		✓		✓
A2-3	Slag Pile Remediation	31	1,003 feet	$500/foot	$501,500	33	41	45.1		✓		✓
A4-13	Streambank Stabilization	35	534 feet	$125/foot	$66,750	38	41	45.1		✓		✓
B3-3	Floating Wetlands	43	0	NA	$30,000	14	45	29.7	✓			✓
B3-4	Fish Baskets and Floating Wetlands	43	100 baskets	$250 each	$25,000	14	32	29.7	✓			✓

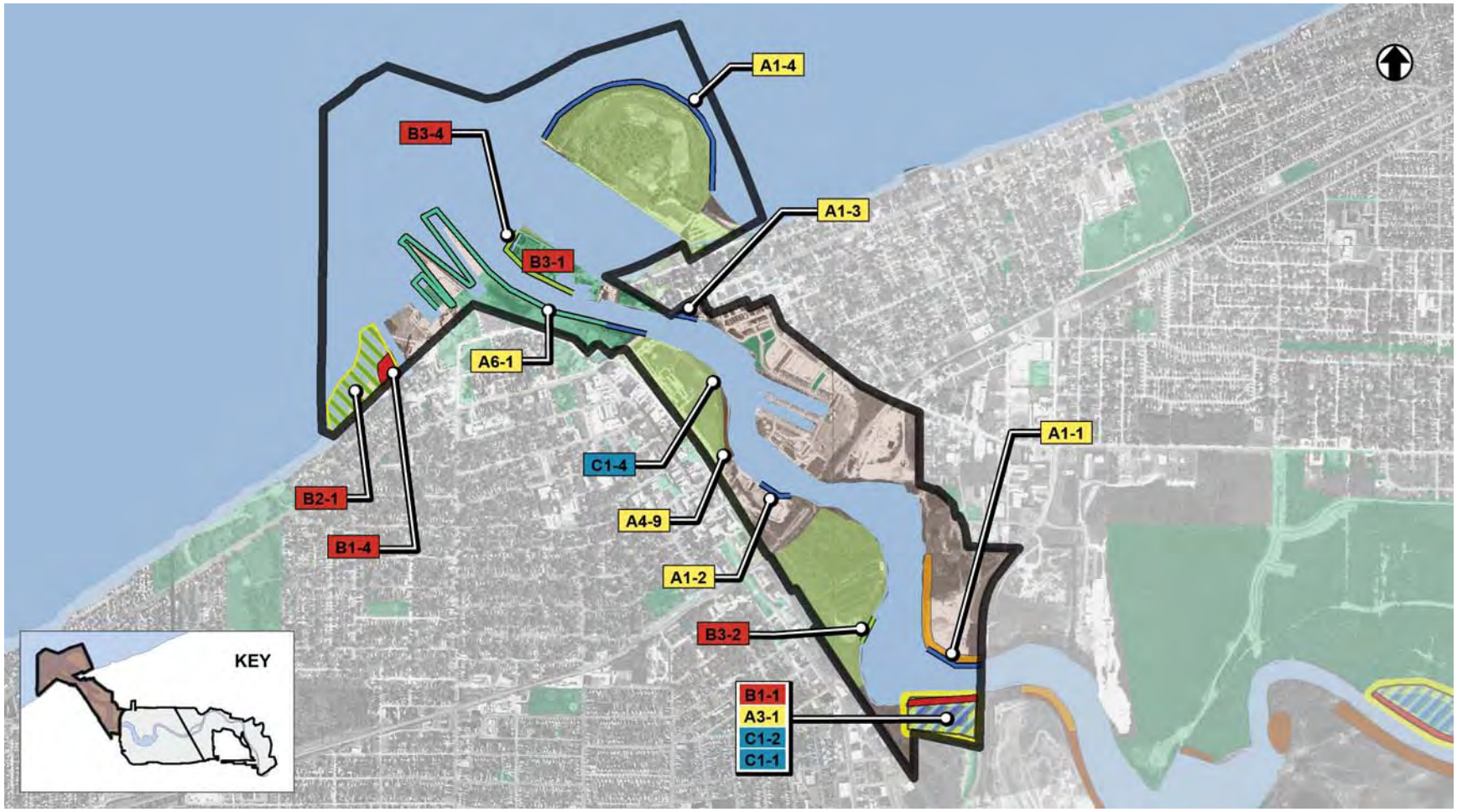


Figure 2.4 – Action Locations, Section 1.

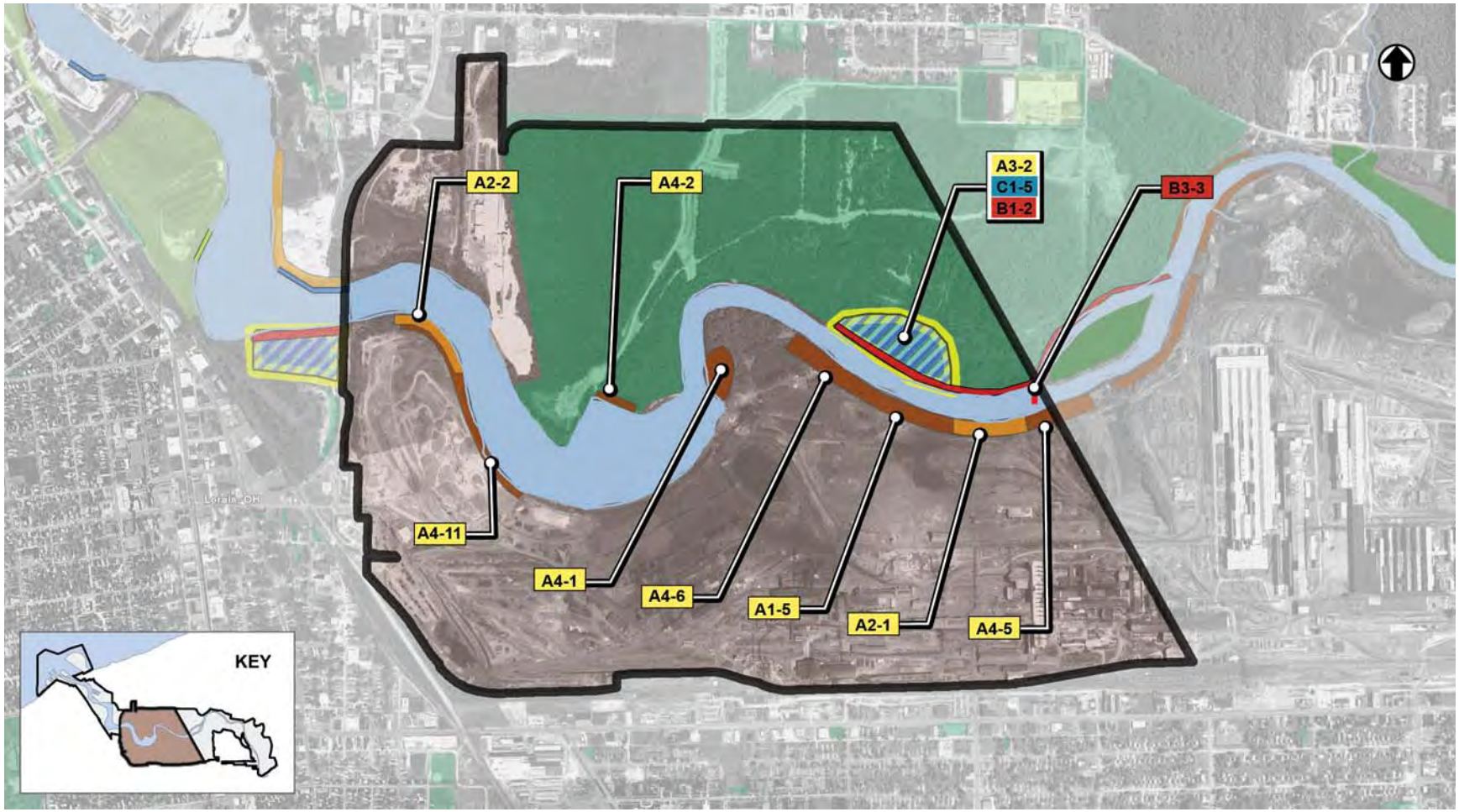


Figure 2.5 – Action Locations, Section 2.

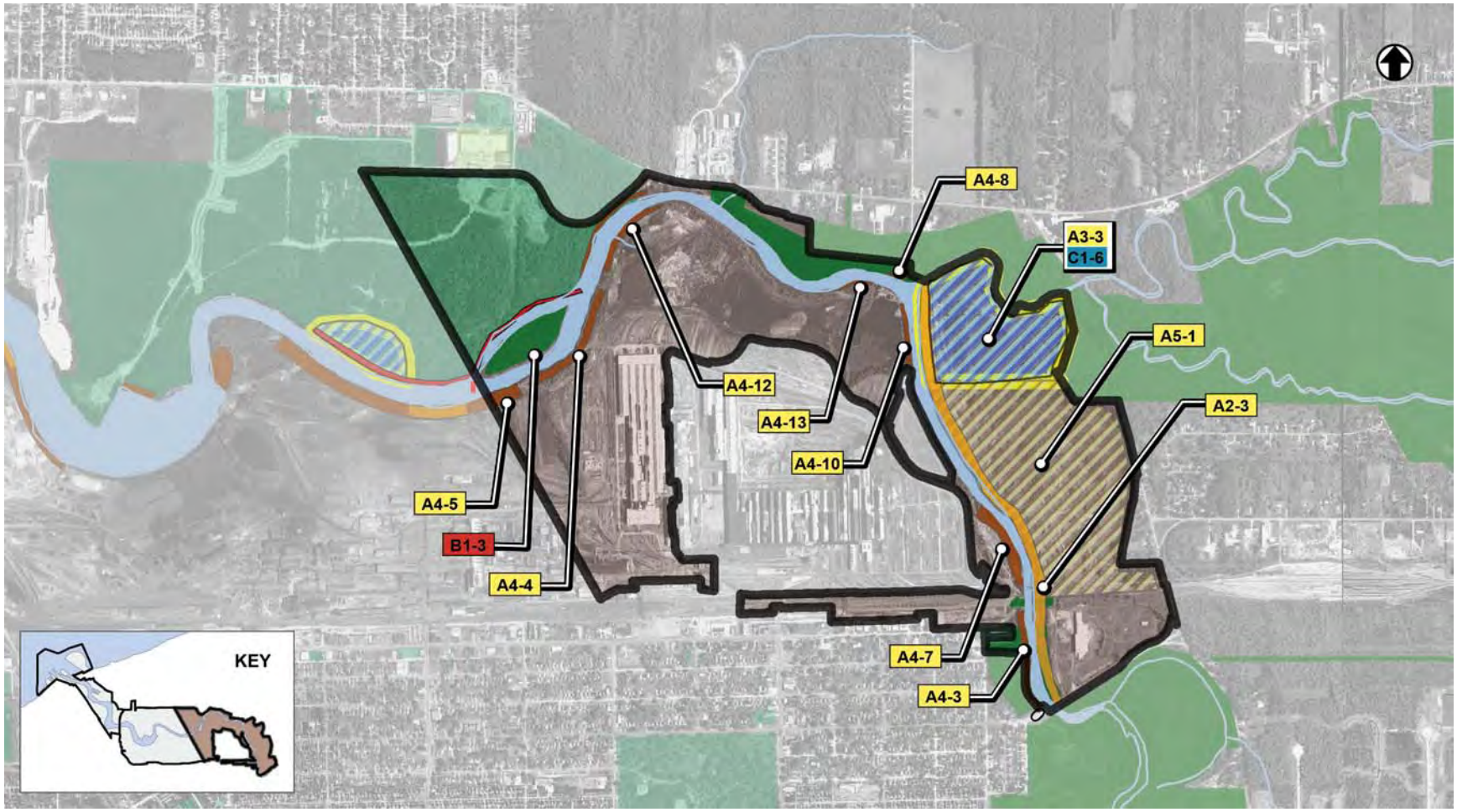


Figure 2.6 – Action Locations, Section 3.

Summary of Costs by Action and Section

Twelve habitat restoration action categories have been suggested to restore ecological health to the Lower Black River. This plan suggests 41 sites on which these actions could take place. *Table 2.2* shows the breakdown of the costs of actions by section. Section 1 is the site of 16 proposed actions, totaling $14,387,690. Thirteen actions were proposed for Section 2, for a total of $4,736,075. Section 3 is the site of 12 actions, totaling $10,155,725. The average baseline LQHEI score for the entire project area was 39.4. If all actions are implemented, the resulting final LQHEI is estimated at 54.04, which is slightly under the goal of 55 established by the Black River RAP. The predicted LQHEI scores are intentionally conservative. Actual scores may be higher, and with proper maintenance, most scores would be expected to increase over time. In any event, and increase in the average LQHEI score from the current 39.4 to 54.05 would represent a substantial improvement in the condition of the Lower Black River.

Table 2.2. Summary of Costs by Action and Sections.

Action		Section 1	Section 2	Section 3	Total
A1	Fish Shelves	$1,022,800	$380,000		$1,402,800
A2	Slag Pile Remediation		$2,709,500	$501,500	$3,211,000
A3	Wetland Restoration or Construction	$300,000	$762,000	$3,750,000	$4,812,000
A4	Streambank Stabilization	$87,500	$551,875	$858,125	$1,497,500
A5	Slag Pile Stabilization			$4,777,500	$4,777,500
A6	Bulkhead Habitat	$11,844,000			$11,844,000
B1	Invasive Species Removal	$72,200	$114,200	$18,600	$205,000
B2	Submerged Aquatic Plantings	$124,440			$124,440
B3	Fish Baskets and Floating Wetlands	$275,000	$30,000		$305,000
C1	Easement Acquisition/Wetland Purchase	$661,750	$188,500	$250,000	$1,100,250
Grand Total		**$14,387,690**	**$4,736,075**	**$10,155,725**	**$29,279,490**

Meeting the Economic Goals

The actions described in the preceding pages were selected in order to help achieve the restoration of ecological function in the Lower Black River. Economic and societal factors have been forcing fundamental changes in Lorain; the industrial base on which the city was built has deteriorated, jobs have been lost and businesses have moved away. All parties involved in development of the plan firmly believe that ecological restoration and economic recovery are inextricably linked. Building on the successes achieved so far in cleaning up the river, this plan is another important step in recovery. Economic recovery will of course depend on factors well beyond the scope of this plan, but the ecological restoration should provide a vital new impetus to help stimulate appropriate growth and development in the river corridor.

Creating a thriving downtown Lorain depends upon restoring the Lower Black River.

Completing the actions described in this plan will have direct economic effects. There are real costs associated with untreated urban runoff. This plan outlines steps to help ensure that runoff volumes are decreased, and that pollutants common to urban run off are removed and treated.

In the Process section we discussed the link between intact ecological systems and property values. Around the country it has been demonstrated that property values are enhanced by the presence of intact natural areas and green space in communities. Undertaking and completing these restoration efforts will send an important message to the business community, by showing the City of Lorain's commitment to its future.

Growing a More Livable Lorain

In addition to providing habitat for aquatic and some terrestrial species, carrying out the actions outlined in this plan will result in a more livable human environment. There is already resurgence in interest in the river. The Lorain Port Authority began boat tours on the river. These have gained popularity each year, and through the tours residents and visitors are discovering the beauty of the natural systems along the Black River. Lorain County Metro Parks has a trail system that now extends past the confluence of French Creek and the Black River, through most of Section 3 of this plan. This trail brings visitors through natural areas and near industrial sites, allowing people to really experience the history of the river. Accomplishing the restoration efforts outlined in this plan can help provide additional links along the trail, which is planned to eventually reach Lake Erie near the Confined Disposal Facility.

As the river and its banks recover, people will naturally be attracted to the water's edge. As the restored areas mature and their plant communities grow and become stabilized, access to many of the areas should be provided. Residents of Lorain have lived for a long time with an industrial river to which they had little access. The restored areas suggested here can continue the trend begun by the city, Port Authority and Lorain County Metro Parks in giving the river back to the people of Lorain.

We recommend that the city take advantage of the educational opportunities offered by the restoration efforts in this plan. Signs can be developed and installed as the activities are constructed. These could describe the actions being taken, illustrate potential benefits, and list the people and agencies involved. Once the individual actions are carried out, permanent signs could be installed to point out various aspects of the restoration.

Ensuring the Plan is Carried Out

The City of Lorain has been a key partner throughout this process. The Lorain Utilities Department, and the Lorain Port Authority, will be the lead agencies who will shepherd this plan and see the actions through to completion. The plan has the support of the Mayor and city administration. Current plans call for the Ecological Restoration Master Plan to be adopted by the Lorain City Council, and endorsed by the Lorain Port Authority.

Several ambitious plans have been developed for Lorain, including this rendering from the 2003 Lorain Harbor Shoreline Master Plan. Attaining such a vision depends upon first restoring the health of the Black River.

The desire is that the plan will be used as a "yardstick" against which all actions that the city takes within the river corridor will be measured against. The areas immediately adjacent to the river banks should be protected to the greatest degree possible. This plan suggests several areas where streambank restoration efforts should be undertaken, where slag and other materials associated with steel making have been deposited, and where wetlands could be constructed.

The Lorain Port Authority's Black River Landing facility is helping to bring new vitality to the river front.

The city already has important rules in place to protect the nearshore areas. Lorain's Riparian Setback ordinance protects this ecologically important area. *Figure 2.4* shows the 300 foot riparian setback in the project area. Enforcement of this ordinance will be a key to helping ensure the gains made through ecological restoration will be maintained over time. When developers request variances to strictures outlined in the Riparian Setback, the requests should be judged against the recommendations of this plan to help determine the potential effects on the river.

New development in the former industrial areas along the Black River is anticipated, in fact encouraged, by all involved in this planning effort. New developments must be appropriately situated though, again in order to help protect the investment made in restoration here. Areas immediately adjacent to the river should be kept in as natural a condition as possible. This plan strongly encourages the implementation of best management practices to control stormwater in new developments. Further, these same ideas should be retrofitted into existing developments in the study area. Appendix C contains a selection of BMPs that are appropriate, and a guide to choosing the appropriate BMPs for specific applications.

This plan lists no specific timeframes in which the actions should be accomplished. As a practical matter, these actions will be undertaken as funds are identified to pay for them. Funds will probably come from a variety of sources, examples of which are outlined in the following pages of the plan.

The plan should be reviewed by the city, the Black River RAP, Ohio EPA and U.S. EPA every five years, to review progress and examine priorities for the coming period.

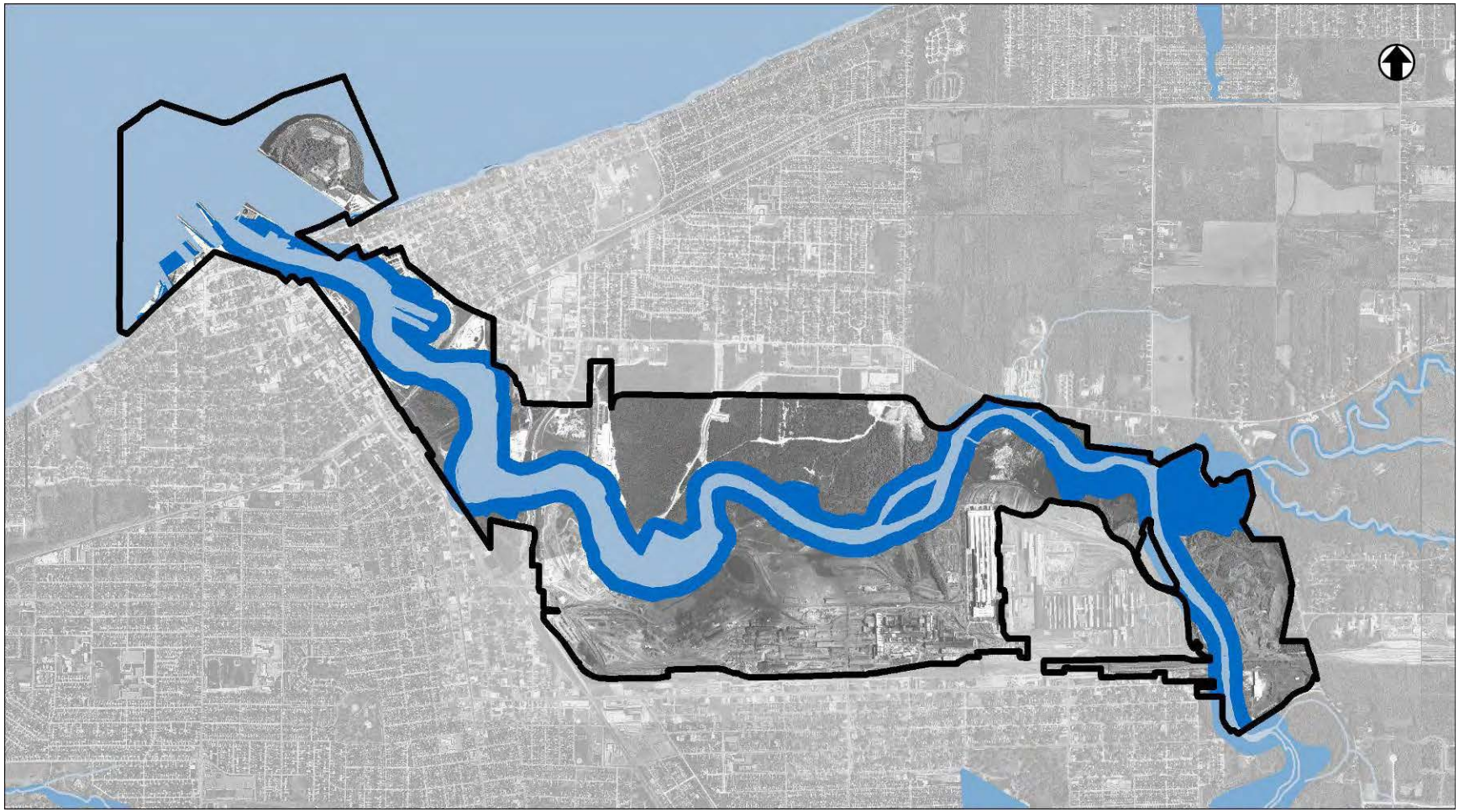


Figure 2.4 – The Riparian Setback within the Project Area. The dark blue area shows the extent of the setback, which is set at 300 feet from the river banks, and broadened to include the 100 year floodplain where the floodplain extends beyond the 300 foot setback.

