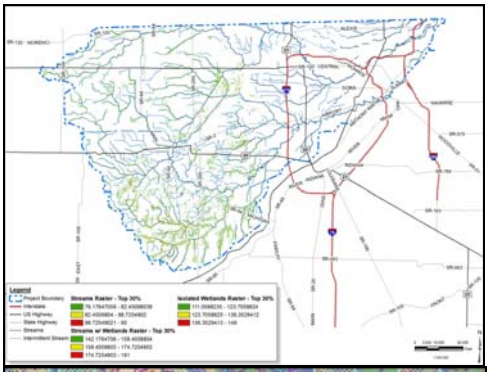

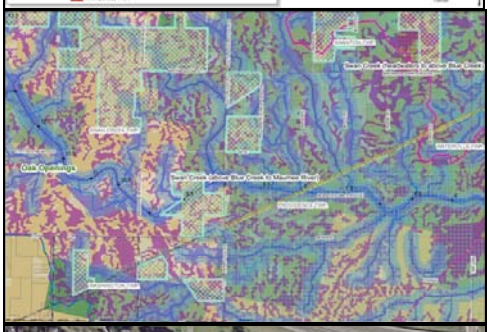

Wetland & Riparian Inventory & Restoration Plan

Swan Creek & Ottawa River Watersheds

October 2009

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FOREWORD

FORWARD

FOREWORD

This report presents a summary of a wetland and riparian inventory that was conducted in 2007 and 2008 by Partners for Clean Streams (PCS) for the Swan Creek and Ottawa River watersheds, located in Northwest Ohio. With funding provided by The Joyce Foundation, this study was implemented to identify specific sites and develop conceptual plans for wetland and riparian restoration within the watersheds that, once implemented, would have measurable positive impacts on fish and wildlife populations, benthic macroinvertebrate communities and fish and wildlife habitats within the Swan Creek and Tenmile Creek/Ottawa River watersheds.

The report is organized in the following manner:

Introduction

This section states the overall purpose of the study, provides a summary of the general characteristics of the Swan Creek and Tenmile Creek/Ottawa River watersheds, identifies the Beneficial Use Impairments that may be enhanced in the two watersheds by implementing these projects, and the overall goals and objectives of the study.

Project Overview and Methodology

This section provides a comprehensive, chronological review of the procedures that were used to identify suitable sites for wetland and stream restoration in the Swan Creek and Tenmile Creek/Ottawa River watersheds. It includes an explanation of the datasets that were used to generate aerial base mapping and evaluate existing conditions within the two watersheds, the development of the GIS predictive model that was utilized to identify potential wetland and stream restoration sites, field verification of the GIS model outputs, ecological field studies, and the procedures that were used to select the final twenty-five sites for the development of conceptual wetland and/or stream restoration plans.

General Recommendation Concepts

During the course of this study, it became evident that while site-specific recommendations could be made to restore wetland and/or stream habitats at numerous locations within the two watersheds, there were also general restoration/enhancement concepts that could be applied to more than one site. Therefore, instead of repeating these same general restoration concepts each time they were appropriate for a given site, the Project Team included a discussion of these general concepts in this section of the report. In all, six general restoration/enhancement concepts are presented in this section. They include:

- Restoration/Enhancement of Wetlands on Clay Soils
- Restoration/Enhancement of Wetlands on Sandy Soils
- Restoration/Enhancement of Historically Channelized Waterways in Sandy Soils
- Restoration/Enhancement of Historically Channelized Waterways in Clay Soils
- Restoration/Enhancement of Large Streams
- Restoration/Enhancement of Riparian Buffers

At the beginning of each site specific recommendation, we have noted where, among the twenty-five sites, each general concept could be applied.

Site Specific Recommendations

This section includes site-specific conceptual restoration/enhancement plans for streams and/or wetlands at twenty-five locations within the Swan Creek and Tenmile Creek/Ottawa River watersheds. Four specific restoration/enhancement plans are presented for the Urban Subregion; fourteen plans are presented for the Oak Openings Subregion; and seven plans are presented for the Agricultural Subregion of the watersheds. Of the twenty-five plans that are provided, eleven are located in the Tenmile Creek/Ottawa River watershed (designated as "OR-#"), while fourteen are located in the Swan Creek watershed (designated as "SC-#").