Funding the Ecological Restoration Master Plan

In this section, we provide a brief overview of potential sources of funds to implement recommended actions. *Table 2.3* at the end of this section, identifies contacts for further information regarding each of these funding sources. Potential sources of funds include:

- **Great Lakes Restoration Initiative:** To accelerate the restoration of the Great Lakes, Congress is finalizing a $400-$475 Million inter-agency initiative to address issues that affect the Great Lakes, such as invasive species, non-point source pollution, and toxics and contaminated sediment. The Initiative builds upon five years of work by the Great Lakes Interagency Task Force (IATF) and stakeholders, guided by the Great Lakes Regional Collaboration Strategy. The Initiative will focus five areas:
  - Toxic Substances and Areas of Concern
  - Invasive Species
  - Nearshore Health and Nonpoint Source Pollution
  - Habitat and Wildlife Protection and Restoration
  - Accountability, Monitoring, Evaluation, Communication, and Partnerships

  The U.S. Environmental Protection Agency will be the lead for the program but will be assisted by 15 other federal agencies. Program is expected late fall 2009.

- **The Clean Ohio Green Space Conservation Program:** Funds preservation of open spaces, sensitive ecological areas, and stream corridors. Special emphasis was given to projects that:
  - Protect habitat for rare, threatened or endangered species;
  - Preserve high quality wetlands and other scarce natural resources;
  - Preserve streamside forests, natural stream channels, functioning floodplains, and other natural features of Ohio's waterways;
  - Support comprehensive open space planning;
  - Secure easements to protect stream corridors, which may be planted with trees or vegetation to help reduce erosion and fertilizer/pesticide runoff;
  - Enhance eco-tourism and economic development related to outdoor recreation in economically challenged areas;
  - Provide pedestrian or bicycle passageways between natural areas and preserves;
  - Reduce or eliminate nonnative, invasive plant and animal species;
  - Provide safe areas for fishing, hunting and trapping in a manner that provides a balanced eco-system.

Hibiscus and other wetland species thrive in the Henderson Road Bridge wetland, an area that could benefit from restoration funds.

- **Ohio Water Resources Restoration Sponsorship Program (WRRSP):** The goal of the WRRSP is to counter the loss of ecological function and biological diversity that jeopardizes the health of Ohio's water resources. The WRRSP seeks to achieve this goal by providing funds, through Water Protection Control Loan Fund (WPCLF) loans, to finance planning and

implementation of projects that protect or restore water resources, ensuring either maintenance or attainment of designated aquatic life uses under Ohio Water Quality Standards. Restoration activities to be undertaken through the WRRSP may focus on biological habitat issues and may range from the preservation and protection of stream and other aquatic habitats to intensive repair and recovery of such impaired habitats. Total of $15 million is proposed for financing WRRSP projects for the next program year. The $15 million announced for 2009 (2010 has not been announced yet) will be divided equally between two categories: a) protection category, and b) restoration category. The WRRSP sponsor will receive a 0.1 percent interest rate discount on its water treatment plant financing, which will reduce its total loan repayments below that which would be required without the WRRSP sponsorship.

- **Environmental Infrastructure for Ohio (594 Program), U.S. Army Corps of Engineers (USACE):** The primary objective of the Section 594 Program is to provide design and construction assistance to non-federal interests for carrying out water-related environmental infrastructure and resource protection and development projects in the State of Ohio. In the Water Resources Development Act (WRDA) of 1999 (Public Law 106-53), Section 594, Congress provided authority for water related environmental infrastructure projects on publicly held lands for the entire State of Ohio. The amount available per fiscal year changes as it is allocated by Congress.

- **Surface Water Enhancement, Restoration and Protection (SWERP) Clearinghouse:** The purpose of the SWERP Clearinghouse is to serve as a networking tool for implementation of potential surface water improvement and protection projects including restoration, protection or enhancement projects. SWERP facilitates the process of identifying potential projects that may be selected as compensation for environmental impacts to surface waters throughout Ohio. Land owners, government agencies, watershed coordinators and others may submit projects that may result in improvement and/or protection of streams, wetlands and lakes. SWERP submissions are not evaluated by Ohio EPA or other organizations prior to listing. The list of projects does not represent a list of "approved" projects. Those selecting projects from this Clearinghouse are responsible for evaluating the listed projects and Ohio EPA will ultimately review them as part of the review of the applicant's permit application or by other entities responsible for implementing surface water protection initiatives.

- **Supplemental Environmental Project (SEP):** Supplemental Environmental Projects (SEPs) are projects funded from the fines imposed upon entities for environmental violations in Ohio by the Ohio EPA. When enforcement occurs, Ohio EPA can fine violators. Those fines can be either paid directly to the State of Ohio or can be used to pay for SEP's. This choice is completely up to the entity being fined. Projects can include restoration and preservation.

- **Aquatic Ecosystem Restoration Section 206**, **USACE:** Under Section 206 (WRDA), the USACE is authorized to study, design, construct projects to restore or protect the aquatic ecosystem for the purpose of improving environmental quality when in the public interest, when the project is cost effective, and when the project does not involve more than $5,000,000 in federal contribution.

- **Partners for Fish and Wildlife (Grant):** The Partnerships for Wildlife Act authorized the establishment of the Wildlife Conservation and Appreciation Fund to receive appropriated funds and donations from the National Fish and Wildlife Foundation and other private sources. The fund may be used to provide grants to states to benefit a broad array of diverse fish and wildlife species and to provide non-consumptive fish and wildlife recreation opportunities. Appropriate state agencies are

the only entities eligible to receive grant funds.

- **National Fish and Wildlife Foundation - General Matching Grant Program:** The National Fish and Wildlife Foundation funds projects to conserve and restore fish, wildlife, and native plants through matching grant programs. The Foundation awards matching grants to projects that address priority actions promoting fish and wildlife conservation and the habitats on which they depend, work proactively to involve other conservation and community interests, leverage Foundation-provided funding, and evaluate project outcomes. Federal, state, and local governments, educational institutions, and nonprofit organizations are welcomed to apply for a general matching grant throughout the year.

- **The Five Star Restoration Program:** Brings together students, conservation corps, other youth groups, citizen groups, corporations, landowners and government agencies to provide environmental education and training through projects that restore wetlands and streams. The program provides challenge grants, technical support and opportunities for information exchange to enable community-based restoration projects. Funding levels are modest, from $5,000 to $20,000, with $10,000 as the average amount awarded per project. However, when combined with the contributions of partners, projects that make a meaningful contribution to communities become possible. At the completion of Five Star projects, each partnership will have experience and a demonstrated record of accomplishment, and will be well-positioned to take on other projects. Aggregating over time and space, these grassroots efforts will make a significant contribution to our environmental landscape and to the understanding of the importance of healthy wetlands and streams in our communities.

- **Mitigating Impacts on Aquatic Resources in Ohio:** Funds may be available from project sponsors who are required to provide compensatory mitigation for fills or other discharges into Waters of the State. Typically, project sponsors may either complete the compensatory mitigation project themselves or may pay funds to a third party who may either through a mitigation bank or In-lieu fee program, provide and maintain the mitigation. With the new USACE rules, greater emphasis is placed on selecting sites identified in an approved watershed plan or selected on the basis of implementing the watershed approach as identified in the revised mitigation rules published in April 2008.

- **R&D Grants, Ohio Water Development Authority (OWDA):** Pursuant to its power to engage in research and development with respect to wastewater, water management facilities, solid waste facilities, and energy resource development facilities, OWDA has established a grant program for qualifying research and development programs. The eligible participants are local government agencies that perform research and/or development. Projects for which grants are awarded must be of such a nature that the benefits to be derived fulfill a general need in the state of Ohio that is within the scope of the powers of the OWDA. Grants are subject to available funds and recommendation by the director of a department of the state government which is responsible for oversight. Priority will be given to projects that have statewide environmental and/or natural resource applications, and grantees must submit a final report. The Cuyahoga RAP used this program to investigate re-aeration technology.

- **Section 319 grant funds:** Intended to correct water quality impairments caused by non-point source pollution discharged to Ohio's surface waters. Section 319(h) implementation grant funding is targeted to Ohio waters where NPS pollution is a significant cause of aquatic life use impairments. The cornerstone of Ohio's 319 program is working with watershed groups and others who are implementing locally developed

watershed management plans and restoring surface waters impaired by NPS pollution. Projects that are identified within completed TMDL reports, state-endorsed watershed plans and/or AMDAT plans that eliminate impairments and/or restore impaired waters will receive higher consideration than projects submitted from watersheds without any of the above plans. Sample projects include:

- Stream Restoration and/or Renaturalization Projects
- Wetland Restoration and/or Renaturalization Projects
- Riparian Restoration Projects
- Riparian and Wetland Protection and Conservation Easement Projects

- **The Coastal and Estuarine Land Conservation Program (CELCP):** Grants are made to eligible state agencies and local governments to acquire property or conservation easements from willing sellers within a state's coastal zone. Preference is given to projects which protect important coastal and estuarine areas that have significant conservation, ecological, historical, aesthetic, or recreation values, or that are threatened by conversion from their natural or recreational state to other uses. The CELCP program is administered as a three-stage process: development of a state CELCP plan, a state competitive process to identify top projects (run by the state's lead agency), and a national peer-review competition.

- **Ohio Brownfield Grant Program**: The State has two sources of funds available under its Clean Ohio brownfield program; the Clean Ohio Revitalization Fund (CORF); and the Clean Ohio Assistance Fund (COAF). CORF is a competitive grant where applications are pooled into rounds and the top projects in each round receive funding. Under COAF, projects are individually evaluated by the Director of the Department of Development. After a site has been designated a brownfield, the Clean Ohio Revitalization or Assistance Fund can provide grant money for a range of activities, including asbestos surveys, demolition, removal of contaminated soil and groundwater, Phase II environmental assessments, and a host of other remediation activities. When the standards of the Ohio Voluntary Action Program (VAP) are met, a property can earn a No Further Action (NFA) letter prepared by a Certified Professional. This letter will be reviewed by the Ohio EPA, who issues a Covenant Not to Sue (CNS) for the property, giving economic interests the confidence to develop there.

No matter the source of funds sought, any application for funding should make reference to this Restoration Master Plan. State and federal funding agencies are more likely to look favorably on applications that request funds to meet goals of established plans such as this. Specific mention should be made of particular actions and potential project sites discussed in this plan.

Table 2.3. Contacts for Potential Funding Sources.			
Source	**Contact**	**Source**	**Contact**
Great Lakes Restoration Initiative	U.S. Environmental Protection Agency Great Lakes National Program Office 77 W. Jackson Boulevard (G-17J) Chicago, Illinois 60604-3511 http://www.epa.gov/glnpo/glri/ (312) 353-2117 - Telephone	National Fish and Wildlife Foundation - General Matching Grant Program	1133 Fifteenth St. N.W., Suite 110 Washington, D.C. 2005 (202) 857-0162 http://www.nfwf.org/AM/Template.cfm?Section=GrantPrograms
The Clean Ohio Green Space Conservation Program	District 9, Natural Resources Advisory Council Steve Hambley - Chair 144 North Broadway Medina, OH 44256 shambley@apk.net (330) 722-9208	The Five Star Restoration Program	USEPA Wetlands Division Room 6105 (4502 T) 1200 Pennsylvania Avenue, NW Washington, DC (202) 566-1225 http://www.epa.gov/wetlands/restore/5star/
Ohio Water Resources Restoration Sponsorship Program (WRRSP)	Division of Environmental and Financial Assistance, Ohio Environmental Protection Agency 50 West Town Street, Suite 700 Columbus, OH 43215 (614) 644-2798 http://www.epa.state.oh.us/defa/09wrrsp.aspx	Mitigating Infrastructure Impacts to Aquatic Resources in Ohio	USACE – Buffalo District 1776 Niagara Street Buffalo, NY 14207-3199 716-879-4363 http://www.lrb.usace.army.mil/orgs/reg/reg-bro.htm#19 Division of Surface Water Street Address: 50 West Town Street, Suite 700 Columbus, OH 43215 Phone: (614) 644-2001 http://www.epa.state.oh.us/dsw/401/mitigation.aspx
Environmental Infrastructure for Ohio (594 Program), USACE	LRH Planning U.S. Army Corps of Engineers, Huntington District 502 Eighth Street Huntington, WV 25701-2070 (304) 399-5636 http://www.lrh.usace.army.mil/projects/current/section594/	R&D Grants, Ohio Water Development Authority	Ohio Water Development Authority 480 S High St Columbus OH 43215 (614)-466-5822 http://www.owda.org/owda0001.asp?PgID=pi-randdgrants
Surface Water Enhancement, Restoration and Protection (SWERP) Clearinghouse	Beth Bailik Ohio EPA Division of Surface Water 50 West Town Street, Suite 700 P.O. Box 1049 Columbus, OH 43216-1049 (614) 644-2039 http://www.epa.ohio.gov/dsw/swerp/index.aspx	Section 319 grant funds	Russ Gibson Nonpoint Source Section Manager Ohio EPA, Division of Surface Water 50 West Town Street, Suite 700 Columbus, Ohio 43216-1049 (614) 644-2020 http://www.epa.ohio.gov/dsw/nps/319Program.aspx

Table 2.3. Contacts for Potential Funding Sources.			
Source	**Contact**	**Source**	**Contact**
Supplemental Environmental Project (SEP)	Linda Merchant-Masonbrink Ohio EPA Division of Surface Water 50 West Town Street, Suite 700 P.O. Box 1049 Columbus, OH 43216-1049 (614) 644-2135 http://www.epa.ohio.gov/dsw/swerp/index.aspx	The Coastal and Estuarine Land Conservation Program (CELCP)	Elaine Vaudreuil NOAA Ocean Service, Office of Ocean and Coastal Resource Management, 1305 East West Highway Silver Spring, MD 20910 (301)-713-3155 x103 http://coastalmanagement.noaa.gov/land/celcp_indepth.html#CELCPeligibility
Aquatic Ecosystem Restoration Section 206	Mr. Michael J. Greer, USACE – Buffalo District Continuing Authorities Program Manager, Planning Branch 1776 Niagara Street Buffalo, NY 14207 (716)-879-4229 http://www.lrb.usace.army.mil/missions/Section%20206%20Flyer.doc	Ohio Brownfield Grant Program	Ohio Department of Development Urban Development Division 77 S. High St., 26th Floor Columbus, OH 43215-6130 (614) 995-2292 http://clean.ohio.gov/BrownfieldRevitalization/
Partners for Fish and Wildlife Program	Kurt Waterstradt U.S. Fish & Wildlife Service 771 East Main St. Suite 102 Newark, OH 43055 (740)-670-5312 http://www.fws.gov/partners/		

3. LITERATURE CITED

Anderson, D.M. 1982. Plant Communities of Ohio: A Preliminary Classification and Description. Division of Natural Ares and Preserves, Ohio Department of Natural Resources, Columbus, Ohio.

Andreas, B.K. 1989. The vascular flora of the Glaciated Allegheny Plateau Region of Ohio. Ohio Biol. Surv. Bull. New Series Vol. 8 No. 1.Boddy, J.J. 2002. Upper Black River Watershed Project. Lorain County General Health District Final Report.

Boddy, J.J. 2002. Upper Black River Watershed Project. Lorain County General Health District Final Report.

Collins, A. R. Rosenberger and J. Fletcher. 2005. The economic value of stream restoration. Water Resources Research. 41.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and Deepwater habitats of the United States. Office of Biol. Services, U.S. Fish and Wildlife Service, Washington, D.C. 103 p.

Fiscenich. J.C. 2001. Technologies for urban stream restoration and watershed management. Ecosystem Management and Restoration. Bulletin no. 01-1.

Leggett, C.G. and N. E. Bockstael. 2000. Evidence of the effects of water quality on residential land prices,. Journal of Environmental Economics and Management. 39:2.

Mahan, B.L., S. Polasky and R.M. Adams. 2000. Valuing urban wetlands: a property price approach. Land Economics. 76 (1).

Ohio Environmental Protection Agency (Ohio EPA). No date. Methods of Assessing Habitat in Lake Erie Shoreline Waters Using the Qualitative Habitat Evaluation Index (QHEI) Approach. Division of Water Quality Monitoring & Assessment, Surface Water Section, Columbus, Ohio.

Ohio EPA. 2008. Total Maximum Daily Loads for the Black River Watershed. Division of Water Quality Monitoring & Assessment, Surface Water Section, Columbus, Ohio.

Ohio EPA. 1999a. Biological and Water Quality Study of the Black River Basin. Lorain and Medina Counties. Ohio EPA Technical Report Number MAS/1998-11-4

Ohio EPA. 1999b. Appendices to Biological and Water Quality Study of the Black River Basin, 1997 Lorain and Medina Counties March 31, 1999, Revised October 2, 2009 Ohio EPA Technical Report MAS/1998-11-4

Ohio EPA. 1990. The use of biological criteria in the Ohio EPA surface water monitoring and assessment program. Division of Water Quality Monitoring & Assessment, Surface Water Section, Columbus, Ohio.

Ohio EPA. 1989a. Addendum to Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Division of Water Quality Monitoring & Assessment, Surface Water Section, Columbus, Ohio.

Ohio EPA. 1989b. Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Division of Water Quality Monitoring & Assessment, Surface Water Section, Columbus, Ohio.

Ohio EPA. 1987a. Biological criteria for the protection of aquatic life: Volume I. The role of biological data in water quality assessment. Division of Water Quality Monitoring & Assessment, Surface Water Section, Columbus, Ohio.

Ohio EPA. 1987b. Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Division of Water Quality Monitoring & Assessment, Surface Water Section, Columbus, Ohio.

Pimentel, D, C. Harvey, P. Resosudarmo, K. Sinclair, D. Kurz, M. McNair, S. Crist, L. Shpritz, L. Fitton, R. Saffouri, and R. Blair.

1995. Environmental and economic costs of soil erosion and conservation benefits. Science: Vol. 267. no. 5201, pp. 1117 - 1123

Poor, P.J., K. Pessagano and R. Paul. 2007. Exploring the hedonic value of ambient water quality: a local watershed-based study. Ecological Economics. 60(4).

Rankin, E.T. 1989. The qualitative habitat evaluation index (QHEI): rationale, methods, and application. Division of Water Quality Monitoring & Assessment, Surface Water Section, Columbus, Ohio.

Reed, Jr., Porter B. 1988. National List of Plant Species That Occur in Wetlands: National Summary. U.S. Fish & Wildlife Service. Biol. Rep. 88 (24). 244 pp.

U.S. Army Corps of Engineers Buffalo District (USACE-Buffalo District). 2009. Dredged Material Management Plan and Environmental Impact Statement for Lorain Harbor, Lorain County, Ohio.

U.S. Army Engineers District (USAED) Buffalo. 1977. Assessment of Streambank Erosion for Major Streams of the Buffalo District. U.S. Army Engineer District, Buffalo, Buffalo, New York.

Appendix A

Lower Black River
Lorain, Ohio
Ecological Restoration Master Plan

APPENDIX A – AREA HISTORY AND EXISTING CONDITIONS

Early History

Earliest records of activity in the Black River Watershed indicate that the first contact by Europeans was the arrival of Jesuit missionaries in the 1600's. Early European arrivals found the area occupied by members of the Huron and Erie tribes. The southern shore of Lake Erie was apparently not home to specific tribes, but rather was used primarily as a hunting and fishing area for several tribes in the Iroquois Five Nations Alliance. Members of the Iroquois Five Nations Alliance apparently drove the Erie tribe from the south shore of Lake Erie by the mid-1600's. Surviving records from the period from the mid 1600's to the mid 1700's indicate much of northern Ohio was sparsely inhabited, due to the Iroquois Five Nations Alliance and the generally swampy terrain, which prevented Europeans from entering the area. Little archaeological material dates back to this time period.

In the late 1600's the Wyandot nation and small bands of Hurons moved into the south shore of Lake Erie and were still there in the 1800's when the area was finally settled by Europeans. The Wyandots were eventually relocated to reservations in Seneca and Sandusky Counties during the early 1800's and then moved out of Ohio around 1830. There are no active Wyandot historic sites on the Black River.

In 1786, Connecticut signed a Deed of Cession turning over most of its western lands to the Federal government, but retaining that land extending 120 miles west of the Pennsylvania-Ohio line, between the Lake Erie shore and the 41st parallel. The Black River watershed was part of this Western Reserve. Early settlers in his portion of the Western Reserve included Moravian missionaries. The first recorded permanent settlement near the current city of Lorain was established as a small trading post at the mouth of the Black River in 1807.

Connecticut eventually sold the Western Reserve to the Connecticut Land Company for $1,200,000. A member of the Connecticut Land Company, Justin Ely, started a small settlement at the current site of Elyria, Ohio, in 1817. Also in that year, Black River Township containing the City of Lorain, was mapped. Lorain County was officially established in 1822.

Shipbuilding, an important feature in the history of Lorain and the Black River, was first established in the area in 1820. Two brothers from Connecticut, whose shipbuilding business was destroyed by British raids during the War of 1812, accepted a land grant in the Western Reserve and relocated the shipyard to the mouth of the Black River. Other shipbuilders followed, by the 1830's the city was established as a center of shipbuilding on Lake Erie.

The City Grows

In the mid 1880's the Nickel Plate Railroad reached Lorain, connecting the city to markets and suppliers in the East. By the 1870's a rail connection was completed between the small city of Lorain and the Ohio River. The rail connections and the natural harbor offered by the mouth and estuary of the Black River made Lorain a convenient port and a logical location for heavy industries, including an expanded shipbuilding industry and steel making plants. Growth was rapid. By 1880 the city was home to some 1,600 people. By 1890 the population had grown to almost 5,000. In 1900, over 16,000 people called Lorain home.

Steel making, shipbuilding and other heavy industries continued to grow, and the city of Lorain along with them, through the 1970's.

Shipbuilding was established early, and became a major industry along the Lower Black River.

Current State

By the 1980's heavy industry was in decline in Lorain. Steel mills were closing. American Shipbuilding, a premier builder of Great Lakes freighters and other craft, closed in the 1980's. Currently, there are no shipbuilding operations left along the Black River. U.S. Steel and the Republic Engineered Products Plant are the remaining steel makers along the river.

In 1980, the census bureau listed just over 75,000 people in the city of Lorain. By 2000, that number had fallen to 68,652. The Census Bureau's estimate of population in 2006 was 70,592.

The Black River History

Industry, agriculture and other land uses have clearly left their marks on the Black River. Regulation of discharges to water bodies like the Black River began with the passage of the Clean Water Act in 1970. The Ohio EPA was established in 1972. In the Early 1980's, Ohio EPA and the U.S. EPA began studies of fish populations in the Black River.

A coking facility associated with the USX-USS/Kobe steel complex released polynuclear aromatic hydrocarbons (PAHs) into the River. These compounds contaminated the sediment near the coke plant and downstream, resulting in high concentrations of some PAH's (some as high as hundreds of parts per million (ppm) near the coke plant outfall). Early fish studies found a high incidence of liver and external tumors including cancers in native brown bullhead (*Ameiurus nebulosus*). Few fish appeared to survive past the age of four and none past age five. Ohio EPA issued a fish advisory and a primary contact advisory for the river during the 1980s.

When steel and coke operations began to decline after 1982, residues of PAH in bullhead caught in the Black River also declined to about one-tenth the levels found in fish captured in 1980 and 1981. Declines in tumors and cancer rates in captured fish continued to decline after coking operations ceased permanently in 1983.

Concern over pollution loads in the River, and the resulting damage to the health of fish and other aquatic organisms, led in 1984 to the listing of the Lower Black River as an Area of Concern (AOC) by the International Joint Commission (IJC). Aside from the concerns to

fish and wildlife, there were concerns on the potential effect of the polluted river system on human health and a contact advisory was listed by Ohio Department of Health. The advisory warned people not to contact the waters and sediments of the lower river. Sources of contamination were suspected to be from the entire watershed. Shortly after the Lower Black River was listed as an AOC, the Black River Remedial Action Plan (RAP) Coordinating Committee expanded listing to the entire watershed, making the Black River one of the few AOC's that encompasses the entire watershed.

Clean up of the contaminated sediments in the Lower Black River began in 1989 and ended in 1990. The Black River Remedial Action Plan was formed in 1991. The Ohio EPA and others continued to study the River, through intensive biological surveys conducted in 1992 and 1997.

The hard work carried out by the Black River RAP, the city and county of Lorain, and a wide variety of other agencies and public groups, has resulted in improvements in the health of the Black River. In 2004, the Ohio Department of Health lifted the contact advisory. Also in 2004, the USEPA and IJC approved the re-designation of the Fish Tumors and Other Deformities beneficial use impairment from Impaired to In Recovery.

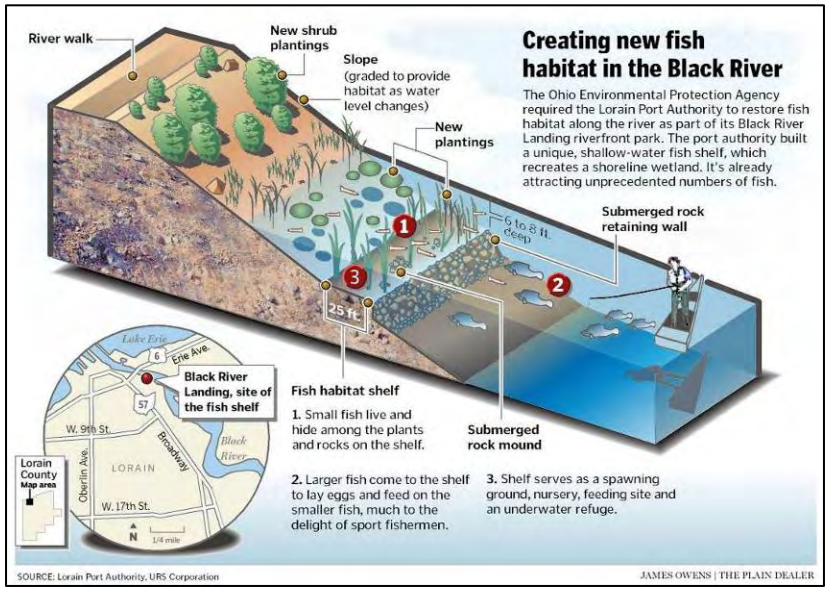
Ecological Importance

The Black River was notorious for the levels of pollution found up through the 1980's. Fish tumors and other malformations were prevalent in the water, due to the toxic effluents in the industrialized portion of the River. Establishing the Black River as an AOC brought attention to the ecological damage that had been done. USEPA lists 14 beneficial uses provided by surface waters like the Black River. Of those 14 uses, 10 were originally listed as impaired in the Black River.

Clearly, the "main street" of the city of Lorain has been damaged by the long history of pollution and physical alteration. Like any vital piece of infrastructure, the ecological repair of this aquatic "main street" is vital to the future economic health of the city.

The ecological goals of this Plan may be simply stated as developing a list of potential projects that address as many of the Beneficial Use Impairments as practical.

Some progress has been made. Fish tumors and other deformities are no longer listed as impaired, but rather since 2004 have been listed as "in recovery", a testimony to the extent to which carcinogens and other toxics have been removed from the water column and the sediments. Small gains have been made in in-stream habitat, as evidenced by the success of the "Fish Shelf" at the Black River Station complex.



The Black River Landing fish shelf provides fish habitat.

Economic Importance

Lorain is a city much like many others in the Great Lakes region. Once a center for transportation, steel making, manufacturing and a major shipbuilder for the Great Lakes, Lorain saw a loss of manufacturing employers and therefore jobs during the 1980's. While the former manufacturing base has largely eroded, some strong core firms remain. Also, the city realizes it is situated at the junction of several important natural features, including the Black River and the Lake Erie shoreline. Enhancement of these natural features, repair of the past damage, the strategic restoration of damaged areas and creation of new natural ecosystems, all can help remove the stigma attached to abandoned, damaged and blighted areas, and help spur new, appropriate and environmentally friendly development.

Ecological and Economic Goals

The ecological and economic recoveries of the Lower Black River corridor are inextricably linked. Thus we have developed linked goals that express the desire to achieve both simultaneously.

The overall desire is to establish a healthy river and riparian ecosystem in a thriving urban environment. The intent is not to return the entire Lower Black River to its condition prior to European settlement. Such a notion is simply not achievable, and clearly not in the interest of the linked economic and ecological recovery this plan seeks to achieve.

Project Area Climate

The city of Lorain has a humid, mid-continental climate, greatly influenced by the city's location on the shores of Lake Erie. Average rainfall in Lorain is at the Ohio statewide average of 37 inches per year. Snowfall averages 43 inches per year, somewhat more than most of the state, but less than that seen in the true "snow belt" east of Cleveland (Figure A.1). Precipitation is on average greatest from April through September of each year and falls on 135 of 365 days. High temperatures occur generally in July and average 85 degrees, January is generally the coldest month, low temperatures average around 19 degrees.

Figure A.1. Average precipitation in Ohio.

Project Area Geology and Soils

To an extent, the ability to successfully restore terrestrial systems along the Black River is dependent upon the soils underlying the area. Basic knowledge of the soils in the area will be important to those charged with carrying out the restoration activities suggested in the plan.

At the very mouth, the Black River lies on a broad, flat plain, mostly underlain by old lacustrine and riverine deposits. Some 360 million years ago northeast Ohio was covered in shallow seas. Thick deposits of glacial materials covered the marine deposits that form the bedrock of the system. Most of the current rivers that flow to Lake Erie in Northeast Ohio were formed by cutting down and eroding through these deposits, often generally following buried valleys that pre-dated the glacial periods. In Lorain County, as the Black River cut down, shale and sandstone formations were exposed, mostly along the northern banks. The Ohio Shale is the oldest exposed rock along the mainstem of the River. This black shale formation is some 360 million years old, and is formed from particles of clay and sand that came from the erosion of the Appalachian Mountains.

The Soil Survey of Lorain County (Soil Conservation Service, 2006) shows 10 soil units mapped as occurring within the study area. Soils in the project area are mainly Mahoning–Urban land complex, nearly level (MmA). This soil type is somewhat poorly drained and has approximately 6-18" depth to water table. The soil map units within the project area include:

AmA—Allis-Urban land complex, nearly level: This is a moderately shallow and level soil that is poorly drained and typically found in depressions. Permeability is moderately low to very low with a depth to the seasonal high water table typically at the surface or to 12 inches below the surface. According to the hydric soils list for the state of Ohio (NRCS), AmA is a hydric soil. AmA is only mapped in a small portion of the study area.

Ch – Chagrin silt loam: This is a deep, level soil that is well drained and typically found in floodplains. Permeability is moderately high to high with a depth to the seasonal high water table typically at 36 inches below the surface. Chagrin silt loam is listed as a hydric soil. This soil type accounts for 21.0% of mapped soils in the study area.

Cz – Udorthents: Udorthents are soils that have been altered by construction, mining, or other earth moving activities that result in a mixing of soil types and horizons. In the study area, these soils are characterized as deep soils and are found along the eastern border of the study area. The depth to the seasonal high water table generally beyond 80 inches below the surface. Cz is not a hydric soil.

HsA—Haskins loam, 0 to 2 percent slopes: This is a deep, level soil that is somewhat poorly drained and typically found in lake and till plains. Permeability is moderately low to very low with a depth to the seasonal high water table where HsA is mapped to be approximately at 6 to 18 inches below the surface. HsA is a hydric soil. HsA is located along the Lower Black River directly downstream of the confluence of French Creek

Lb — Lobdell silt loam: This is a deep, level soil that is moderately well drained and typically found in floodplains. Permeability is moderately high to high and the depth to the seasonal high water table is approximately at 18 to 30 inches below the surface. Lb is not a hydric soil. This map unit accounts for a very small portion (0.7%) of mapped soils in the study area and is located at the confluence of French Creek and the Black River.

MgA—Mahoning silt loam, 0 to 2 percent slopes: This is a deep, level soil that is somewhat poorly drained and typically found in till plains. MgA accounts for 15.6% of mapped soils in the study area and is located throughout the study area. Permeability is moderately low to very low with a depth to the seasonal high water table at 6 to 18 inches below the surface. MgA is a hydric soil.

MmA—Mahoning-Urban land complex, nearly level: This is a deep, level soil that is somewhat poorly drained and typically found in till plains. Permeability is low to very low with a depth to the seasonal high water table where MmA is mapped to be approximately at 6 to 18 inches below the surface. MmA is a hydric soil, and accounts for 33.7% of mapped soils in the study area.

Mr—Miner silty clay loam: This is a deep, level soil that is very poorly drained and typically found in depressions. Permeability is moderately low to moderately high; the seasonal high water table occurs at or near the surface. Mr is a hydric soil, and is a minor component of the soils in the study area.

RdC2—Rawson loam, 6 to 12 percent slopes, moderately eroded: This is a deep, non-hydric soil that is moderately well drained and typically found on hills and slopes. Permeability is moderately low to moderately high and the depth to the seasonal high water table is approximately at 18 to 30 inches below the surface. RdC2 accounts for 0.1% of mapped soils in the study area. Rawson loam is not a hydric soil.

Tg—Tioga fine sandy loam: This is a deep, level soil that is well drained and typically found in floodplains. Permeability is moderately high to high with a depth to the seasonal high water table where Tg is mapped to be approximately at 36 inches below the surface. According to the hydric soils list for the state of Ohio (NRCS), Tg is not a hydric soil. Tg accounts for 0.1% of mapped soils in the study area.

Portions of the area are covered in slag that was deposited during steel production, and in soils derived from fill and construction rubble. Such activities are typical of urban industrial areas. Restoration in these areas will require removal of the deposited slag, and, depending on the nature of the underlying material, potentially the amendment of remnant soils to ensure that sufficient nutrient and organic matter is present to support the desired plant communities.

Project Area Land Cover

Land cover can have direct and indirect effects on water quality. A number of studies have examined this relationship, and in general there seems to be some agreement that when impervious cover reaches values of around 10% of a watershed, water quality variables begin to decline. *Figures A.2* through *A.4* show views of land use along the river in the project area. Table A.1 shows a summary of land cover by acreage and percent within the study area. Data for this table came from the U.S. EPA 2001 land cover data set, the most recent data for which full metadata could be located. These data were derived from an analysis of satellite images.

Land cover in the study area is strongly dominated by urban, developed land cover types. Developed land, both high intensity and low intensity categories, accounts for 57.74% of the land cover.

Table A.1. Land Cover Summary		
Land Cover	**Acres**	**Percent**
High Intensity Developed	935.52	46.08
Low Intensity Developed	236.80	11.66
Deciduous Woods	195.40	9.62
Evergreen Woods	0.45	0.02
Mixed Woods	0.69	0.03
Scrub/Shrub	21.19	1.04
Grassland	49.60	2.44
Palustrine Forested Wetland	129.57	6.38
Palustrine Emergent Wetland	85.39	4.21
Water	375.70	18.50
Total	2,030.30	100.00

Water, predominantly in the Black River channel and the portions of the study area beyond the mouth of the river, account for just over 375 acres, roughly 18% of the study area. Two categories of wetlands were mapped in the study area. Palustrine wetlands are wetlands that are not associated with marine systems, large lakes, or located within the channels of larger rivers. Palustrine forested wetlands, typically referred to as swamps, occupy just over 129 acres, according to the U.S. EPA data. Palustrine emergent wetlands, generally marshes dominated by non-woody plant species, cover approximately 85 acres. Together, both wetland types comprise just over 10% of the landscape in the study area.

Deciduous woods (dominated by trees that drop their leaves) occupy almost 10% of the project area. Woodland areas offer habitat for a variety of terrestrial wildlife, even in urban areas. More importantly in this case, urban woodlands offer some respite from the heat island effect, the increase in temperatures seen as a result of the increase in the reflection of solar radiation associated with large paved areas. Both deciduous and coniferous woodland cover is important along riparian corridors. Forest habitats in riparian areas are particularly good at preventing excess soil erosion on banks, and in cooling nearshore stream waters. They also provide habitat for a variety of birds and other wildlife.

There is a clear need to increase the percentage of natural cover in the study area. Additional green areas, dominated by native plants, would be particularly beneficial in the very urban Section 1.

Wetlands are important features that provide habitat and a variety of other ecological functions. Unfortunately, they are particularly scarce in the urban landscape of Lorain. The National Wetland Inventory (NWI), a program of the U.S. Fish and Wildlife Service, has been mapping wetlands since the 1980's. NWI maps are created by analyzing color infra-red or black and white aerial photography. Wetlands identified in the imagery are mapped on USGS 7.5 minute quadrangle basemaps, and classified according to the U.S. Fish and Wildlife Service classification (Cowardin *et al*, 1982). In general, NWI maps tend to underestimate the number and extent of jurisdictional wetlands in an area, but they represent the best source of remotely sensed wetland data currently available.

The digital NWI map for the project area is shown in *Figure A.5.* Wetlands are shown as green polygons, the Black River as a light blue polygon, and ponds or small lakes are shown in grayish blue. Figure A.5 shows several rather small wetlands along the north side of the river, downstream from Bungart Island. There is a larger wetland and a larger pond (locally referred to as the "Beaver Pond") mapped near the southern end of the project area (the 31st Street Bridge forms the southern boundary). Two other ponds are mapped on the south bank downstream of Bungart Island.

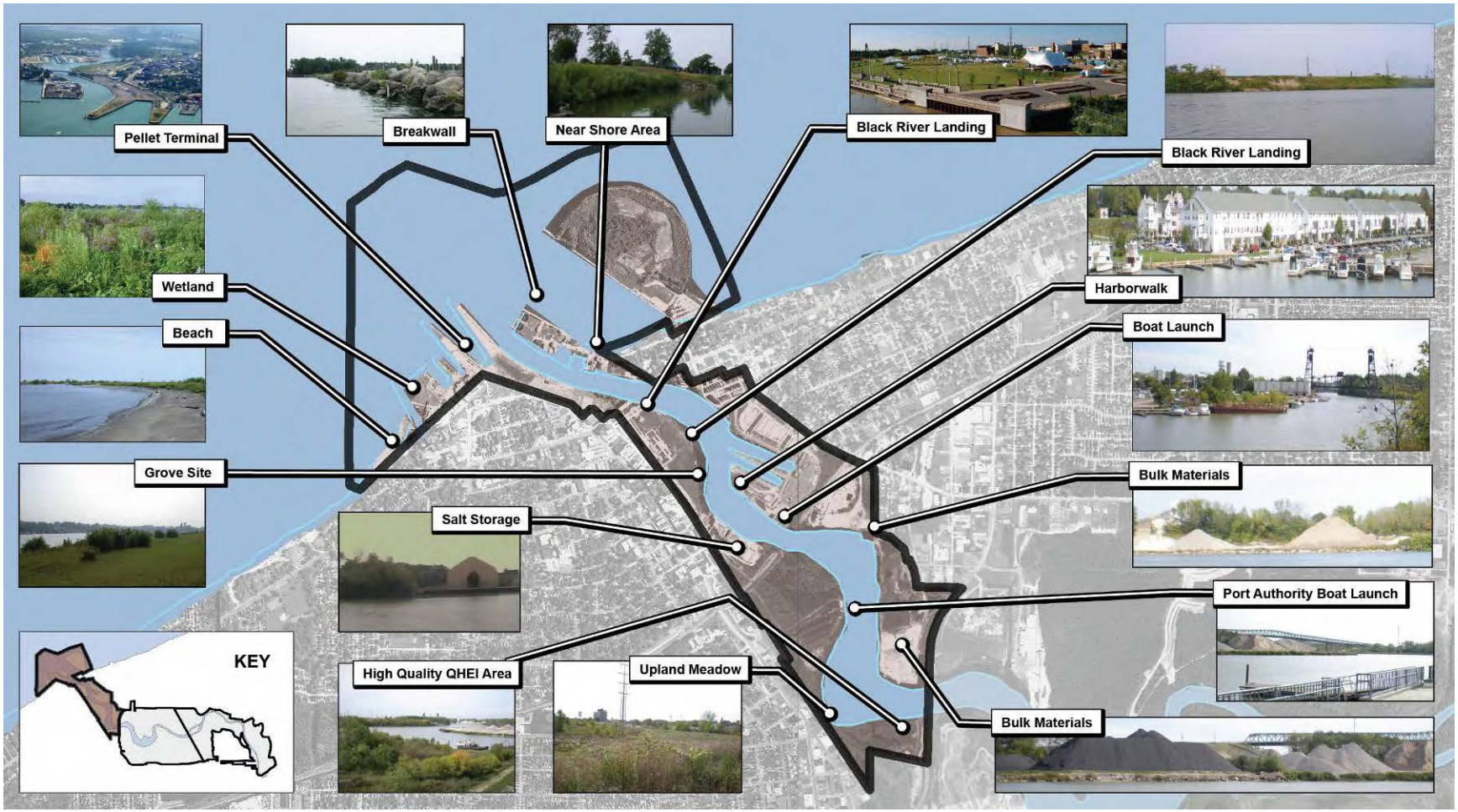


Figure A.2. Photo Inventory Showing Land Use and Land Cover in Section 1.