Each site-specific plan also contains a discussion of the estimated cost of restoration and/or enhancement. Readers are cautioned that the cost estimates that are provided within this report are intended to provide general estimates of the costs to construct each proposed restoration and/or enhancement project. The estimates provided within this report do not contain costs for the following items:

- Negotiation of agreements with land owners to use their property
- Land acquisition fees
- More detailed site evaluations (e.g., Phase I and Phase II Environmental Site Assessments, detailed topographic and boundary surveys, geotechnical evaluations, etc.)
- Hydrologic monitoring and modeling
- Development of detailed construction plans, specifications and bid packages for each site
- Fees associated with the development of conservation easements or environmental covenants
- Preparation of regulatory permit application packages (e.g., Section 404 and 401 permit applications, NPDES permits, Isolated Wetland Permit Applications)
- Permitting fees
- Long term monitoring for regulatory compliance
- Any other unforeseen items that may become apparent when a project is considered in greater detail during the final design process

More comprehensive and detailed cost estimates should be prepared as each specific project is carried forward through the process of detailed design.

Comparative Matrices for Restoration/Enhancement

This section presents a comparative matrix that summarizes the various site-specific plans with respect to subregion, watershed, type of project (isolated wetland, non-isolated wetland, stream), size of project and estimated project cost.

Implementation

This section is intended to present various implementation strategies and funding sources that can be considered to actually construct the various site-specific recommendations that are presented in this report.

References

This section contains a listing of all outside sources that were utilized to complete this report.

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CHAPTER 1
INTRODUCTION

INTRODUCTION

INTRODUCTION

1.1 PROJECT PURPOSE

In 2007 Partners for Clean Streams obtained funding from The Joyce Foundation to develop a wetland and riparian inventory and restoration plan for the Swan Creek and Ottawa River watersheds. The desire to complete this inventory arose from the realization that the conversion of land to agriculture, residential, commercial and industrial development has negatively impacted the physical, chemical and biological properties of the aquatic ecosystems within the two watersheds. The desire to carry out this inventory arose from the realization that while historic land use changes within the watersheds have negatively impacted the physical, chemical and biological characteristics of Swan Creek and Tenmile Creek/Ottawa River, positive changes to these streams could only begin to be realized by restoring or enhancing wetland habitats and stream segments within the two watersheds. This study therefore, was intended to identify 25 of the most desirable locations for wetland and/or stream restoration or enhancement within the study area.

1.2 CHARACTERISTICS OF THE TENMILE CREEK/OTTAWA RIVER AND SWAN CREEK WATERSHEDS

The Ottawa River/Tenmile Creek watershed encompasses approximately 221 square miles in portions of Lucas and Fulton counties, Ohio (147 square miles) and Lenawee and Monroe counties, Michigan (74 square miles) (Figure 1-1). Its average gradient is 4 feet per mile. Many miles of smaller streams and ditches drain into the mainstem within this watershed. More prominent tributaries include, from downstream to upstream, Sibley Creek, Heldman Ditch, Hill Ditch, North Tenmile Creek, Prairie Ditch, Zinc Ditch, Wiregrass Ditch, Roberts Ditch and Schmitz Ditch.

The Swan Creek Watershed occupies approximately 204 square miles in portions of Henry, Fulton and Lucas counties, Ohio. Over 200 miles of creeks and ditches drain this watershed (Maumee RAP and Duck & Otter Creeks Partnership, 2006). The mainstem of Swan Creek is only about 40 miles long. More prominent tributaries within this watershed, from downstream to upstream, include Wolf Creek, Cairl Creek, Blue Creek, Gail Run and Ai Creek. It should be noted that both Wiregrass and Prairie Ditches, which are included as tributaries in the Tenmile Creek/Ottawa River watershed, also have the ability to drain into the Swan Creek watershed.

Both watersheds contain three rather distinct subregions, based on general patterns of land use and predominant soil associations. The first is the Agriculture Subregion, where all of the headwater areas in the Tenmile Creek/Ottawa River watershed, and a portion of the Swan Creek Watershed, exist in a predominantly agricultural area of eastern Fulton County and northwestern Lucas County. Here soils consist predominantly of Hoytville-Nappanee-Mermill Association, which is described as a level to gently sloping, very poorly drained and somewhat poorly drained soils that formed in glacial lake sediment (Stone et al, 1980). Tributaries within this portion of both watersheds tend to be low-gradient systems that have historically been channelized and subsequently maintained to promote agricultural drainage. Riparian corridors tend to lack natural woody vegetation. As a result, the streams tend to be fully exposed to sunlight. The majority of wetlands in this area have been eliminated for agricultural purposes.

Downstream of the Agricultural Subregion, a narrow portion of the Tenmile Creek/Ottawa River watershed and a much larger portion of the Swan Creek watershed flow through the Oak Openings Region of Northwest Ohio, one of the most ecologically unique regions of the Midwest United States. Here, soils consist predominantly of a wide band of the Granby-Ottokee-Tedrow Association, characterized by level to gently sloping, poorly drained, moderately well drained and somewhat poorly drained soils that formed in sandy material. Agriculture is still present in this subregion, but to a lesser extent due to the lower fertility of the sandy soils.

After leaving the Oak Openings Subregion, both streams and their tributaries flow through the urbanized, densely populated area of eastern Lucas County. Here soils consist of the *Urban Land Association* which is most prevalent in the Urban Subregion, followed by the *Bixler-Dixboro Association* and then the *Del Rey-Lenawee Association*. Within this subregion, the Granby-Ottokee-Tedrow Association is limited to the northwest corner of the Ottawa River watershed.

Table 1-1

Soil Association	Ottawa River Watershed	Swan Creek Watershed
Granby-Ottokee-Tedrow	X	X
Bixler-Dixboro	X	X
Del Rey-Lenawee	X	X
Toledo-Fulton		X
Urban Land	X	X

Agriculture is for the most part absent in Urban Subregion of the Tenmile Creek/Ottawa River and Swan Creek watersheds, being replaced by residential, commercial and industrial development. Within this subregion, the Ottawa River passes through the City of Sylvania, the Sylvania Country Club, the Camp Miakonda Boy Scout Camp, Wildwood Metropark, the Village of Ottawa Hills, The University of Toledo, Ottawa and Jermain Parks and then an industrial corridor that contains numerous capped and abandoned landfills. At its most downstream end, east of Interstate 75, the river widens and is bordered by private properties, public marinas, yacht clubs and restaurants before emptying into the Maumee Bay and the western basin of Lake Erie.

In the Urban Subregion, Swan Creek passes through the Village of Whitehouse and Monclova Township, where it winds its way through Brandywine Country Club. Once it crosses I-475/US 23, the creek passes residential and commercial areas before flowing through Swan Creek Metropark. After leaving the metropark, the river continues through residential areas of increasing density, until entering the urban core of the City of Toledo. Here the creek continues past numerous businesses and warehouses, until it empties into the Maumee River.

Over the years, the Tenmile Creek/Ottawa River and Swan Creek watersheds have experienced numerous alterations that have impacted the physical, chemical and biological properties of the mainstems and their numerous tributaries. The ditching and tiling of agricultural land in the upper reaches of both streams, combined with increased development in the middle and lower reaches of both watersheds have caused the flow regimes to become more erratic in both watersheds. This has caused increased erosion along the banks of the main channels, which in turn has caused increases in turbidity and embeddedness of substrate within the stream channels. Removal of streamside vegetation has contributed to the problem of increased erosion, and also caused an increase in the temperature of waters and reduced oxygen concentrations. These changes have selected for species of aquatic macroinvertebrates and fish that are more tolerant to these types of environmental conditions.

1.3 BENEFICIAL USE IMPAIRMENTS (BUIS) IN THE OTTAWA RIVER AND SWAN CREEK

In 1978 the United States and Canada agreed to cooperate with State and Provincial Governments to ensure that Remedial Action Plans (RAPs) would be developed to improve the quality of our Great Lakes. RAPs were developed at 43 locations known as Areas of Concern (AOC) around the Great Lakes. Of the 43 AOCs, 26 are located entirely within the United States; twelve are located entirely in Canada; and five are shared by both countries (USEPA, 2009).

The Maumee AOC, which is depicted in Figure 1-1, covers 775 square miles and contains a portion of the Maumee River watershed, as well as Swan Creek, Tenmile Creek/Ottawa River, Duck Creek, Otter Creek, Grassy Creek, Cedar Creek, Crane Creek, Turtle Creek, Packer Creek and the Toussaint River (USEPA, 2009a).