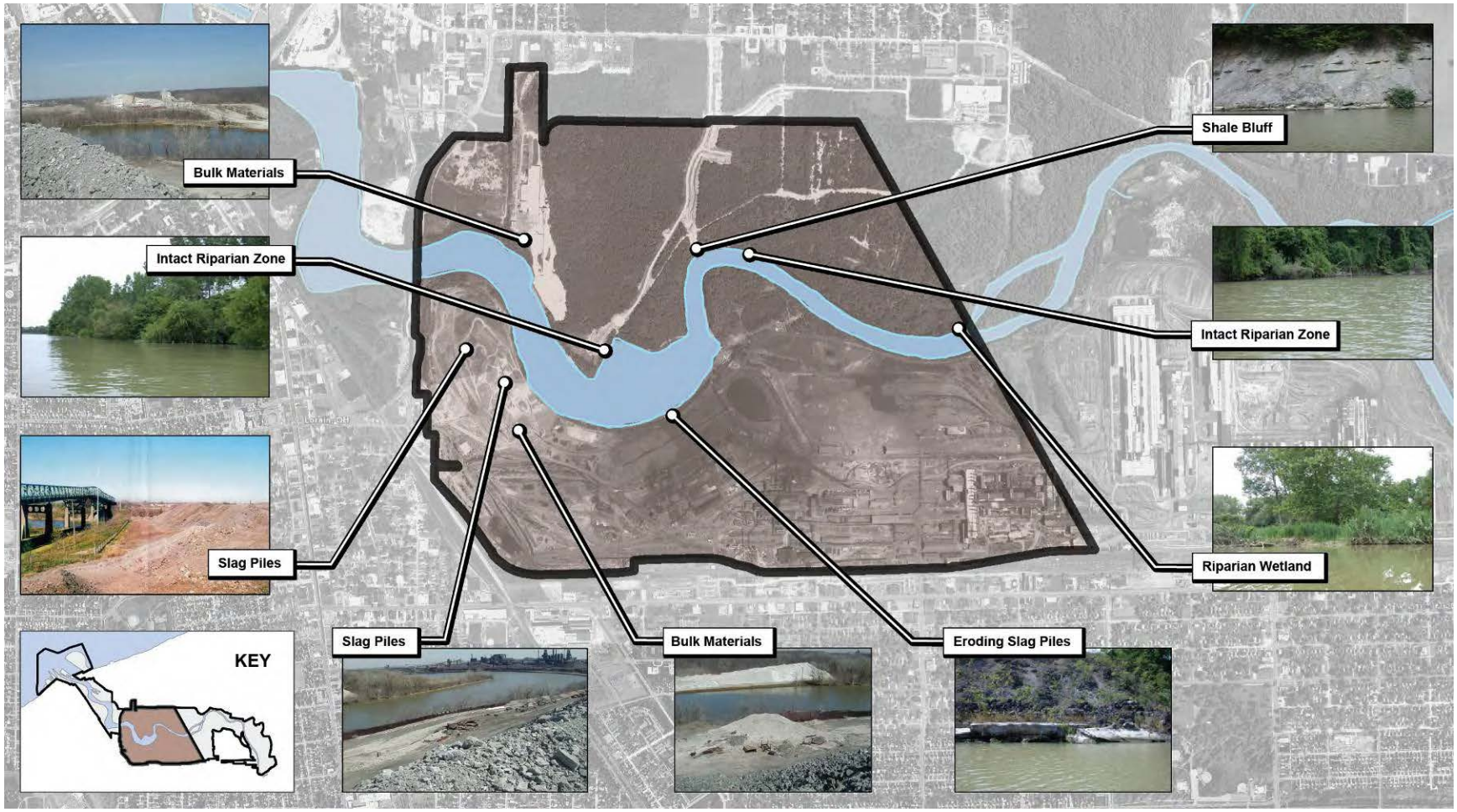


Figure A.3. Photo Inventory Showing Land Use and Land Cover in Section 2.

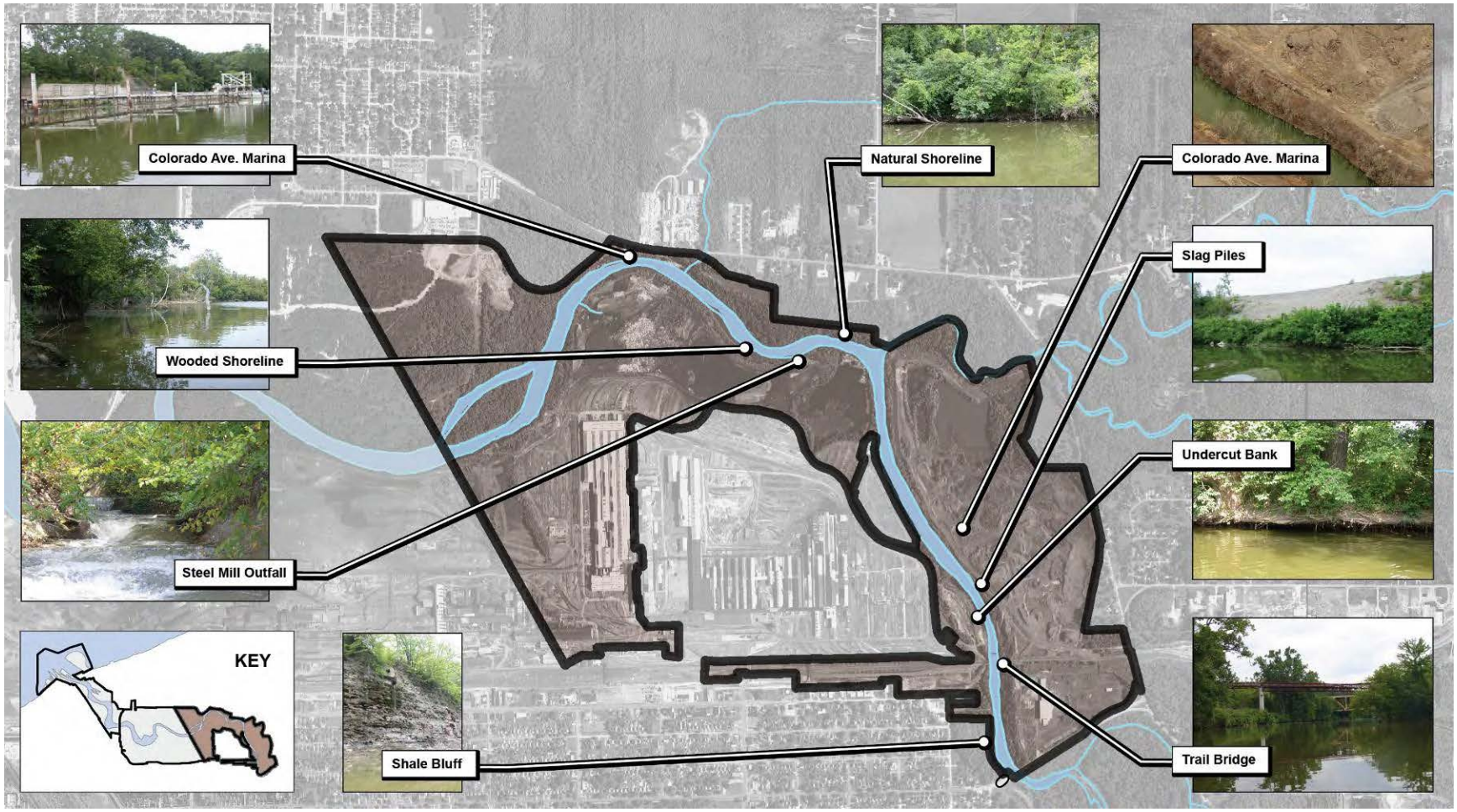


Figure A.4. Photo Inventory Showing Land Use and Land Cover in Section 3.

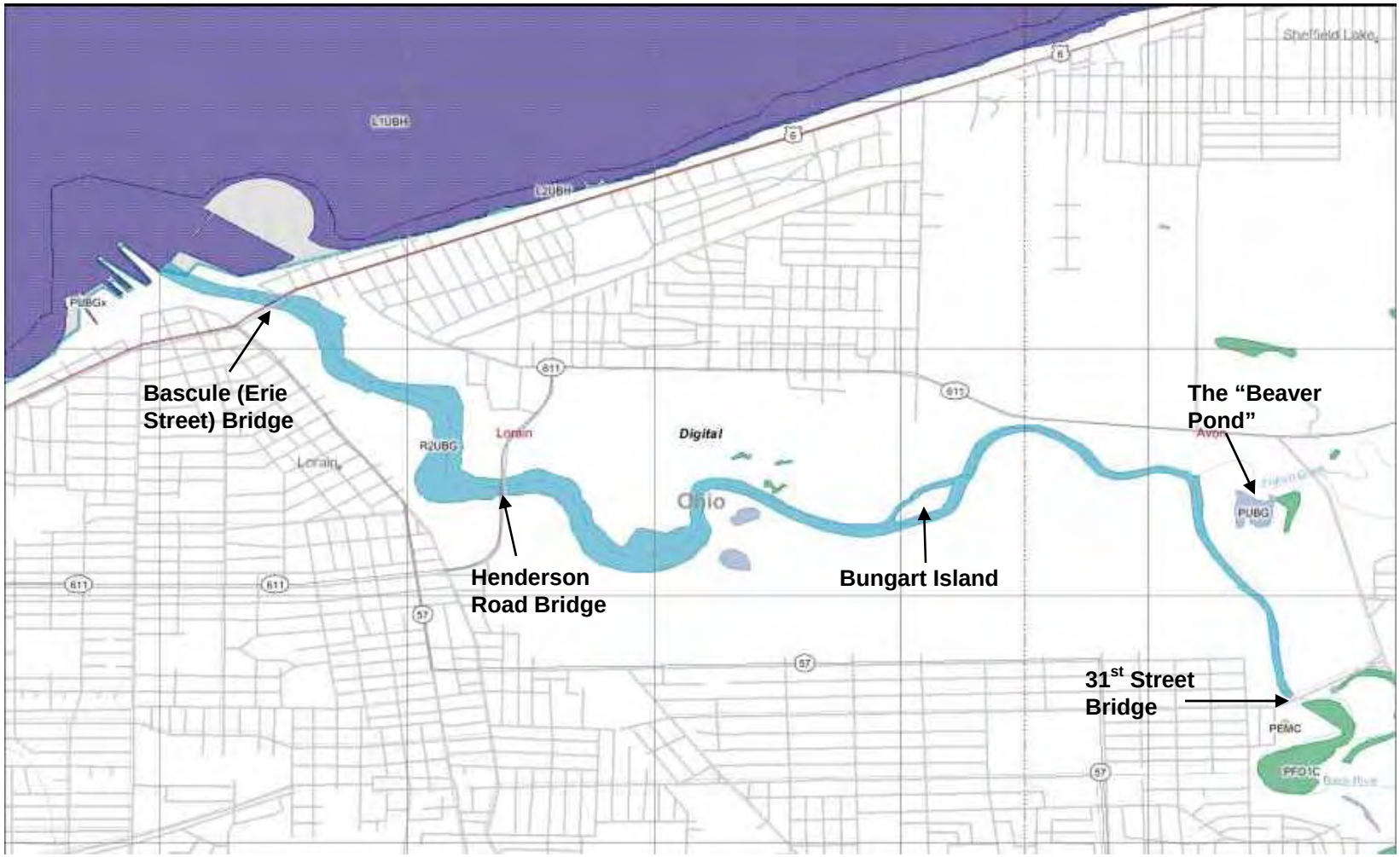


Figure A.5. The National Wetland Inventory Map for the Project Area.

Project Area Fish and Wildlife

Aquatic life is defined as the organisms that live all or most of their life cycles in the water. Many regulatory agencies, including Ohio EPA, monitor the health and community make-up of aquatic life to indicate stresses that may degrade the environment. These aquatic life studies are able to show problems or environmental stressors that might otherwise be underestimated or even missed.

Table A.2 lists the aquatic life use attainment status for segments of the Black River sampled within the project area for this Master Plan. Scores are shown by river mile (distance along the stream from the mouth). Scores are given for the Index of Biotic Integrity (IBI), a water quality metric that assess the health of fish populations; the Modified Index of Well-Being (MIwb), another metric based on fish population data; and the Invertebrate Community Index, a water quality metric based on invertebrate population data (Descriptions of the IBI, ICI MIwb and QHEI may be found in: Ohio EPA, 1999a; 1999b; 1990; 1989a; 1989b; 1987a;1987b; Rankin, 1989). The QHEI (Qualitative Habitat Evaluation Index) is a rapid index that assesses the quality of fish habitat in a river reach. The last column indicates the water quality use designation attainment status. Note that most of the reaches are not attaining the current status for Warm Water Habitat streams.

Ohio EPA reports 37 fish species found during their surveys at stations from just downstream of the confluence of French Creek and the Black River, to the mouth of the River (*Table A.3*). The surveys which are the source of this data were completed in 1997. In general, species richness decreases as one approaches the mouth of the river. Species richness ranged from a low of 6 species at the mouth of the river, to 22 species at river mile 2.3. The average species richness for the 15 stations sampled by Ohio EPA was 16.2.

Table A.2 Use Attainment Status for the Lower Black River.
Source: *Biological and Water Quality Study of the Black River Basin, 1997 Lorain and Medina Counties March 31, 1999 Revised October 2, 2009 Ohio EPA Technical Report MAS/1998-11-4 (Ohio EPA, 1999b)*

River Mile	IBI	MIwb	ICI	QHEI	Status
5.8	36*	7.6	--	58.0	Partial
5.5	32*	6.5*	10*	42.5	NON
5.2	36*	6.8*	10*	48.5	NON
4.8/4.9	25*	6.1*	24*	55.0	NON
3.7	32*	*7.4ns*	--	--	
3.6			12*		NON
3.1	37*	*7.3ns*		53.5	Partial
2.3	34*	*7.2ns*	20*	45.0	NON
0.9	45	8.5	18*	34.5	NON
0.1	24*	6.2*	12*	27.0	NON

** - Indicates significant departure from applicable biocriteria*
ns - Non-significant departure from biocriteria

The populations and health of fish communities in the river are driven by water and sediment quality and the availability of quality habitat. Water and sediment quality, particular in terms of the concentrations of toxic compounds in the Black River are, improving. Water quality has been improving since the 1980s and now the sediments of the Outer Harbor and 80% of the federal navigation channel no longer need to be confined in a disposal facility. With the restoration of habitat associated with this plan, the number of species and the numbers of individuals of each species, especially the more desirable species, are expected to increase.

The Lake Erie shore is a haven for a wide variety of birds. Passerines (perching birds) particularly warblers, as well as waterfowl cross the lake during spring and fall migrations. Raptors

generally follow the lake shore, preferring not to cross large stretches of open water. *Table A.4* lists the confirmed, probable and possible breeding birds in the project area, extracted from the Ohio Breeding Bird Survey for 2006 through 2010. Twenty species of birds are confirmed breeders in the area. These species have been directly observed on nests or otherwise exhibiting breeding behavior. Twenty-five species are listed as probable breeders, these species were observed in the are, during the breeding period for each species, but nest sites could not be confirmed. Eleven bird species are listed as possible breeders. These species were observed in the area, but not during the breeding window for the species. Avian diversity is increased by the number of migrants and accidental species that are found along the lake shore. Shorebirds, such as plovers and sandpipers, move through the area in spring and fall. A large number of waterfowl pause in the nearshore areas and in the river during their spring and fall movements. Hooded mergansers can be particularly abundant. Herring and Ring-billed Gulls are resident in the area, but other species, such as the small, black-headed Bonaparte's Gull move through the area. A large colony of Great Blue Herons nests in the project area. Common raptors in the area include the ubiquitous Red-tailed Hawk, and Red-shouldered and Cooper's Hawks. Peregrine Falcons have been reported but not confirmed as breeders in the area. Bald Eagles are often seen cruising along the river and its banks, even in the dense urban area. The former Pellet Terminal and the CDF are both locations where snowy owls may be found during some winters.

Most of the mammals found in the project area are common species typically seen in urban areas. Deer are certainly found, and coyotes are likely to inhabit the area. Common urban species such as gray and fox squirrels, mice, eastern cottontail rabbits, skunks and various species of bats are no doubt found. A re-introduction of the otters to Ohio began in 1986 and efforts continued for seven years. Although no otters were introduced to the Black River watershed, members of the Black River RAP located an otter in a French Creek tributary.

Hooded mergansers often congregate in the central portion of Lake Erie.

Table A.3. Fish found in the project area. Source: *Appendices to Biological and Water Quality Study of the Black River Basin, 1997 Lorain and Medina Counties March 31, 1999 Revised October 2, 2009 Ohio EPA Technical Report MAS/1998-11-4*

Common name	Scientific Name	Common name	Scientific Name
Alewife	*Alosa pseudoharengus*	White Crappie	*Pomoxis annularis*
Longnose Gar	*Lepisosteous osseus*	Black Crappie	*Pomoxis nigromaculatus*
Gizzard Shad	*Dorsoma cepadianum*	Rock Bass	*Ambloplites rupestris*
Northern Hog Sucker	*Hypentelium nigricans*	Smallmouth Bass	*Micropterus dolomieu*
White Sucker	*Catostomus commersonii*	Largemouth Bass	*Micropterus salmoides salmoides*
Spotted Sucker	*Minytrema melanops*	Freshwater Drum	*Aplodinotus grunniens*
Smallmouth Buffalo	*Ictiobus bubalus*	Logperch	*Percina caprodes*
Golden Shiner	*Notemigonus crysoleucas*	Green Sunfish	*Lepomis cyanellus*
Emerald Shiner	*Notropis atherinoides*	Bluegill Sunfish	*Lepomis macrochirus*
Spottail Shiner	*Notropis hudsonius*	Pumpkinseed Sunfish	*Lepomis gibbosus*
Mimic Shiner	*Notrpois volucellus*	Orangespot Sf X Pumpkseed	*Lepomis humilis* x *gibbosus*
Fathead Minnow	*Pimephales promelas*	Green Sf X Bluegill Sf	*Lepomis cyanleeus* x *macrochirus*
Shorthead Redhorse	*Moxostoma macrolepidotum*	Green Sf X Hybrid	*Lepomis cyanellus*
Bluntnose Minnow	*Pimephales notatus*	Green Sf X Pumpkinseed	*Lepomis cyanellus x humilis*
Yellow Bullhead	*Ameiurus natalis*	Yellow Perch	*Perca flavescens*
Brown Bullhead	*Ameiurus nebulosus*	Common Carp	*Cyprinus carpio*
Channel Catfish	*Ictalurus punctatus*	Common Carp X Goldfish	*Cyprinus carpio*
White Bass	*Morone chrysops*	Round Goby	*Neogobius melanostomus*
White Perch	*Morone americana*		

Table A.4. Breeding birds in the Project Area (Ohio Breeding Bird Survey Blocks Lorain 4 and Lorain 5), According to 2006 to 2010 Ohio Breeding Bird Survey data. Status codes: Con = confirmed breeder; Prob = probable breeder; Poss = possible breeder.

Common Name	Scientific Name	Status	Common Name	Scientific Name	Status
Canada Goose	*Branta canadensis*	Con	American Crow	*Corvus brachyrhynchos*	Poss
Mallard	*Anas platyrhynchos*	Con	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Con
Wood Duck	*Aix sponsa*	Prob	Cliff Swallow	*Petrochelidon pyrrhonota*	Con
Great Blue Heron	*Ardea herodias*	Con	Barn Swallow	*Hirundo rustica*	Con
Green Heron	*Butorides virescens*	Poss	Carolina Wren	*Thryothorus ludovicianus*	Prob
Red-shouldered Hawk	*Buteo lineatus*	Prob	House Wren	*Troglodytes aedon*	Prob
Cooper's Hawk	*Accipiter cooperii*	Con	Eastern Bluebird	*Sialia sialis*	Prob
Peregrine Falcon	*Falco peregrinus*	Prob	Wood Thrush	*Hylocichla mustelina*	Prob
Killdeer	*Charadrius vociferus*	Con	American Robin	*Turdus migratorius*	Con
Ring-billed Gull	*Larus delawarensis*	Con	Gray Catbird	*Dumetella carolinensis*	Con
Herring Gull	*Larus argentatus*	Prob	Brown Thrasher	*Toxostoma rufum*	Prob
Rock Pigeon	*Columba livia*	Poss	Northern Mockingbird	*Mimus polyglottos*	Prob
Mourning Dove	*Zenaida macroura*	Prob	European Starling	*Sturnus vulgaris*	Con
Common Nighthawk	*Chordeiles minor*	Prob	Yellow Warbler	*Dendroica petechia*	Con
Chimney Swift	*Chaetura pelagica*	Prob	Common Yellowthroat	*Geothlypis trichas*	Prob
Belted Kingfisher	*Megaceryle alcyon*	Poss	Hooded Warbler	*Wilsonia citrina*	Prob
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Poss	Eastern Towhee	*Pipilo erythrophthalmus*	Prob
Red-bellied Woodpecker	*Melanerpes carolinus*	Poss	Chipping Sparrow	*Spizella passerina*	Prob
Northern Flicker	*Colaptes auratus*	Con	Song Sparrow	*Melospiza melodia*	Prob
Ruby-throated Hummingbird	*Archilochus colubris*	Con	Northern Cardinal	*Cardinalis cardinalis*	Con
Eastern Wood-Pewee	*Contopus virens*	Prob	Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Poss
Willow Flycatcher	*Empidonax traillii*	Prob	Indigo Bunting	*Passerina cyanea*	Prob
Great Crested Flycatcher	*Myiarchus crinitus*	Prob	Common Grackle	*Quiscalus quiscula*	Poss
Eastern Kingbird	*Tyrannus tyrannus*	Poss	Brown-headed Cowbird	*Molothrus ater*	Prob
White-eyed Vireo	*Vireo griseus*	Prob	Baltimore Oriole	*Icterus galbula*	Con
Red-eyed Vireo	*Vireo olivaceus*	Con	House Finch	*Carpodacus mexicanus*	Con
Tufted Titmouse	*Baeolophus bicolor*	Prob	American Goldfinch	*Carduelis tristis*	Poss
White-breasted Nuthatch	*Sitta carolinensis*	Con	House Sparrow	*Passer domesticus*	Poss

Project Area Water and Sediment Quality

The Black River TMDL (Ohio EPA, 2008) lists sediment, elevated nutrient concentrations and elevated bacteria levels as the major pollution problems in the watershed. From the confluence of the East and West Branches, the Black River is listed as a Warm Water Habitat.