Annex 2 of The Great Lakes Water Quality Agreement of 1978, as amended by Protocol in 1987, lists 14 Beneficial Use Impairments (BUIs) against which the health of the Great Lakes AOC are to be measured. These impairments are:

- BUI #1 - Restrictions on fish and wildlife consumption
- BUI #2 - Tainting of fish and wildlife
- BUI #3 - Degraded fish and wildlife populations
- BUI #4 - Fish tumors or other deformities
- BUI #5 - Bird or animal deformities or reproductive problems
- BUI #6 - Degradation of benthos
- BUI #7 - Restrictions on dredging activities
- BUI #8 - Eutrophication or undesirable algae
- BUI #9 - Restrictions on drinking water consumption or taste and odor
- BUI #10 - Beach closings
- BUI #11 - Degradation of aesthetics
- BUI #12 - Added costs to agriculture and industry
- BUI #13 - Degradation of phytoplankton and zooplankton
- BUI #14 - Loss of fish and wildlife habitat

In the Ottawa River/Tenmile Creek watershed, BUIs 1, 3, 4, 6,7,10, 11 12 and 14 have been listed as Impaired by the Maumee RAP. In the Swan Creek Watershed, BUIs 3, 4, 6, 10, 11 and 14 have been listed as Impaired.

This project was intended to provide recommendations that would have the potential to positively impact BUI #3 (Degradation of fish and wildlife populations), BUI #6 (Degradation of Benthos) and BUI #14 (Loss of fish and wildlife habitats) in both watersheds.

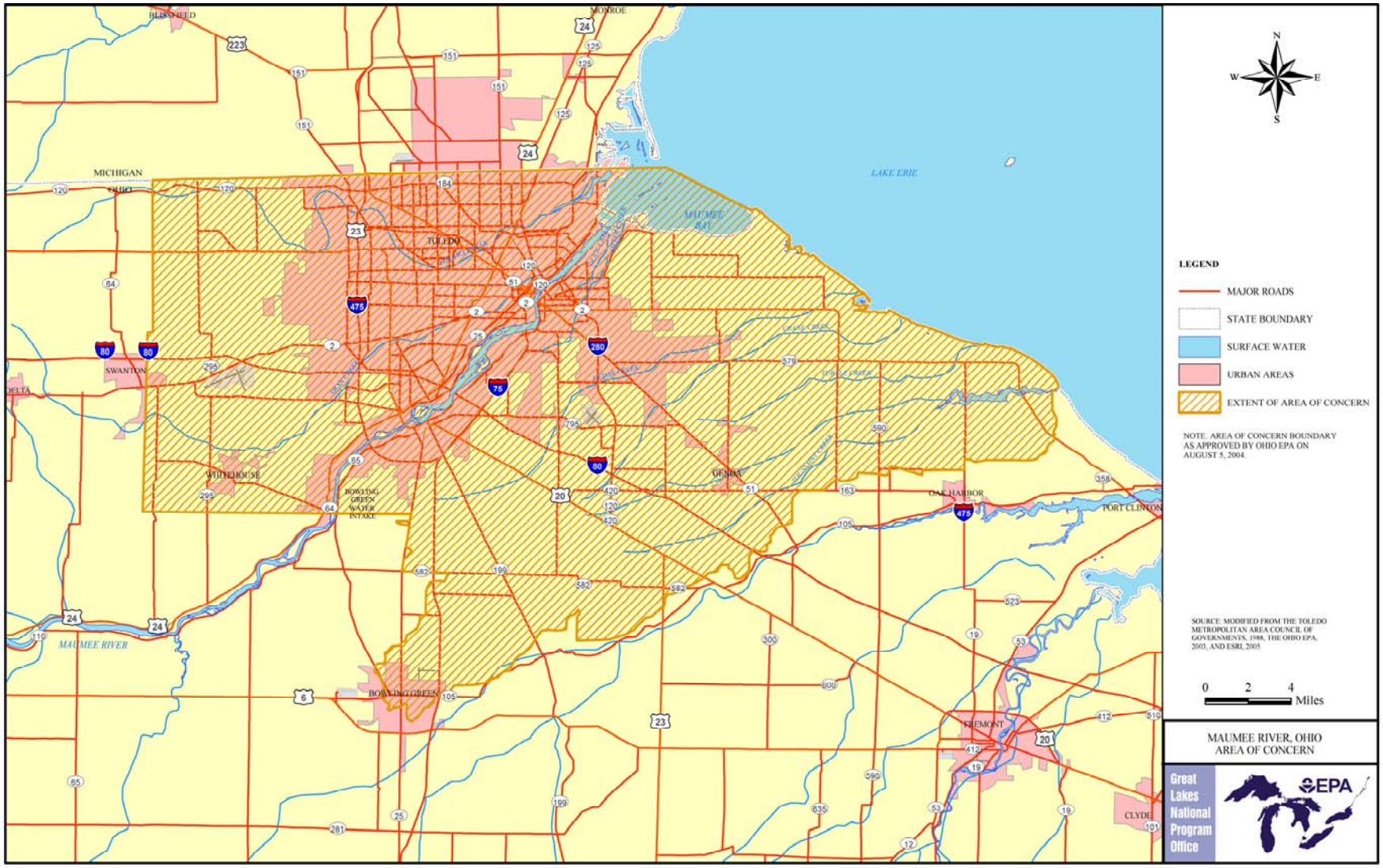
LEGEND
MAJOR ROADS
STATE BOUNDARY
SURFACE WATER
URBAN AREAS
EXTENT OF AREA OF CONCERN
NOTE: AREA OF CONCERN BOUNDARY AS APPROVED BY OHIO EPA ON AUGUST 5, 2004.
SOURCE: MODIFIED FROM THE TOLEDO METROPOLITAN AREA COUNCIL OF GOVERNMENTS, 1988, THE OHIO EPA, 2003, AND ESRI, 2005.
0 2 4 Miles
MAUMEE RIVER, OHIO
AREA OF CONCERN
Great Lakes National Program Office
EPA
LAKE ERIE
MAUMEE BAY
MAUMEE RIVER
TOLEDO
MONROE
BLISSFIELD
MICHIGAN
OHIO
SWANTON
WHITEHOUSE
BOWLING GREEN WATER INTAKE
BOWLING GREEN
GENOA
OAK HARBOR
PORT CLINTON
FREMONT
CLYDE