Nutrient concentrations are also elevated within the Black River and its major tributaries. Phosphorus and nitrates reach the river through numerous point source discharges, agricultural runoff, and discharges from home septic systems. The results are algal blooms, and the accompanying decrease in available dissolved oxygen, which lead to changes in aquatic community structure and composition (Ohio EPA, 1999a).

Increased bacteria levels, particularly levels of fecal coliforms, can come from failing home septic systems and illegal dumping of septic materials (Boddy, 2002), combined sewer overflows, manure application in agricultural fields, and runoff from both feedlots and urban areas (Ohio EPA, 1999a). Elevated bacteria counts are often associated with increases in sediment and nutrient concentrations as well. In addition to concerns regarding the health of ecological communities, human health is also a concern, particularly when bacteria levels are elevated. Although bacteria levels in surface waters can vary under different meteorological conditions, improvements have been noted in the lower river by Ohio EPA. In their 2008 Integrated Water Quality Monitoring and Assessment Report, the agency determined that recent bacteria data indicate that a prior impairment listing for recreational use in the main stem is no longer supported and the impairment has been removed. Future monitoring of bacteria levels in the Lower Black River will determine if this improvement continues.

Lorain Harbor – Sediment, Dredging and the CDF

Sediment has a major impact in the river (Ohio EPA, 1999a). Agricultural land uses, which comprise of 44% of the total watershed, contribute substantial amounts of sediment. Stream bank erosion is also a significant source of sediment (USAED Buffalo, 1977). When riparian areas are cleared and the native vegetation is removed, banks are prone to erosion. Erosion can also be acerbated by increased runoff volumes and velocities associated with urban areas.

The excess sediment loads throughout the Black River basin causes both environmental and economic stresses. Environmentally, highly turbid waters can hinder light transmission and therefore photosynthesis and is the main reason efforts to introduce aquatic vegetation at the Black River Landing Fish Habitat Shelf failed in the past. Sediment suspended in the water column can clog fish gills and in extreme circumstances can lead to fish kills. Deposition of sediment on the river bottoms can smother habitat sites for aquatic invertebrates.

Economically, excess sediment can stress the local economy, especially for ports as active as in the City of Lorain. Based on 2005 data of total tonnage handled (3,055,000), Lorain Harbor is the 25th busiest port on the Great Lakes and 102nd busiest port in the nation. Iron ore has been the dominant commodity moving through Lorain Harbor and in 2005 accounted for 49 percent of all traffic at the harbor. Stone (limestone, gypsum, sand, and gravel) accounted for 41 percent and other bulk commodities for the remaining 10 percent of the harbor's waterborne bulk traffic. As a Federal harbor, the maintenance of authorized channel depths, disposal of dredged material, and dredging and dredged material disposal by other harbor interests is required to meet shipping requirements. A portion of the sediments dredged are not suitable for open-lake placement and have to be confined to a confined disposal facility. Since 1979,

the average volume of dredged material has been 135,400 cubic yards. Due to sediment contamination, all sediments dredged from the river, from the late 1970s until recently, had to be contained in specially designed facilities.

In 1978, the USACE constructed a CDF for discharge of material periodically dredged from the harbor to maintain its adequate authorized project depths for deep-draft commercial navigation. The CDF is a semicircular structure that adjoins the East Breakwater Shorearm. The CDF is 58 acres and has an estimated design capacity of 1,850,000 cubic yards (cy). In 2006 (end of dredging season), the Lorain Harbor CDF was filled to design capacity. Starting in 2007, USACE initiated a DMMP study to provide a new CDF or alternative method of managing dredged material by 2014. As a part of the study, interim dredged material management options were developed 2008 through 2013, when a new facility or other option becomes available.

It was determined that sufficient additional capacity can be obtained at the existing CDF using a fill management plan (FMP) internal to the CDF (e.g., dewatering, consolidation of dredged material, raising interior berms). It has been determined that the CDF will be transferred to the non-Federal sponsor for future waterfront use when it is no longer able to accept any more dredged material. The Lorain Port Authority and the Lorain Metro Parks have developed a Master Plan which will guide reuse of the CDF once filing of the site has been completed.

In addition to disposal of sediments in the existing CDF, USACE and Ohio EPA determined that a portion of the River sediments meet guidelines for unconfined open-lake placement. In their decision, the two agencies determined that the sediments from these locations posed no significant threat to human health or the environment.

Aerial view of the Lorain Confined Disposal facility.

Finally, the USACE - Buffalo District is working with the City of Lorain to provide technical guidance in preparing an upland brownfield parcel, a former coke plant site to be used for dredged material placement (location of proposed relocated wastewater treatment plant – *Figure 1.2*). The 130 acre site is considered a viable location with a minimum 15 year capacity for placement of dredged material and this use is consistent with the City of Lorain's Master Plan for brownfields redevelopment. A Memorandum of Agreement (MOA) will be negotiated with the City. Under the MOA, the City will be required to obtain applicable State and Federal permits, and modify the property as necessary to comply with those permits and other applicable regulations at 100 percent non-federal cost (Source: USACE – Buffalo District, Lorain Harbor Final DMMP/EIS, April 2009).

Appendix B

Lower Black River
Lorain, Ohio
Ecological Restoration Master Plan

APPENDIX B – MASTER PLAN DEVELOPMENT PROCESS

Plan Development Process

The project team adopted a planning concept that is geared toward the eventual adoption and shepherding of the plan by the City of Lorain, in cooperation with the USEPA and other agencies. As such, it was critical to first develop an advisory committee that would help develop the plan, and work in partnership the city and Lorain Port Authority to adopt, implement and manage the ideas presented here. Advisory Committee members are shown on page 13 of this plan. Most members of the Advisory Committee have attended all of the meetings held to date, and all have contributed to the understanding of the challenges faced, and development of potential solutions.

The following page shows a schematic of the planning process used and important milestones for this project.

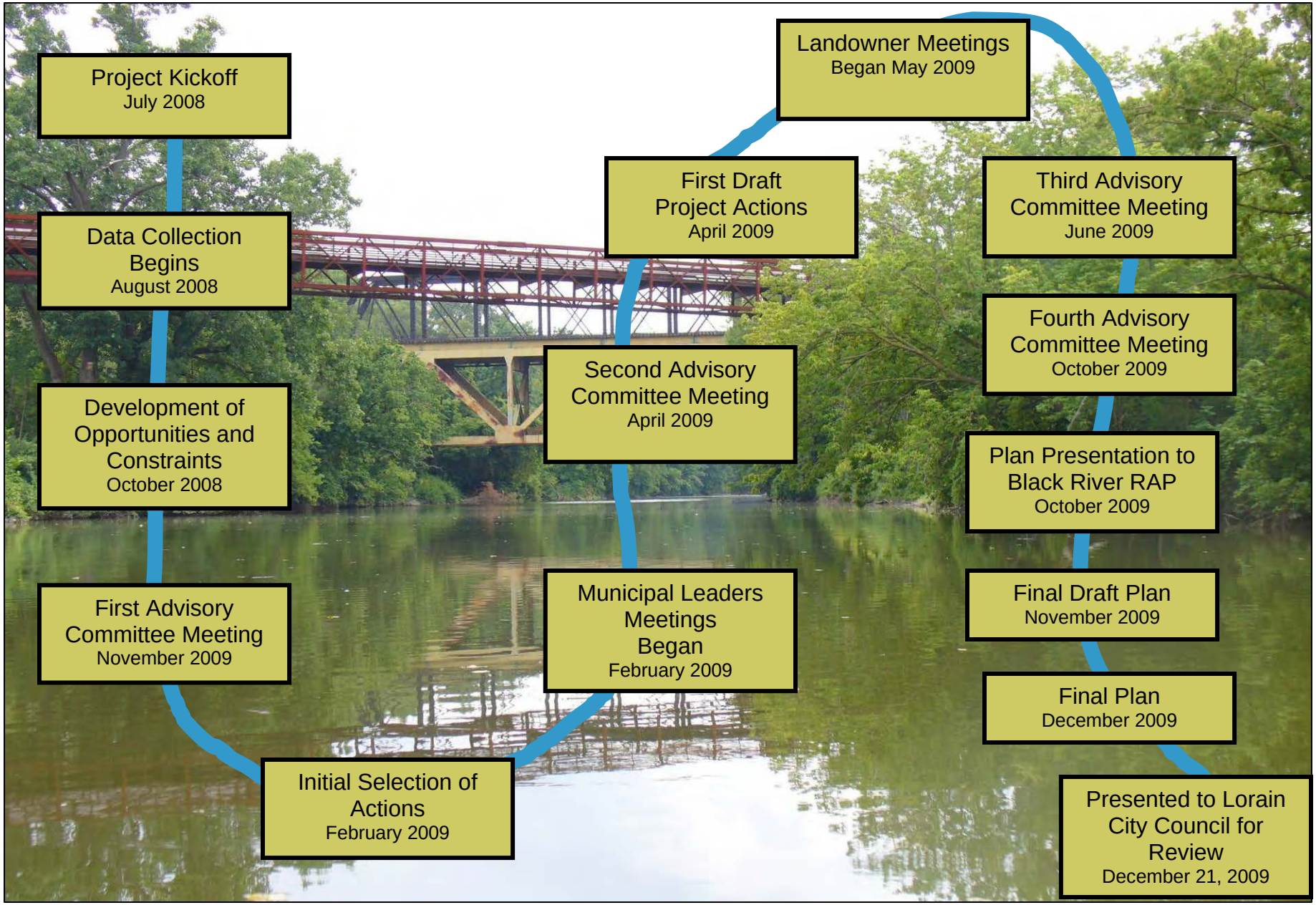
After kicking off the project, the project consultant team began the process of collecting data on the river. Reference material collected included Ohio EPA and U.S. EPA reports on the river, materials from the Black River RAP, planning documents and other data from the city of Lorain, historical data from a wide variety of sources, and data from Ohio DNR. We also assembled the GIS data sets needed to map and analyze data on the River.

The consultant staff spent two weeks performing an assessment of the habitat conditions in the River, along the shoreline and on lake areas near the mouth. The crew cruised up and down the river, gathering data on fish and macroinvertebrate communities. The team assessed habitat in the stream and along the lakeshore using Ohio EPA's Lacustrine Qualitative Habitat Evaluation Index (LQHEI), to assess lakeshore habitats. Field crews performed an assessment of the qualities of all bank areas, and mapped features along the banks. This gave the team an idea of the condition of the riparian areas along the Lower Black River.

All the data were compiled and analyzed to develop an "existing conditions" assessment of the Lower Black River. Data sets used included:

- Hydrologic conditions.
- Geology.
- Soil and sediment conditions.
- Upland, wetland, shoreline, and riparian vegetation communities.
- Invasive species populations.
- Black River channel maps.
- Zoning and land use.
- Known data on fish, bird, wildlife, and insect communities.
- Data on populations of rare, threatened, and endangered species.
- Recreational features and amenities.
- Site history.
- Proposed developments.

During August, September and October of 2008, data were analyzed and a series of thematic maps were developed. The maps helped the team define potential opportunities for and constraints upon future restoration efforts. A "toolbox" of potential actions was started. Maps depicting topography, land use and other important features were developed. All were important tools for the first Advisory Committee Meeting.



First Advisory Committee Meeting: The first major project meeting was held in November 2008. At this meeting, the history of how the plan came about was discussed. A brief history of the Black River was presented. Results of the preliminary analyses of current conditions were presented, the toolbox was reviewed, and a list of "early action projects" was proposed.

Following the first meeting, and relying on feedback from the participants, the team began to develop the first round of potential actions.

Municipal Leaders Meetings: It is obvious that strong leadership from the local government will be a key to accomplishing the goals and objectives of this plan. Staff from the city Planning Department, and the Utilities department, were integral members of the advisory committee from the start of this process. A series of meetings were held with the Mayor and his staff, other city department leaders and City Council members, to outline the goals and objectives of the plan, and to present some of the findings to date. At these meetings the team helped guide the municipal leaders to the understanding that the project was not intended to result in additional regulatory burdens, but rather would help spur potential and appropriate development along the Black River corridor. To date, all city departments and staff that the team has met with are solidly in favor of and actively contributing to the project. Meetings with city leaders continued throughout the project.

Second Advisory Committee Meeting: After meeting with city officials, and further developing potential options, a second Advisory Committee meeting was held in April, 2009. At this meeting, the discussions centered around updates as to the progress to date. The toolbox was presented to the group, and discussions as to the efficacy of the various restoration techniques ensued. Areas where specific techniques might be implemented were outlined and discussed.

Finally, draft goals and objectives were developed, and comment on these was sought from the Committee.

First Draft, Project Actions: A first, very rough partial draft of the Ecological Restoration Master Plan was developed and forwarded to the Advisory Committee. This draft focused on the description of the plan's proposed Actions.

Landowner Meetings: Meetings with large landowners began in May of 2009, once the proposed Actions had been initially developed. It was felt that this timing was appropriate, given that the landowners could have something rather concrete to react to, and conversely that the Actions had not been developed to the point that changes requested by the landowners could not be made. These meetings continued throughout the rest of the project, and landowners were brought into subsequent Advisory Committee meetings.

Third Advisory Committee Meeting: A third Advisory Committee meeting was held in June of 2009. At this meeting, the city and the Agencies presented their individual visions for the plan, and an exercise was held to identify those areas where visions were held in common, and those areas where parties may need to be brought closer together, to accomplish this complex plan. A detailed discussion of the proposed Actions was held, and a rough prioritization exercise was undertaken, during which participants were able to express their choices for which actions were most important to them. Finally, suggestions for additional outreach were solicited. Participants at this meeting were able to tour the river on the Port Authority's boat.

Fourth Advisory Committee Meeting: In October 2009, the fourth Advisory Committee meeting was held. A second, partial rough draft of the plan was circulated prior to the meeting. At this meeting, Participants were broken into small groups to discuss the proposed actions and their locations. There was a strong sense from these

discussions that fish baskets and floating wetlands were best left as experimental actions, to be funded only if applicants interested in these techniques could identify a source of money. In addition, there was a strong desire expressed to ensure that slag and other materials that could potentially be sources of pollution not be used as materials to provide bottom structure in the river.

Presentation to the Black River RAP: Also in October, 2009, the draft plan was presented to and discussed with the Black River RAP. This meeting was an attempt to broaden the participation beyond the Advisory Committee, city staff and Council. Comments obtained at this meeting were similar to those obtained from the October Advisory Committee meeting.

Final Draft Plan: Substantial revisions to the second rough draft were made, and a reformatted final draft was developed and submitted in November 2009.

Presentation to Council and Adoption of the Plan: The plan will be presented to the Lorain City Council on December 21, 2009. The intent is that Council formally will adopt the plan so that it may serve as the basis for future land use decisions within the project area. Current plans call for the plan to be sent to a City Council committee for review in January, adoption should occur after this review is complete.

Developing Actions and Setting Priorities

From the beginning, this plan was intended to result in the restoration and protection of habitat in and along the Lower Black River. There are several reasons for this focus on habitat. First, aquatic and terrestrial habitat has been affected by the long history of urban development in the project area. Land use changes that removed native plant communities, particularly from riparian areas, have resulted in a lowering of water quality.

Some progress has been made in cleaning up chemical contamination in the Black River. Most of the toxic sediments have been removed, and as a result the incidence of fish tumors has decreased. The remaining water quality problems have affected habitat, largely through sedimentation and nutrient enrichment.

In addition, Ohio is a leader in using biological criteria to assess water quality and set standards. As a result, measures of the availability of aquatic habitat have been developed to assess conditions in streams. A focus on restoring habitat is therefore consistent with the measurements Ohio uses to assess water quality.

As a result, the actions selected for this plan were developed to restore in-stream and riparian habitat. In-stream habitat is primarily restored in the short term through the construction of fish shelves. As conditions in the river improve, and as sediment controls are instituted upstream in the remainder of the watershed, the hope is that the rest of the river bottom habitat will be restored through natural processes. Actions upstream of the 31st Street Bridge are beyond the scope of this document, but such actions will be needed to fully restore the lower section of the mainstem.

Potential actions were prioritized using a simple ranking system. Draft systems were tried, including one that took into account non-ecological factors such as cost of the actions, and whether an action was located on public or private property. Eventually, we settled on a system that ranks projects according to their weighted, predicted LQHEI scores. To do this, we first assigned predicted scores based on conservative estimates of the metric scores that might be achieved by accomplishing each action. These scores were developed by the consultant team, and vetted by Black River RAP staff. Once agreement was reached on the scores, we weighted the scores using graduated weighting factors. The weighting process is described on page 28 of the plan, and the resulting ranks are shown in *Table 2.1*.

The ranks express the notion of the ecological importance of each action. A clear importance is assigned to those actions that preserve and enhance the remaining existing higher quality systems in the project area. Protecting those existing systems helps to stem the tide of the loss of ecosystem functions in the project area, and preserves the best of the systems as reference areas against which to gauge other restoration efforts. Projects to accomplish the recommended actions may not be carried out in the order shown in the plan. Rather, it is likely, and logically expected, that projects will be completed as funds become available. Still, consideration should be given to accomplishing the actions in the order presented, to the degree possible.

The Future of the Ecological Restoration Master Plan

The Lorain Utilities Department and the Lorain Port Authority have agreed to be the main City of Lorain sponsors of this plan. They will be jointly responsible for carrying out the actions recommended here. After its adoption by the Lorain City Council, this plan will serve to guide the city's actions in restoring the ecological health of the Black River. The actions presented in this plan are a shopping list of activities for which the city will seek funding. Further, the plan is meant to be a guide for future actions taken by the city in the project area, particularly as redevelopment decisions are made in the riparian setback zone. Data in this plan can be used to help guide development toward those parcels on which it is most appropriate. The Best Management Practices in Appendix C are presented to help the city choose and encourage the use of those practices that will help maintain and protect the investment made in restoring habitat along the Lower Black River.

Almost all plans include statements expressing the desire for the plan to be a "living document". That is a particular need for this plan. Without careful referral to this document during the city's redevelopment planning, without the insistence on incorporating suggested best management practices in new developments, without the enforcement of the city's current riparian setback ordinance, any gains realized by the habitat restoration actions outlined here would be lost.

No timeline for accomplishing this plan has been set, in recognition of the notion that it is to be a "living document". We do recommend that the plan be revisited every 5 years, to check progress and set goals for the upcoming period, and to make amendments and changes.

Appendix C

Lower Black River
Lorain, Ohio
Ecological Restoration Master Plan

APPENDIX C - RESTORATION TOOLBOX

Introduction

The purpose of this restoration tool box is to highlight the current City of Lorain ordinances that guide development to appropriate locations and forms, and to identify specific Best Management Practices which:

- Advance the ecological restoration goals set forth in this plan and their identified benefits.
- Support City of Lorain economic development goals and job creation needs by improving the overall livability of the community and thus attracting businesses and redevelopment opportunities.
- Potentially reduce infrastructure costs associated with managing stormwater runoff and thus save development and operation and maintenance costs.
- Serve as a guide to help identify measures that can be incorporated into redevelopment projects which will compliment the actions identified in this plan (shoreline stabilization and restoration, wetland creation, riparian preservation, etc.) as a way to create additional restoration opportunities.
- Sustain existing green infrastructure and expand green infrastructure assets (which slow, store, and purify rain and runoff water) in the Lower Black River while complying with applicable regulatory requirements.