Figure 1-1

1.4 PROJECT GOALS AND OBJECTIVES

The primary objective of this study was to identify specific sites and develop conceptual plans for wetland and riparian restoration within the watersheds that, once implemented, would have measurable positive impacts on the following BUIs:

- BUI #3 Degradation of fish and wildlife populations
- BUI #6 Degradation of benthos
- BUI #14 Loss of fish and wildlife habitats

As a secondary objective, this study is also intended to provide wetland and stream restoration opportunities for permit applicants who are required to mitigate lost wetlands and stream habitat and functions under Sections 404 and 401 of the Clean Water Act and the State of Ohio's Isolated Wetlands Law. Past experiences have shown that with no local mitigation opportunities readily available, wetland mitigation has oftentimes been accomplished outside of the watersheds where the impacts have occurred, either by restoring wetland habitat on project-specific sites, or by purchasing wetland mitigation credits from a wetland mitigation bank that has been approved to service an area that encompasses several watersheds. While such mitigation projects meet the mitigation requirements under Sections 404 and 401 of the Clean Water Act, without the replacement of wetland and stream functions within the watershed where the impacts occur, BUIs 3, 6 and 14 may continue to decline in the Swan Creek and Ottawa River watersheds as more wetland and stream impacts occur.

In addition to permit actions, the projects that are included within this report may be funded by other means, for example through various grants or with funding obtained from Supplemental Environmental Projects (SEPs).

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CHAPTER 2
PROJECT OVERVIEW / METHODOLOGY

PROJECT/OVERVIEW METHODOLOGY

PROJECT OVERVIEW/METHODOLOGY

The various activities that were completed for this project are shown in Figure 2-1 and are explained in greater detail below.

2.1 INITIAL DATA GATHERING AND GIS MAPPING

In August 2007, in order to develop the necessary mapping to assist in the evaluation of existing conditions and the development of conceptual wetland and/or stream restoration plans, the Project Management Team and the Consultant gathered GIS shape files and other electronic data that were available for the two watersheds. These are listed in Table 2-1.

Table 2-1 Wetland and Riparian Inventory for Swan Creek and Ottawa River Watersheds Initial Electronic Datasets Used in GIS Mapping	
Orthographic	
Lucas County 2002	GIS\ReferenceData\State\OH\Lucas\Orthos\Lucas_Co_2002\Lucas.sid
Lucas County 2003	GIS\ReferenceData\State\OH\Lucas\Orthos\Lucas_Co_2003\LC_IA_2003.sid
NAIP 2005 - Lucas/Fulton County	GIS\ReferenceData\State\OH\Lucas\Orthos\NAIP_2006\naip_1-1_2n_s_oh095_2006_1.sid
OSIP 2006 - Lucas/Fulton County	GIS\ReferenceData\State\OH\Lucas\Orthos\OSIP_2006\Lucas.sid
Raster	
Digital Elevation Model	GIS\ReferenceData\State\OH\Lucas\Shape\Lucas.sid
NWI Maps (non-digital)	GIS\ReferenceData\State\OH_NWI\berkey 1977AP.tif
	GIS\ReferenceData\State\OH_NWI\sylvania 1977AP.tif
	GIS\ReferenceData\State\OH_NWI\toledo 1977AP.tif
	GIS\ReferenceData\State\OH_NWI\oregon 1977AP.tif
	GIS\ReferenceData\State\OH_NWI\genoa 1966AP.tif
	GIS\ReferenceData\State\OH_NWI\wallbridge 1977AP.tif
	GIS\ReferenceData\State\OH_NWI\grand rapids 1971AP.tif
	GIS\ReferenceData\State\OH_NWI\whitehouse 1977AP.tif
	GIS\ReferenceData\State\OH_NWI\reno beach 1977AP.tif
	GIS\ReferenceData\State\OH_NWI\Maumee 1977AP.tif
	GIS\ReferenceData\State\OH_NWI\rossford 1977AP.tif
Shapefiles	
Rivers & Streams	GIS\ReferenceData\State\OH_Statewide\SurfaceWater\oh_hydro_lines.shp
Ohio Wetland Inventory	GIS\ReferenceData\State\OH_Statewide\OWI\stateowi_sps83.shp
Soils	GIS\ReferenceData\State\OH\Lucas\Shape\oh095_a.shp
Streets	GIS\ReferenceData\State\OH\Lucas\Shape\streets.shp
Ohio DNR Lands	GIS\ReferenceData\State\OH_Statewide\Ohio_State.gdb\Conservation\OH_DNRLand
NLCD - impervious	
NLCD - Canopy	
NLCD - Land Cover	
ODNR - Detailed Watersheds	
ODNR - Land Use/Land Cover	
ODNR - groundwater resources	
Database Files:	
Parcels	GIS\ReferenceData\State\OH\Lucas\AREIS_GDB.mdb\Parcels
Ohio Watershed Boundaries	
NHD	
IMS:	
University of Toledo : wetlands	University of Toledo : wetlands