An important objective of this Lower Black River Ecological Restoration Master Plan is to share information with the City's decision-makers on the importance of the natural resource that is the Black River. Another objective of the document is to point the decision-makers to local, regional and federal tools and techniques that will enable restoration and protection efforts while the City undergoes an economic rebirth. Toward that end, this restoration toolbox has been developed.

It is not the purpose of the Restoration Toolbox to be used as a design manual or present all of the BMPs that could be used or required. For more information on the BMPs highlighted in this appendix, please see the following for more specific information (complete references are supplied in the Bibliography at the end of this appendix).

- ODNR Rainwater Manual (adopted by reference by City of Lorain's stormwater ordinance).
- LID Center.
- Center for Watershed Protection.

As noted earlier in the plan, a series of restoration and protection actions have been identified that when completed will help substantially improve habitat and near shore water quality and support economic development. At the same time, redevelopment and other land use changes which are driven by community economic development priorities and private sector interests (some of which are identified in the plan), will provide additional opportunities to advance restoration goals through incorporation of measures which protect restored ecological assets and also assure compliance with community and agency environmental goals & regulatory requirements. Finally, it presents an opportunity to creatively protect restoration investments recommended by this plan through minimizing impacts of land use changes.

Ordinances and regulations designed to protect and sustain the ecological assets of the Lower Black River include:

- City of Lorain Riparian Setback Ordinance (Ord. 109-04),
- City of Lorain Stormwater Management Ordinance,
- U.S. Army Corps of Engineers Section 404 Fill and Dredge Permit Rules,
- Ohio EPA Section 401 Certification requirements,
- Ohio EPA NPDES General Permit.

Each of these either control development in sensitive areas (such as

riparian setbacks) subject to certain conditions and protect aquatic resources by requiring permits and measures to mitigate impact from actions (Dredge and Fill Permits) or use of specific best management practices to reduce water quality impacts typically associated with increased stormwater runoff and land use changes.

City of Lorain Planning

The City of Lorain has no comprehensive plan; Ohio law does not require that cities prepare comprehensive plans. A comprehensive plan can be the foundation for municipal decision-making regarding land use, and would clearly be a useful tool in helping to guide the restoration of ecological and economic health in the city. Completing a Comprehensive Plan, in particular one which adopts the recommendations of this Ecological Restoration Master Plan, would be a substantial step in documenting Lorain's vision for its future growth, and help ensure that ecological and economic restoration truly go hand in hand. Lorain's Department of Community Development has developed a number of different plans over the last decade, many of these plans focus on the area encompassed by this plan. Master plans were developed for two prime development areas, the Upper Black River Master Plan, which was the foundation for developing the Riverbend Commerce Park, and the Black River Lorain Harbor Shoreline Master Plan, which is being used to assist the City in determining the redevelopment of the former Lorain Pellet Terminal. Riverbend Commerce Park has been designed, and the infrastructure (roads and major utilities) have been installed. No businesses have located there yet. These plans were reviewed during the development of this Restoration Master Plan, to avoid potential conflicts with Lorain's aims for these properties. As the Riverbend Commerce and Harbor Shoreline plans are put into action, the city is encouraged to make use of Lower Black River Habitat Restoration Master Plan as well. Incorporating the suggested actions into these two development plans will help reach the goals of ecological and economical enhancement.

In 1998, Lorain began the first of several Urban Renewal eligibility surveys and planning initiatives. The Urban Renewal designation provides several benefits to the city and the planning areas. The designation allows the city to issue bonds for public improvements, property acquisition, demolition, environmental clean-up and other activities that are consistent with the plan. The plan is formally adopted by both the Planning Commission and City Council and is a document that guides the redevelopment of the plan area, providing insight to the private development community of the desires of the community for the specific area. It provides additional review requirements to ensure that developments that occur within the plan area are consistent with the plan and require that the developer enter into a development agreement with the city.

Currently the City has adopted 8 Urban Renewal plans, those in bold lie within this plan's area:

- **Revised Riverfront Urban Renewal Plan.**
- **Colorado Avenue Industrial Area Urban Renewal Plan.**
- Washington Avenue Urban Renewal Plan.
- Central Lorain Urban Renewal Plan.
- **Lighthouse Village Urban Renewal Plan.**
- Lorain West Urban Renewal Plan.
- South Lorain Urban Renewal Plan.
- **Lakefront Urban Renewal Plan.**

Again, as these plans are implemented, the city is encouraged to use the Lower Black River Habitat Restoration Master Plan as a guide to include ecological restoration in those urban renewal areas. Such restoration could do much to restore the quality of life and help economic recovery in these designated areas.

City of Lorain Ordinances

Riparian and Wetland Setback: The City of Lorain has adopted, in Chapter 1533 of Codified Ordinances, Riparian and Wetland Setback

requirements. The specific purpose of such regulation is to regulate uses and developments within the setback zone which impair riparian and wetland areas to:

- Reduce flood impacts, slow floodwater velocity, and regulate base flow.
- Reduce watercourse bank erosion and downstream sedimentation.
- Reduce pollutants already in the watercourse through filtering, settling and transformation.
- Reduce pollutants before they enter the watercourse through filtering, settling and transformation.
- Provide shade and food in watercourses.
- Provide aquatic and wildlife habitat.
- Avoid costly engineering solutions to flooding and erosion.
- Reduce property damage costs from flooding.
- Contribute to the scenic beauty and quality of life in Lorain and corresponding property values.

Ordinance requirements include a riparian setback of 300 feet on

Riparian setbacks help protect a variety of functions that help support water quality.

both sides of the Black River. City required setbacks from delineated wetlands are defined in the ordinance as based on drainage area; a minimum 25' setback is defined.

Uses permitted in the riparian setback include:

- Passive recreational uses such as hiking, fishing, hunting, picnicking, and similar uses.
- Removal of damaged or diseased trees.
- Revegetation or reforestation.
- Maintenance of lawns, gardens, and landscaping which existed at the time of the ordinance passage in 7/19/04.

Uses prohibited in the riparian setback include:

- Construction. There shall be no structures of any kind.
- Dredging or Dumping.
- Roads or Driveways.
- No use of Motorized Vehicles.
- No disturbance of natural vegetation.
- Parking Lots.
- New surface or subsurface sewage disposal or treatment areas.
- Utility crossings without regulatory permits.

Non Conforming Uses or structures in the Riparian Setback in existence at the time of ordinance passage (7/19/04) may continue, however they may not be changed or enlarged. A non conforming use or structure which is discontinued or abandoned for six months or more, may not be revived or re-established.

A property owner can try and obtain a variance from the setback requirements by demonstrating hardship. When setback variances are granted, compensatory mitigation is typically required.

City of Lorain Stormwater Management, Water Quality Requirements: The City of Lorain has adopted Post Construction Water Quality Control Plan requirements contained in Ordinance 1531.

Proposed new development projects require a Post Construction Water Quality Control Plan which includes a: Construction Site Conservation Plan, and a Riparian and Wetland Setback Plan.

BMPs used must comply with the latest edition of Ohio's Rainwater

and Land Development Manual, ODOT Post Construction stormwater standards, or other manual acceptable to the City Engineer or Ohio EPA. BMPs selected must be sized to treat the water quality volume (WQ) complying with Ohio's Water Quality Standards (OAC 3745-1) equivalent to the volume of runoff from a 0.75 inch rainfall.

City of Lorain Stormwater Management, Quantity Requirements: The City of Lorain has adopted Post Construction Water Quality Control Plan requirements contained in Ordinance 1529.

The peak rate of runoff from new development projects must not be greater after development than before development. Calculations must prove no increase in runoff rates for the 1, 2, 5, 10, 25, 50 and 100 year design storm events.

If site constraints exist which compromise the intent of the ordinance, the City Engineer may approve practical alternatives, which may include fees, off site mitigation, watershed restoration, or retrofitting of existing city facilities.

Emerging Approaches

LID: Low-Impact Development (LID) has emerged in the past 10 years as a way which systematically integrates stormwater management tools into sites to control stormwater runoff. Initiated in Prince George's County, Maryland and introduced initially into Northeast Ohio by the Chagrin River Watershed Partners in 1999, LID is focused on an entirely different approach to managing stormwater. Instead of the "end of pipe" approach that typically have driven stormwater management, LID looks at the entire site to identify ways to manage stormwater at its source using an array of structural and nonstructural tools. LID design can be applied to both new development and to existing development (retrofits). LID measures can include a range of structural and non-structural measures such as bioretention, vegetated swales, pervious pavement, constructed wetlands, green roofs, soil amendments, disconnecting pervious surfaces, rain barrels and open space preservation.

Green Infrastructure: U.S. EPA defines green infrastructure as an approach to wet weather management that is cost-effective, sustainable, and environmentally friendly. Green infrastructure management concepts infiltrate, evapotranspire, capture and reuse stormwater to maintain or restore natural hydrology.

At the largest scale, the preservation and restoration of natural landscape features (such as forests, floodplains and wetlands) are critical components of green stormwater infrastructure. By protecting these ecologically sensitive areas, communities can improve water quality while providing wildlife habitat and opportunities for outdoor recreation.

Low impact development preserves green space and provides ecological functions.

On a smaller scale, green infrastructure integrates LID practices such as rain gardens, porous pavements, green roofs, infiltration planters, trees and tree boxes, and rainwater harvesting for non-potable uses such as toilet flushing and landscape irrigation.

Green roofs such as this one in Wisconsin help filter rainwater, cool buildings and provide added green areas.

Economic Benefits of Green Infrastructure: Investments in ecological restoration and green infrastructure measures must be seen in the broader context of Lorain's movement to re-invent itself as a more sustainable 21st century city. Lorain, like many major American cities, is faced with an array of economic, social, and environmental challenges. These challenges require that government agencies break out of their traditional roles of providing narrowly defined services and seek to work together toward larger goals.

The Green Infrastructure approach provides multiple measurable economic benefits. These benefits include:

- Enhance recreation.
- Reduce flooding.
- Reduce flood damages.
- Improve water quality.
- Enhance wildlife habitat.
- Improve community quality of life.
- Improve community property values.
- Create green jobs.
- Help revitalize distressed neighborhoods and commercial districts.
- Reduce urban heat island effect.
- Improve air quality.
- Save energy.
- Offset climate change.

A Triple Bottom Line (TBL) analysis of the environmental, social, and economic benefits means expanding the traditional financial reporting framework to take into account ecological and social performance so that the total benefits can be evaluated against the financial investment. The City of Philadelphia has announced a Green Infrastructure program to significantly reduce Combined Sewer Overflows. The $1.6 billion plan, the largest in the U. S., calculates the total benefits at over $2.2 billion in present value. The TBL concept should be applied as Lorain moves to accomplish the goals of the Ecological Restoration Master Plan, and in particular as the city incorporates the concepts presented in this plan into their other planning exercises.

Green Space Design: Green Space Design is an approach that requires new developments to provide green space either in the proposed development or at least within the community. The concept is intended to provide and protect the open space that the community desires before development pressures dictate how a community will look. In the past, the look of the river corridor was dictated by industrial need. As the City of Lorain re-invents itself and now sees the Black River corridor as its Main Street, the community has been given a second chance to decide how it grows and develops.

Green spaces can perform important functions on their own. These functions can be amplified and enhanced when green space design is used to connect patches of natural area and habitat, through connecting corridors. Appropriate connecting corridors increase the "functional size" of the areas they connect. They protect the long term viability of the patches they connect by providing paths along which animals and plant propagules (seeds and vegetative reproductive parts by which plants reproduce and spread) can move among patches. This movement helps ensure that wildlife populations can survive. Connecting corridors need not be single use, appropriate designs can provide for both ecological function and recreational use as bike and hike paths.

Compensatory Mitigation and Banking: Compensatory mitigation is required by the state and federal agencies that oversee wetland and stream impact permits, to offset unavoidable degradation of ecological areas or functions caused through permitted activities. Strictly speaking, compensatory mitigation is the last step in a three step process. Under Section 404(b)(1) of the Clean Water Act, the required mitigation sequence is:

- Avoid – Adverse impacts to aquatic resources should be avoided if practicable.
- Minimize - If impacts cannot be avoided, appropriate and practicable steps to minimize adverse impacts while still meeting the project purpose and need must be taken.
- Compensate - Appropriate and practicable compensatory mitigation is generally required for any unavoidable adverse impacts which remain.

There are at present no mitigation banks in the lower Black River area but one could be potentially be established or sponsored by the city, or by a corporation or other entity such as a nonprofit organization. In the past, ecologically functions have been "exported" from the Black River watershed, through compensatory mitigation supplied by mitigation banks outside the watershed. Some of the preservation sites identified in the Lower Black River Ecological

A good example of local compensatory mitigation efforts is this developing wetland in the Colorado Industrial Park.

Restoration Master Plan could be established as mitigation banks, or as consolidated mitigation areas, or as individual compensatory mitigation sites. Under current Corps of Engineer's rules, there is a preference for banking as opposed to smaller individual compensatory wetland projects cited on or near developments. To establish a bank, a banking plan and prospectus must be developed, following Corp's of Engineers and Ohio EPA guidelines. All banks in Ohio must be approved by the Mitigation Banking Review Team.

Barring the official establishment of a mitigation bank site, this plan can serve as a tool to guide permit applicants to potential mitigation sites called out as action locations in the Lower Black River Habitat Restoration Master Plan.

Best Management Practices

Best Management Practices (BMPs) are methods, measures, or practices used to manage the quantity and quality of runoff. They include management practices such as street sweeping or structural practices such as rain gardens designed to reduce runoff volume and to remove pollutants, such as sediment, nitrogen, phosphorous, and heavy metals, that are washed by rain and snow melt into nearby water ways.

Effective control or reduction of non-point source loads will require implementation of best management practices or BMPs in the Black River watershed. BMPs may involve efforts to change land-use practices or watershed activities in ways that reduce pollutant runoff or the construction and operation of features that reduce the rate at which pollutants runoff from the watershed.

BMPs for urban and residential watersheds follow two strategies: reducing or preventing runoff and resultant pollutant loading, and treating runoff water. Limiting the amount of impervious surface is a prime consideration for reducing runoff and the resulting reduction of pollutants. This often involves the inclusion of infiltration features (infiltration trenches or basins) in landscape designs, limitations in the use of curbs on streets and driveways, and parking lot designs that include permeable, vegetated areas.

The specific BMP's discussed in this section include:

- Stormwater wetlands.
- Filter strips.
- Grassed swales.
- Bioretention.
- Tree box filters.
- Green streets.
- Green roofs.
- Urban forestry.
- Cisterns.

Table C.1, located on page C 18, is a decision matrix designed to help users of this plan determine appropriate BMPs for a variety of situations.

Local Application of BMPs: Future development in Lorain Ohio and the Black River corridor present significant opportunities to reduce runoff and improve water quality. BMPs have been installed or are being designed at numerous projects in Northeast Ohio.

One prominent local example of development which exemplifies this approach is the proposed expansion of the Cuyahoga Community College (Tri-C) Eastern Campus. Tri-C required the design to incorporate as many appropriate green technologies as appropriate. Techniques that were incorporated into TriC's plan include:

- Minimized wetland impacts.
- Preserve native vegetation.
- Roof runoff for rain gardens.
- Extended wet detention basin.
- Green roofs.
- Parking lot Bioswales.
- Porous pavement of various types.
- Native plantings.
- Preservation of quality natural areas.
- Stream and wetland restoration.

Figure C-1 shows the conceptual layout for Tri-C's Eastern campus, with the various BMP's and other "green" suggestion called out.

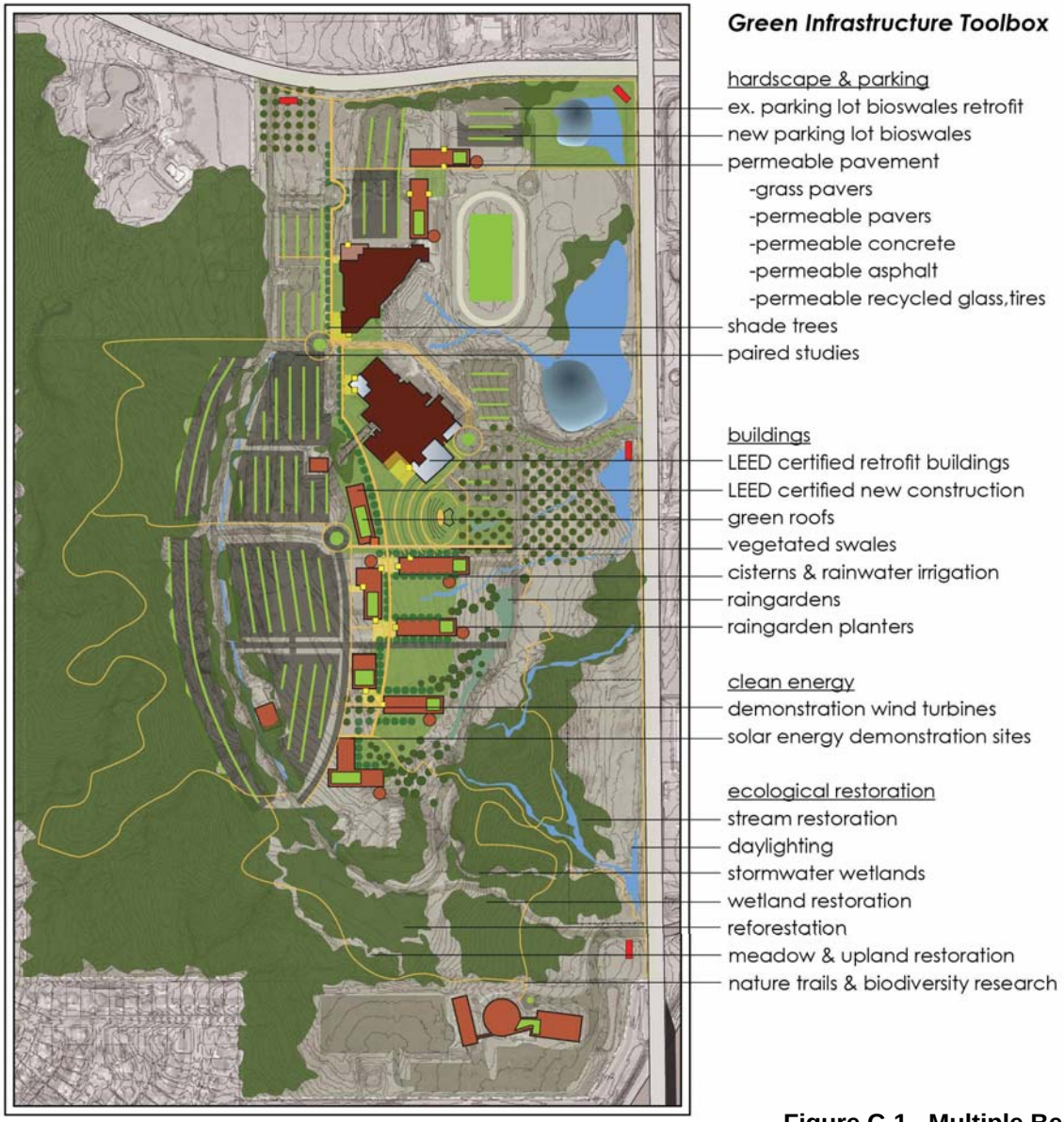


Figure C-1. Multiple Best Management Practices Employed in Tri-C's new Campus Master Plan

"Natural" BMPs Needing Little Design

Some BMPs can be realized using existing areas of natural vegetation. Techniques in this category might be accomplished with little or no engineering design.

Filter Strips: Filter strips are land areas of either planted or indigenous vegetation, situated between a potential, pollutant-source area and a surface-water body that receives runoff. Often located along stream, lake, or pond boundaries, filter strips help remove pollutants from runoff, and may also serve as habitat for wildlife.

The purpose of a filter strip is to trap sediment, plant nutrients, organic matter and chemicals as runoff from urban areas passes through the vegetated area. Filter strips generally are more effective in trapping sediment, and therefore, sediment-bound nutrients and pesticides, than soluble nutrients and pesticides. Nutrients that bind to sediment include phosphorus and ammonium; soluble nutrients include nitrate.

Filter strips have been employed rather extensively in agricultural settings, less so in urban areas. Developing an effective filter strip requires information on the pollutants to be treated, contributing slope and drainage area, and soil and plant characteristics of the proposed filter strip.

Location of the filter strip is important. In general, the most efficient strips are those that intercept shallow, uniform flow. Filter strips do not tend to perform well when flow enters in concentrated channels. The structure and composition of the plant community is important. Species selected should have a dense growth of stems, and a dense, fibrous root system. Clearly, native species should always be used. Because of their fibrous and often rhizomatous roots, the dense sod they form and the dense pattern of stem growth, grasses tend to be more effective than broadleaf plants. From many perspectives, cool-season grasses are more desirable than warm-season grasses since they grow more vigorously in the spring and

The vegetated areas surrounding this urban stream, pond and wetland restoration area serve as urban filter strips to help treat runoff. This example is located in Akron, Ohio.

fall when other species have not sprouted or have senesced, and rainfall can be intense.

The width of filter strips is an important factor in their function. Again, width is in part dependent upon drainage area and slope. Studies in the Midwest indicate widths between 10 and 40 feet seem to be effective in trapping phosphorous and sediment. For slopes of one percent or less, strips of 10 feet appear to be functional. For areas where the contributing slope is 20 percent or more, filter strip widths of 25 feet or more may be required.

Well designed filter strips generally require little maintenance, therefore costs may be reduced compared to other methods of handling stormwater. Mowing twice a year should help keep woody vegetation from dominating. Mowing frequencies much greater than two or three times a year could promote the growth of non-native grasses. Mowing should not be close-cropped, mowed heights of six inches are desirable.

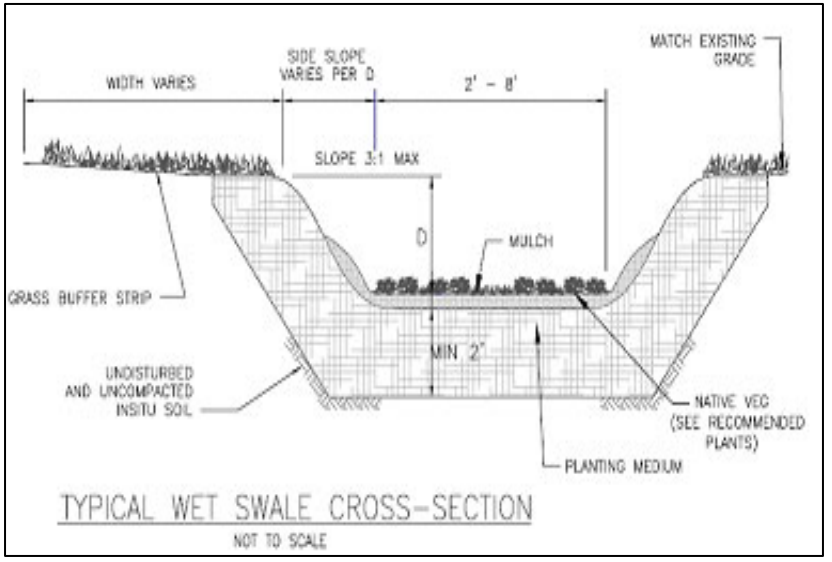
A good primer on filter strips in Ohio, with an admitted agricultural focus, is: http://ohioline.osu.edu/aex-fact/0467.html.

Grassed Swales: Swales are a low cost low maintenance option to remove sediments, nutrients and pollutants. They increase stormwater infiltration and add a visually aesthetic component to a site.

A grassed swale is a graded and engineered landscape feature appearing as a linear, shallow, open channel with trapezoidal or parabolic shape. The swale is planted with flood tolerant, erosion resistant plants.

The design of grassed swales promotes the conveyance of storm water at a slower, controlled rate and acts as a filter medium removing pollutants and allowing stormwater infiltration. When properly designed to accommodate a predetermined storm event volume, a grassed swale results in a significant improvement over

Grassed swales are often used in rural settings, but as shown in the photo above, the concept can be applied in the urban environment as well. A typical design is shown below.

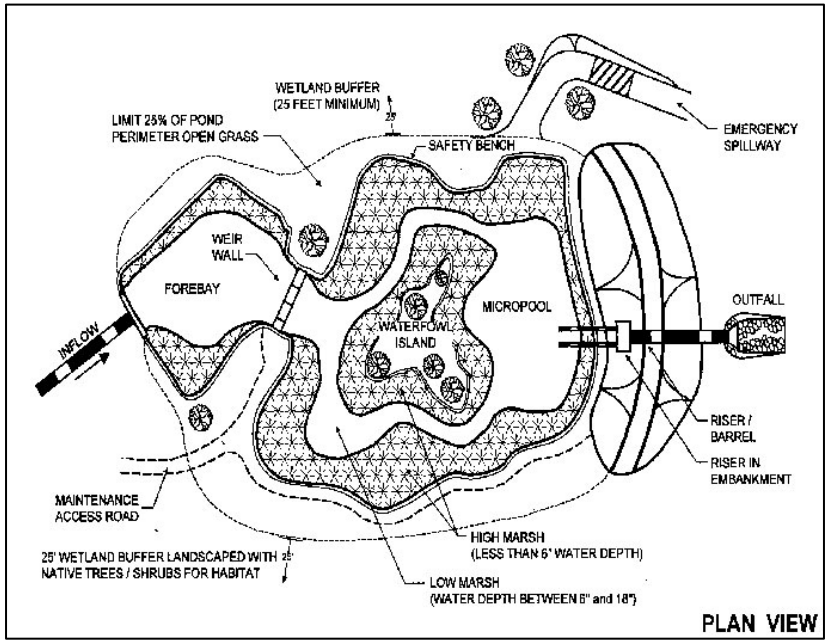


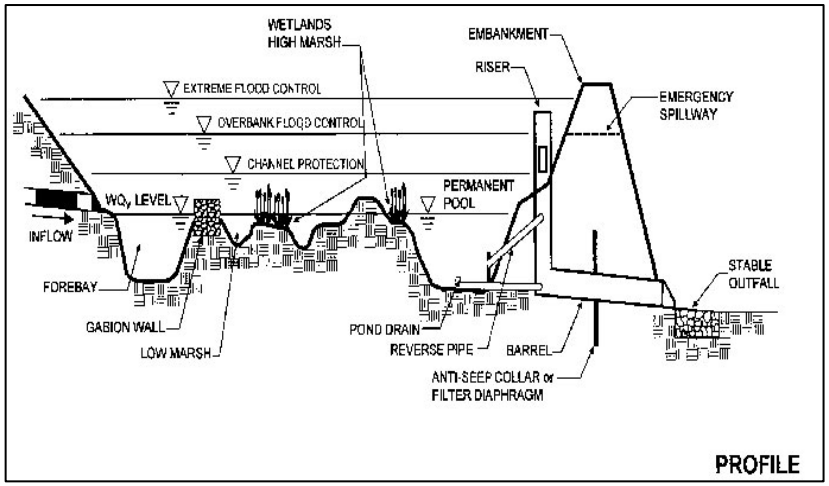
the traditional drainage ditch in both slowing and cleaning of water.

Stormwater Wetlands: Stormwater wetlands (constructed wetlands) are structural practices that in their simplest form incorporate wetland plants in a shallow pool. As stormwater runoff flows through the wetland, pollutant removal is achieved by settling, biological uptake, and the anaerobic chemical pathways in wetland soils. Wetlands are among the most effective stormwater practices in terms of pollutant removal, and also offer aesthetic value.

Stormwater wetlands are fundamentally different from natural wetland systems. Stormwater wetlands are designed specifically to optimize the treating stormwater runoff, and may have lower levels of species richness and diversity than natural wetlands or compensatory mitigation wetlands, since high diversity is sometimes not a design goal for constructed wetlands. Stormwater wetlands may provide some habitat and other values that natural wetlands offer, but their designs necessarily include features such as forebays (deeper pools located at the inlet of stormwater wetlands, these are designed to retain sediment) that typically require regular maintenance. Stormwater wetlands are quite different in intent and design from wetlands developed as part of a compensatory mitigation plan. The maintenance needs, and the difference in intent of design, generally preclude stormwater wetlands from receiving credit as part of a compensatory mitigation package.

The conceptual plans below show typical stormwater treatment wetland designs. Designs for stormwater wetlands generally feature a forebay. The most effective designs mix wetland communities, with shallow areas dominated by emergent plant (high marshes in the diagrams), and deeper areas dominated by submerged aquatic and floating leaved plants (low marsh in the diagrams). These systems are primarily detention systems, and the effectiveness of the treatment depends largely on the retention time (time that water is held in the system) and the surface area and volume for contact of the water with soil and plant roots.





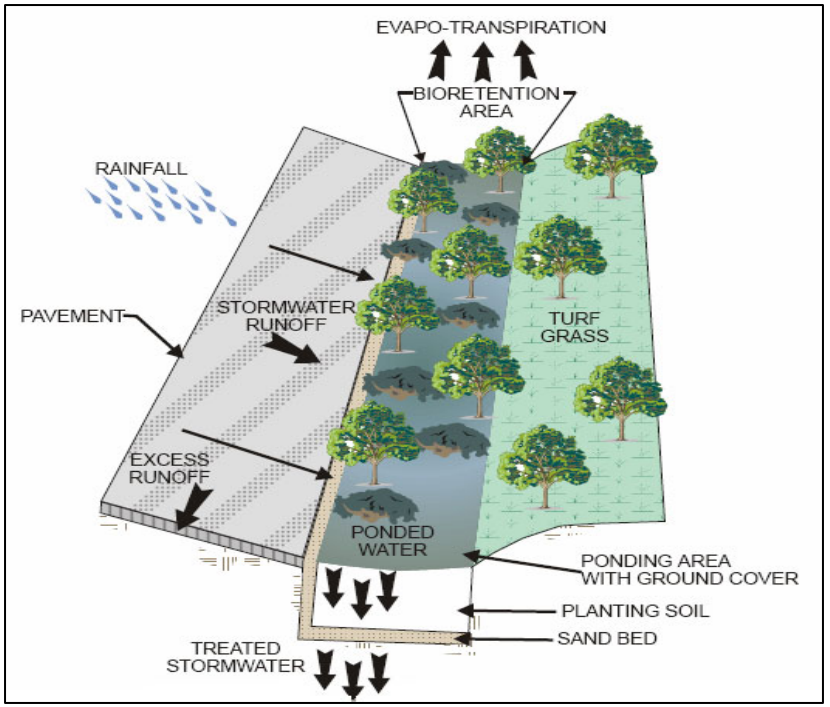
Typical plan and cross section for a stormwater treatment wetland.

Advantages:

- Improvement in downstream water quality.
- Settlement of particulate pollutants.
- Reduction of oxygen-demanding substances and bacteria from urban runoff.
- Biological uptake of pollutants by wetland plants.
- Flood attenuation.
- Reduction of peak discharges.
- Enhancement of vegetation diversity and wildlife habitat in urban areas.
- Aesthetic enhancement and valuable addition to community green space.

Well designed Bioswales provide a mechanism for infiltration and filtering stormwater.

Bioretention: Bioretention areas function as soil and plant-based filtration devices that remove pollutants through a variety of physical, biological, and chemical treatment processes. Rather than simply conveying the stormwater flows to an outfall, where stormwater and all the pollutants the flow has collected reach the receiving stream,



Cross section through a typical bioswale design. The general design for a Raingarden would follow the same concepts, but the structure would be less linear in shape .

these BMPs help reduce pollutant loads. The reduction of pollutant loads then helps cities and other permitted entities achieve their regulated water quality goals. Ohio Stormwater Code requires the collection and filtration of the first 0.75" of rainfall. Studies have found that properly designed and constructed bioretention cells are able to achieve excellent removal of heavy metals and other pollutants. Raingardens, and bioswales are types of bioretention.

Raingardens and bioswales generally function by providing a mechanism for the slow infiltration of runoff through a plant and soil

matrix. As this infiltration occurs, water is physically filtered as it slowly moves through the porous medium. Further, some nutrients and other pollutants are taken up into plants, or adsorbed onto clay particles. Some nutrients and other materials are broken down by soil microbes.

Small bioswale located in a curb cut.. Runoff from the road surface enters the curb cut in the foreground, and is filtered through the soil and vegetation.

In order to function best, bioretention areas should be placed over soils that show at least moderate permeability. Locating over such soils allows the bioretention areas to function as a means to hold water for longer terms in the soil. There are some situations where these BMPs can be sited over soils that are not permeable. In brownfield and other industrial areas, and may not be desirable to infiltrate water through deeper contaminated layers. In such cases, raingardens and bioswales can be constructed as beds of permeable material (sand and gravel generally) over an impermeable layer that prevents contact with deeper strata. In these cases, designed holding times for storm flows are on the order of 48 hours., and the treatment is largely reduced to physical filtering of the flows through the permeable sand and gravel layers. Treated waters are then discharged to the receiving stream or storm sewer system.

One of the primary objectives of Low Impact Development site design is to minimize, detain, and retain post development runoff uniformly throughout a site so as to mimic the site's predevelopment hydrologic functions. Originally designed for providing an element of water quality control, bioretention cells can achieve quantity control as well. By infiltrating and temporarily storing runoff water, bioretention cells reduce a site's overall runoff volume and help to maintain the predevelopment peak discharge rate and timing.

Permeable Pavement: Alternative paving materials can be used to infiltrate rainwater and reduce the runoff leaving a site. This can help to decrease downstream flooding, the frequency of combined sewer overflow (CSO) events, the frequency of sanitary sewer overflows (SSO) events, and the thermal pollution of sensitive waters. Use of these materials can also eliminate problems with standing water, provide for groundwater recharge, control erosion of streambeds and riverbanks, facilitate pollutant removal, and provide for a more aesthetically pleasing site. Alternative pavers can even eliminate the requirement for underground sewer pipes and conventional stormwater retention / detention systems.

Permeable pavement comes in four forms: permeable concrete, permeable asphalt, permeable pavers, and grid pavers. Permeable concrete and asphalt are similar to their impervious counterparts but are open graded or have reduced fines and typically have a special binder added. Permeable pavers and grid pavers are modular systems. Permeable pavers are installed with gaps between them that allow water to pass through to the base. Grid pavers are typically a durable plastic matrix that can be filled with gravel or vegetation. All of the permeable pavement systems have an aggregate base in common which provides structural support, runoff

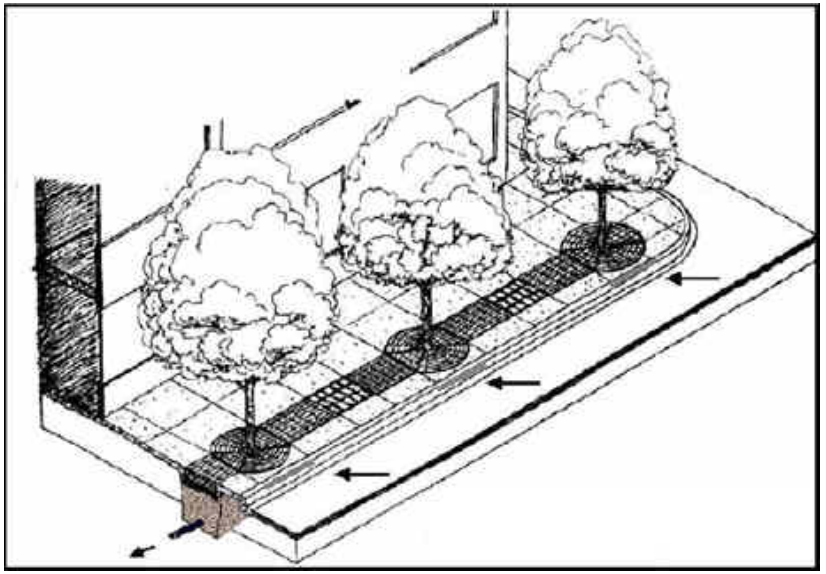
storage, and pollutant removal through filtering and adsorption.

Nearby examples of the use of, permeable paving materials can bee seen at Cleveland State University's campus, and in the streetscapes of Cuyahoga Falls.

Some permeable pavement systems are indistinguishable from traditional impermeable pavement.

Tree Box Filter: Tree box filters are mini bioretention areas installed beneath trees that can be very effective at controlling runoff along streets or parking lots. Runoff is directed to the tree box, where it is cleaned by vegetation and soil before entering a catch basin. The runoff collected in the tree-boxes helps irrigate the trees.

Tree box filters are based on an effective and widely used "bioretention" technology with improvements to enhance pollutant removal, increase performance reliability, increase ease of construction, reduce maintenance costs and improve aesthetics. Typical landscape plants (shrubs, ornamental grasses, trees and flowers) are used as an integral part of the bioretention / filtration system. They can fit into any landscape scheme increasing the quality of life in urban areas by adding beauty, habitat value, and reducing urban heat island effects.



A typical tree box filter design.

The system consists of a container filled with a soil mixture, a mulch layer, under-drain system and a shrub or tree. Stormwater runoff drains directly from impervious surfaces through a filter media. Treated water flows out of the system through an under drain connected to a storm sewer / inlet or into the surrounding soil. Tree box filters can also be used to control runoff volumes / flows by adding storage volume beneath the filter box with an outlet control device.

Green Streets: Urban Street right-of-ways integrated with green techniques are often called "green streets". In most cities, street right of ways represent about 25% of land area. Green streets achieve multiple benefits, such as improved water quality and more livable communities, through the integration of stormwater treatment techniques which use natural processes and landscaping. Green streets can incorporate a wide variety of design elements previously described such as permeable pavements, roadside bioinfiltration swales, tree box filters,

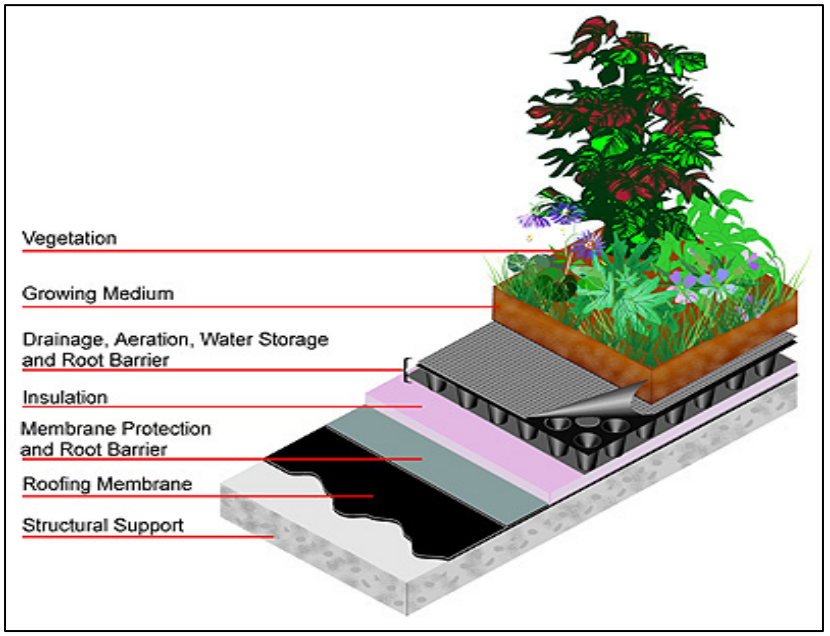
Green streets provide ecological benefits and improve the local quality of life for residents.

and urban forestry. Although the design and appearance of green streets will vary, the functional goals are the same: provide source control of stormwater, limit its transport and pollutant conveyance to the collection system, and provide environmentally enhanced roads.

Green Streets provide multiple benefits including:

- Integrated system of stormwater management within the right-of-way.
- Volume reductions in stormwater which reduce the volume of water discharged via pipe into receiving streams, rivers and larger bodies of water.
- Key linking component in community efforts to develop local green infrastructure networks.
- Improves local air quality by providing interception of airborne particulates and shade for cooling.
- Enhanced economic development along the transit corridor.
- Improved pedestrian experience along the street right of way.

Green Roofs: Green roofs are structural components that help to mitigate the effects of urbanization on water quality by filtering, absorbing or detaining rainfall. They are constructed of a lightweight soil medium, underlain by a drainage layer, and a high quality impermeable membrane that protects the building structure. The soil is planted with a specialized mix of plants that can thrive in the harsh, dry, high temperature conditions of the roof and tolerate short periods of inundation from storm events.



Cross section through a typical green roof design.

Green roofs provide stormwater management benefits by:

- Utilizing the biological, physical, and chemical processes found in the plant and soil complex to prevent airborne pollutants from entering the storm drain system.
- Reducing the runoff volume and peak discharge rate by holding back and slowing down the water that would otherwise flow quickly into the storm drain system.

Green roofs are not only aesthetically pleasing, but they also:

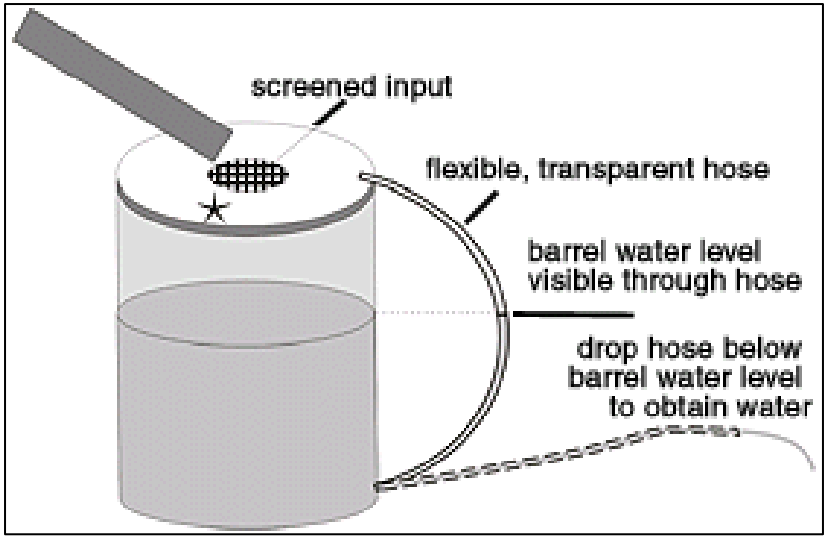
- Reduce city "heat island" effect.
- Potentially lengthen roof life 2 to 3 times.
- Treat nitrogen pollution in rain.
- Help reduce volume and peak rates of stormwater.

Urban Forestry: Trees are indicators of a community's ecological health. Trees and soils function together to reduce stormwater runoff. Trees reduce stormwater flow by intercepting rainwater on leaves, branches, and trunks. Some of the intercepted water evaporates back into the atmosphere, and some soaks into the ground reducing the total amount of runoff that must be managed in urban areas. Trees also slow storm flow, reducing the volume of water that a containment facility must store.

For example, in the Metropolitan Washington DC region, the existing 46% tree canopy reduces the need for retention structures by 949 million cubic feet, valued at $4.7 billion per 20-year construction cycle (based on a $5/cubic foot construction cost). The Green Build-out Model integrates GIS land cover data and hydrologic processes using rainfall storage and coverage areas for trees and green roofs. For an average year, the intensive greening scenario prevents over 1.2 billion gallons of stormwater from entering the sewer systems, resulting in a reduction of 10% or over 1 billion gallons in discharges to the District's rivers, and a 6.7% reduction in cumulative CSO frequencies (74 individual CSO discharges).

A widespread and systematic increase in tree canopy in Lorain will result in reduced runoff, and a reduced incidence of combined sewer and sanitary sewer overflows.

Rain Barrels: A rain barrel connected to a roof downspout is a great way to reduce stormwater going to the storm sewer system and to provide free water for gardening. Because runoff is collected right off the roof, it has few contaminants and is perfect for landscape watering. Rain barrels may be installed on single family homes, apartments, as well as commercial and public buildings.



Typical rain barrel design.

Diverting water from a downspout into rain barrels has several advantages:

- Lowers the percentage of roof top rainfall as a component of urban runoff.
- Reduces the volume of water flowing to the sewer treatment facility.
- Provides a backup source of water during times of drought or between rain showers.

- Helps to keep our creeks and beaches clean.
- Provides naturally softened water, great for delicate houseplants, auto cleaning and window washing.
- Saves money by lowering residents' water bill.
- Reduces the need for additional tax dollars earmarked for sewer expansion.
- Provides chlorine-free water helps maintain a healthy biotic community in the soil.
- Can be used as an educational tool for teaching residents about water conservation.

Cisterns: Cisterns are built to catch and store rainwater. They are larger versions of rain barrels and range in capacity from a few gallons to several thousand gallons.

Stormwater runoff cisterns are roof water management devices that provide retention storage volume in above or underground storage tanks. They are typically used for water supply. Cisterns are generally larger than rain barrels, with some underground cisterns having the capacity of 10,000 gallons or more. On-lot storage with later reuse of stormwater also provides an opportunity for water conservation and the possibility of reducing water utility costs.

Bibliography/Graphics Sources

American Forests website
http://www.americanforest.org/resources/urbanforests/naturevalue.php

Center for Watershed Protection. 2009. http://www.cwp.org/

Low Impact Development Center. 2009. New LID Web Site Design. Beltsville, Maryland. http://www.lowimpactdevelopment.org/

Ohio Department of Natural Resources. 2006, Rainwater and Land Development Manual. Columbus, Ohio.
http://www.dnr.state.oh.us/tabid/9186/Default.aspx

Ohio State University Food, Agricultural and Biological Engineering Department Vegetative Filter Strips: Application, Installation and Maintenance http://ohioline.osu.edu/aex-fact/0467.html

Treelink
http://www.treelink.org/linx/?navLocationRef=9

The Green Build-out Model: Quantifying the Stormwater Management Benefits of Trees and Green Roofs in Washington, DC
http://www.caseytrees.org/planning/greener-development/gbo/documents/GBO_Model_Report_Abstract_051607.pdf

Urban Design Tools Low Impact Development
http://www.lid-stormwater.net/treeboxfilter_home.htm

Table C.1. Guide to Selection of Best Management Practices.

Service Area Characteristics	Best Management Practice (BMP)											
				Bioretention								
	Stormwater wetlands	Filter strips	Grassed swales	Bioswale	Raingarden	Tree box filter	Permeable Pavement	Green streets	Green roofs	Urban forestry	Rain Barrels	Cisterns
Residential Areas												
High Density Single Family												
Existing Residential property				■	■	■	■	■			■	
Residential property with flat roofs				■			■	■			■	
Vacant lots				■	■	■		■		■		
Streets with smaller ROW				■		■	■	■				
Low Density Single Family												
Existing Residential Property				■	■		■	■		■	■	
New Residential Development	■	■	■	■	■		■		■	■	■	
Residential feeder streets with flat grades	■		■	■			■	■		■		
Multifamily												
Flat roof buildings									■			■
Shared parking lots, open space, etc.	■	■	■	■			■	■	■	■		
Commercial/Industrial/Public Spaces/Institutional												
Flat roof buildings									■			■
Building(s) with water intensive landscaping												■
Shared parking lots, open space, etc.	■	■	■	■		■	■	■		■		
Vacant lots/brownfields				■						■		
Streets with flat grades and curbs				■		■	■	■		■		
Streets with flat grades without curbs			■	■			■	■		■		
Parkland/Natural areas	■	■	■	■	■		■			■		

Bibliography/Graphics Sources

American Forests website
http://www.americanforest.org/resources/urbanforests/naturevalue.php

Center for Watershed Protection. 2009. http://www.cwp.org/

Low Impact Development Center. 2009. New LID Web Site Design. Beltsville, Maryland. http://www.lowimpactdevelopment.org/

Ohio Department of Natural Resources. 2006, Rainwater and Land Development Manual. Columbus, Ohio.
http://www.dnr.state.oh.us/tabid/9186/Default.aspx

Ohio State University Food, Agricultural and Biological Engineering Department Vegetative Filter Strips: Application, Installation and Maintenance http://ohioline.osu.edu/aex-fact/0467.html

Treelink
http://www.treelink.org/linx/?navLocationRef=9

The Green Build-out Model: Quantifying the Stormwater Management Benefits of Trees and Green Roofs in Washington, DC
http://www.caseytrees.org/planning/greener-development/gbo/documents/GBO_Model_Report_Abstract_051607.pdf

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Appendix D

Lower Black River
Lorain, Ohio
Ecological Restoration Master Plan

APPENDIX D – ECONOMIC BENEFITS OF ECOLOGICAL RESTORATION, CASE STUDIES

Overview

Ecological Restoration of the Lower Black River Corridor holds significant potential to produce a wide variety of environmental, social, public health, and economic benefits for the City of Lorain. Measurable economic benefits associated with Ecological Restoration are listed below:

- Improved water quality.
- Increased tourism for sports fishing, bird watching.
- Create a recreational destination for visitors and residents.
- Beautification.
- Community image enhancement.
- Attract redevelopment.
- Property values increase.
- Create green jobs.

Economic Benefit Strategies

Clean up of degraded sites must begin before old industrial sites can be used, this project sets priorities for restoration which may attract grant funds to spur further clean up. The plan complements current removal of marketable materials, such as slag, thus helping to advance the City's redevelopment vision for these areas along the river.

Continued restoration of the Black River will help the City to attract development to the core of the City, the area along the river. This plan will guide restoration toward those areas where it is most appropriate, while maintaining the core parcels that should be redeveloped to draw jobs, people and money to the core of the City.

Grant Funds are available for "quick-hit", short term restoration projects that will show an immediate benefit. These could be high visibility restoration projects, are relatively inexpensive, that help quickly improve the River's health while drawing important attention to the City's redevelopment efforts, and the greater plan itself.

Potential dollars from permit applicants needing mitigation elsewhere could be brought to the project. The Plan is the vehicle for helping secure these funds by identifying locations and priorities.

Potential exists to provide mitigation sites for potential development projects along the river, thereby reducing development costs and permitting time frames. This creates a winning situation for all.

Improvements along the river provide an important symbol to visitors, who are currently supporting the very popular river tours sponsored by the Lorain Port Authority.

The Staubach Report, a general plan for the city developed in 2006, assessed the development feasibility of Lorain's waterfront areas. Some of the fundamental conclusions of this report included:

- Old and deteriorating industrial facilities were highly visible, and left a bad impression on residents and visitors.
- Environmental issues will make redevelopment a "non-starter" for most developers unless the issues are cleaned up.
- There was a pervasive lack of confidence in the city's resurgence among residents.

An ecological restoration program for the Black River could respond to each of the above issues.

Where Has Ecological Restoration Created Economic Benefits Before?

There are numerous examples of big and medium sized cities undertaking major ecological restoration initiatives which are part of significant economic development strategies.

An initiative to restore the lower 6.8 miles of the long abused Anacostia River in southwest Washington DC has a goal of restoring riparian functions and providing a swimmable river by 2025. This initiative is envisioned as stimulating the redevelopment of over 2800 acres of urban land area in 5 separate neighborhood districts.

The City of Philadelphia has published a Triple Bottom Line (TBL) Analysis of the environmental, social, and economic benefits of their proposed $1.6 billion green infrastructure and watershed restoration program. This TBL analysis calculates $2.2 billion in current value benefits, not including redevelopment values, from the Green Infrastructure program.

The attached case studies profile the restoration and redevelopment successes of mid sized, Great Lakes cities comparable to Lorain.

Economic Benefits Bibliography

Austin, J.C., S. Anderson, P.N. Courant, R.E. Litan. 2007. Healthy Waters, Strong Economy: The Benefits of Restoring the Great Lakes Ecosystem. The Brookings Institution Metropolitan Policy Program. Washington, D.C. 16pp.

Austin, J.C., S. Anderson, P. N. Courant, R.E. Litan. 2008. Place-Specific Benefits of Great Lakes Restoration: A Supplement to the "Healthy Waters' Report. The Brookings Institution Metropolitan Policy Program. Washington, D.C.

Austin, J.C., S. Anderson, P. N. Courant, R.E. Litan 2007. America's North Coast: A Benefit-Cost Analysis of a Program to Protect and Restore the Great Lakes. Ann Arbor, Michigan: Healing Our Waters. Ann Arbor, MI. 86pp.

Great Lakes Coalition. Braden, J.B., L.O. Taylor, D.H. Won, N. Mays, A. Cangelosi, A.A. Patunru. Economic Benefits of sediment remediation. Final Report for Project GL-96553601. Great Lakes National Program Office. U.S. Environmental Projection Agency. Chicago, IL. 113pp.

Cairns, J. Jr. and S.E. Palmer. 1995. Restoration of Urban Waterways and Vacant Areas: The First Steps toward Sustainability Environmental Health Perspectives*, Vol. 103, No. 5, pp. 452-453.*

Cangelosi, A., R. Weiher, J. Taverna, P. Cicero. 2001. Economic Value of Protecting the Great Lakes. The Northeast-Midwest Institute & NOAA, Washington, D.C. 247pp.

Freshwater Future. No date. Restoring the Great Lakes—One Community at a Time. Petroskey, MI.

Government of Canada. 2009. Canada's Great Lakes Program – The Economic Benefits of the Great Lakes Sustainability Fund. Environmental Canada Great Lakes.

Mays, N. No date. Local Benefits of Cleaning Contaminated Sediments. Northeast-Midwest Institute. Washington, D.C. 2 pp.

National Park Service. 2001. Economic Benefits of Conserved Rivers - An Annotated Bibliography. Rivers, Trails, & Conservation Assistance Program. 31pp.

SUCCESS STORIES

Toledo Marina District, Toledo OH





- 100 acre brownfield, site of former Acme Power Plant along Maumee River.
- 15 acre Riverfront Park created as an amenity for $320 million mixed-use development containing 1000 new housing units.
- Naturalized habitat edge, aquatic baskets, Green Infrastructure.
- Population 313,619; Median income $32,546.

City of Sheboygan Promenade, Sheboygan WI




- Population 50,792; Median Income $40,066.
- Former manufacturing community, polluted river, superfund site, significant job loss 1980's.
- Remediated contaminated sites- used creative developer finance mechanisms.
- $12 million in public infrastructure assessment.
- $54 million in hotel/resort development.
- 300-400 new jobs, $1 million in tax revenue.

Lower Don Lands Urban Redevelopment, Toronto Ontario

- Transformed port to sustainable green city.
- Former brownfield and channelized edges.
- Created an estuary to spark 150 acre development.
- Urban estuary, naturalized edge, floodway, 80 acre recreational park.
- Highend parkfront or riverfront property to support $900 million mixed use neighborhood.





SUCCESS STORIES

Waukegan Harbor, Waukegan IL



"We all agree that no single project is more important to Waukegan's economy than the environmental restoration of the harbor" ~U.S. Rep. Mark Kirk

- Waukegan population 87,901.
- $2.6 million in environmental restoration, sediment decontamination
- Will remove the harbor from the "Area of Concern" list to the "Area of Recovery" list.
- Over 1,600 acres of lakefront property to be restored.
- Will attract new homeowners and tourists, commercial and recreational investments.
- Property values could increase an average of $53,000 per home.
- Harbor cleanup could add over $800 million.

Old First Ward, Buffalo Riverfront, Buffalo, NY

- **Studies show homebuyers were willing to pay 15% more for homes near the Buffalo River if contamination was eliminated.**
- Contaminated former factories and steel mills.
- Water quality improvements, habitat restoration, brownfields.
- Could trigger an additional $543 million in taxable value for properties near the river.
- Buffalo population 292,648; Median income $24,536.
- Sparked plans for $1 billion waterfront mixed-use redevelopment on a brownfield.
- Ecological restoration, riverfront trail, aquatic & bird habitat enhancement.



Collingwood Harbor, Ontario



- Area of Concern, Remedial Action Plan for Lake Huron.
- Ecological restoration.
- Removal of 8,000 cubic meters of contaminated sediment.
- Improvements to sewage treatment plant.
- Cleaner water, stabilized stream slopes, improved fish habitat, increased recreational areas.
- Over $8 million invested to cleaup the contamination; over $3 million has been raised to continue improvements.
- Sparked sustainable growth along the waterfront.

SUCCESS STORIES

Grand Calumet River Remediation Project, Gary IN




- **Removing contaminated sediments could increase home values by 27%**
- Formal analysis of economic benefits of ecological remediation.
- Highly contaminated sediment remediation project, U.S. Steel brownfields.
- $41 million in restoration and river clean-up.
- Redevelopment opportunities along restored river.
- Gary population 102,746; Median income $27,195.

Stamford Harbor Redevelopment Project, Stamford CT

- Former gas plant, fuel oil depot, and manufacturing complex.
- Highly contaminated brownfields.
- Cleanup and redevelopment of 3 brownfields will leverage $370 million in private investment.
- Will create 600 construction and 1,300 permanent jobs.
- 25% of families currently below poverty level.
- Stamford population 118,475.


New Bedford Port Cleanup, New Bedford MA

- Federal Portsfield Program.
- One of the goals of NOAA.
- Superfund site cleanup.
- Attracting federal money from habitat restoration & brownfield cleanup.
- Habitat restoration as part of port revitalization, waterfront planning.
- Redeveloped brownfields in port areas can improve marine transportation wile providing environmental, eocnomic, and social benefits.
- New Bedford population 93,768.

Appendix E

Lower Black River
Lorain, Ohio
Ecological Restoration Master Plan

APPENDIX E – GLOSSARY OF TERMS

AOC: Area of Concern. They are defined by the U.S.-Canada Great Lakes Water Quality Agreement (Annex 2 of the 1987 Protocol) as "geographic areas that fail to meet the general or specific objectives of the agreement where such failure has caused or is likely to cause impairment of beneficial use of the area's ability to support aquatic life."

Aquatic: Living or growing in or on water.

Assemblage: A group of species found together in a particular area.

Beneficial Use Impairment (BUI): A potential use or trait of an area that is compromised by current ecological conditions

BMP: Best Management Practice. Refers to a design or technique that is generally adopted as a control, in this case generally as a control for surface run-off of stormwater.

Brownfield: Abandoned or underused industrial or commercial properties where redevelopment is complicated by actual or potential environmental contamination. Brownfields vary in size, location, age and past use.

Bulkhead: A large metal wall built to shore up and hold back river banks, particularly in navigation channels.

Carcinogenic: A substance or agent capable of causing cancer.

Community: A group of organisms that occupy a particular area. In general, community structure and composition is driven by environmental conditions. Thus, over particular soils, on particular slopes and in particular regions, one expects to find similar assemblages of plants and animals.

Conservation Easement: An easement placed to conserve or protect natural resources on a property or portion of a property.

Delisting: Removal of the AOC designation for a location after it has been sufficiently restored. Delisting requires removing the BUI targets.

Easement: An easement is a permanent restriction put on a piece of or an entire property, generally restricting its use or providing for a specific use. Easements are legally binding and are transferred when the property is transferred.

Ecological enhancement: Actions taken to improve the quality of an existing ecosystem. Actions may include stabilization of soils, planting, altering local hydrology, the removal of invasive species and others.

Ecological function: A measurable property of an ecosystem that characterizes that system. Examples include rates primary productivity and nutrient cycling.

Ecological restoration: Ecological restoration is an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability.

Ecoregion: A geographic area defined by a shared set of physical and ecological characteristics including climate, geology, and vegetation.

Ecosystem: An assemblage of plant and animal communities, and the physical environment in which they live, linked by a variety of processes that allow for the transfer of energy and materials between and among the component communities.

Fauna: The sum total of the animal species in an area.

Flora: The sum total of the plant species in an area.

Geographic Information System (GIS): A computer analysis system that combines an electronic map with an electronic data base which contains attributes describing various properties of the mapped features.

Great Lakes Legacy Act: This act, adopted in 2002, provides funding to take the necessary steps to clean up contaminated sediment in "Areas of Concern located wholly or partially in the United States," including specific funding designated for public outreach and research components.

Great Lakes National Program Office (GLNPO): A federal EPA office created in 1978 to oversee the U.S. fulfillment of its obligations under the Great Lakes Water Quality Agreement with Canada.

Green Infrastructure: Natural solutions that take the place of hardened, engineered structures, generally for storing and treating stormwater in this context.

Habitat: The area or environment in which an organism or community of organisms lives. There are many components to habitat, for most animals these include feeding, breeding, nesting or rearing, and escape habitat.

Impervious: The quality of not allowing water to pass. Most developed surfaces are impervious in that they do not allow water to percolate to the soil.

Infiltration: The process by which water moves from the surface to pore spaces in the soil.

Invasive species: Plants and animals that are not native to an area, and that since they generally have no natural predators or consumers in the area to which they were introduced, may thrive to the point that they crowd out native species.

Invertebrate: Species in the kingdom Animalia that lack backbones.

Lacustrine: Of or relating to lakes.

Low Impact Development: Land development techniques intended to alleviate some of the environmental impacts associated with residential, commercial and industrial development.

LQHEI: Lacustrine Qualitative Habitat Evaluation Index. A rapid assessment technique developed by the Ohio EPA for assessing lake shores and the banks of large rivers that drain to Lake Erie.

Macroinvertebrate: Invertebrate species that are greater than 5 microns in size. Typical aquatic macroinvertebrates include insect larvae and pupae, worms, arthropods and crustaceans.

Mitigation: The process of alleviating the effects of an impact. When used in wetland and stream regulation, the term involves a three-step process by which impacts to wetlands and streams are first avoided to the extent possible, the reduced to the extent possible, and finally compensated for by restoring damaged systems, or constructing new ones.

Morphology: The shape or structure of an object.

Mutagenic: A substance or agent that tends to increase the rate of genetic mutations.

Non-native: In this report, these are species that are not native to the northeast Ohio area, meaning they were not part of the flora and fauna prior to European settlement.

Polynuclear (or Polycyclic) Aromatic Hydrocarbons (PAHs): Chemical compounds that consist of three or more fused benzene (aromatic) rings. PAHs occur in oil, coal, and tar deposits, and are produced as byproducts of fuel burning. As pollutants, they are of concern because some compounds have been identified as carcinogenic, mutagenic, and teratogenic.

QHEI: Qualitative Habitat Evaluation Index. A rapid assessment technique developed by the Ohio EPA for habitat in rivers.

Reference ecosystem: A reference ecosystem can serve as the model for planning an ecological restoration project, and later serve in the evaluation of that project. Existing, high quality streams and wetlands can serve to document restoration targets for this Plan.

Remediation: The act of improving restoring a contaminated site involving enclosure, encapsulation, capping or removal of the material.

Riparian area: The land area extending from the banks of a river or stream landward, within which activities have direct impacts on stream ecosystem function.

Setback: A protection area set around a resource. Riparian setbacks are set around streams, and limit activities within the protection zone.

Slag: Rock like deposits that are by-products of steel production. Slags are mildly alkaline rocks that are often used as construction materials, particularly for road sub-grades.

Teratogenic: A substance or agent that tends to cause developmental malformations.

TMDL: Total Maximum Daily Load. A limit set on the total amount of pollution a stream may receive and still meet water quality standards.

Triple Bottom Line: An accounting theory that takes into account fiscal, ecological and social costs and profits.

Watershed: An area of land from which water drains to a river, pond or lake.

WWTP: Waste Water Treatment Plant. A plant used for treating sewage and other liquid wastes.