PROJECT OVERVIEW/METHODOLOGY

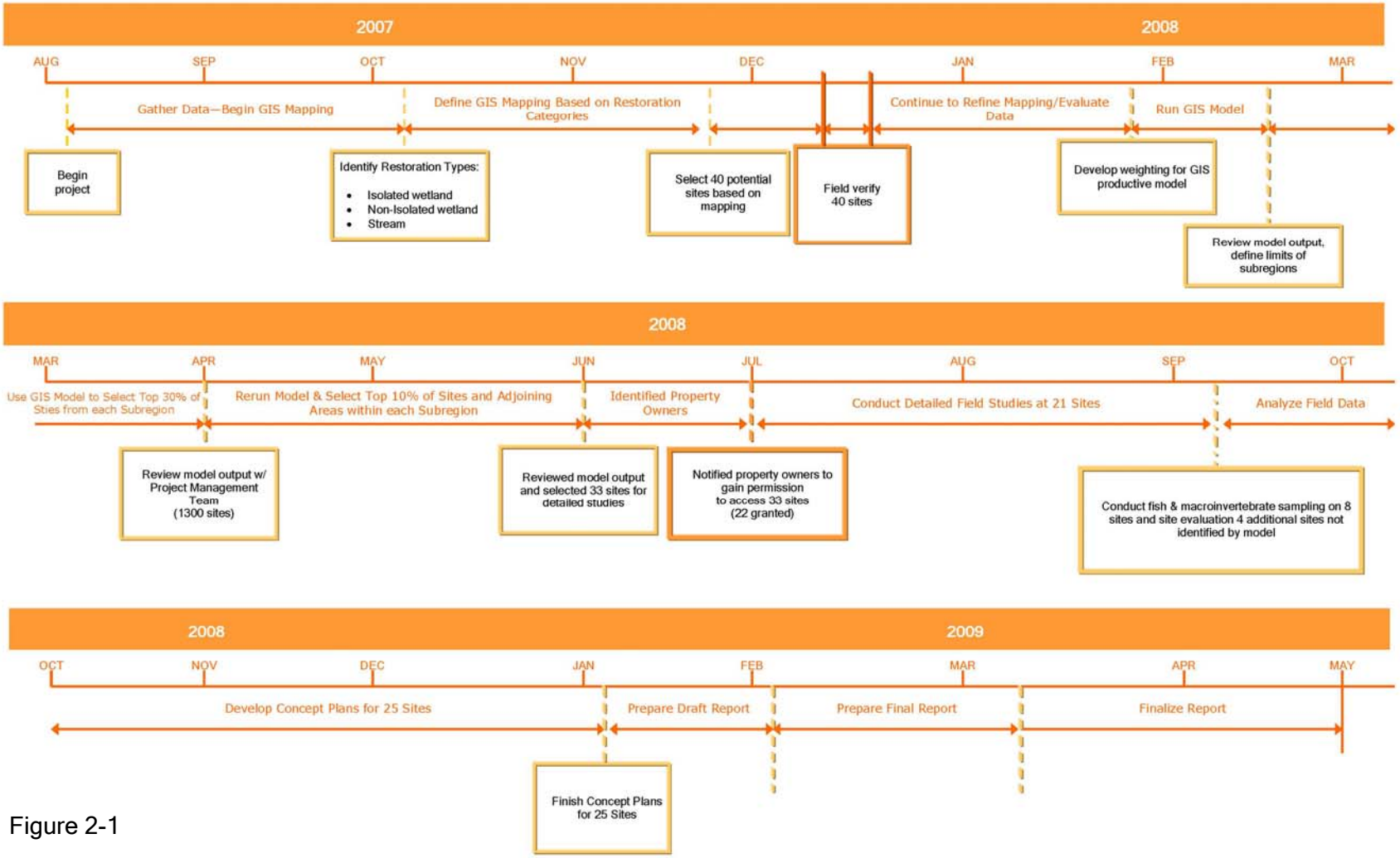

Figure 2-1

Using these data sources, the Consultant assembled a working base map with superimposed geographic datasets that included surface water networks, wetlands data from multiple local and regional sources, land use/land cover, canopy and riparian data, the Oak Openings Region boundaries, conservation and recreation lands in programs, and agricultural lands.

2.2 PRELIMINARY EVALUATION OF GIS-BASED MAPPING

On October 1, 2007, the Project Management Team and the Consultant (collectively referred to as the Project Team reviewed the GIS mapping to determine how it could be utilized to select areas for possible wetlands and/or stream restoration/enhancement sites. Four general restoration categories were developed based on this evaluation:

- **Stream Restoration/Enhancement Sites** – This designation included stream segments that were found to be in the "restorable warmwater" habitat quality range, i.e. having a Qualitative Habitat Evaluation Index (QHEI) = 45-60, with a very narrow 100-year floodplain (indicative of channelization or natural incision), and very little forest cover within 200 feet of the channel.

- **Wetland Restoration/Enhancement Sites** - This category was developed to identify hydrologically isolated, generally topographically flat hydric areas containing hydric soils that were currently farmed or were recently abandoned agricultural fields.

- **Streams with Adjacent Wetlands** - This category was developed to identify those streams in the 'restorable warmwater' habitat quality range (QHEI = 45-60), with a wider 100-year floodplain (indicating minimal channelization or natural incision), the presence of topographically flat hydric soils or nonhydric soils with hydric inclusions, and very little forest cover within 500 feet of the stream channel. These areas were considered to be prime candidates for non-isolated, floodplain wetland restoration where, once restored, the wetlands habitat would have the potential to positively impact Beneficial Use Impairments (BUIs) through shading, sediment deposition and filtering, reducing erosion, increasing and extending baseflow, etc. There may also be some in-channel work associated with this category.

- **Urban Restoration/Enhancement Areas -** In addition to the above categories, the Project Team also considered an Urban restoration/enhancement restoration/category, where there are floodplain encroachments and impervious surfaces limiting lateral expansion of the stream cross section. Here, the only option in urban situations might be multi-stage channel construction to restore some channel morphology and increase bank stability.

In October and November 2007 the Project Team continued to refine the GIS mapping to ensure that data obtained from the various sources would be useful in developing a predictive model that would identify sites that fell within the four categories listed above with varying degrees of restoration/enhancement potential. The most currently available aerial base mapping was also added to the GIS mapping, so that existing land use could be better assessed before going into the field for data verification.

2.3 INITIAL FIELD VERIFICATION OF GIS MAPPING

In November 2007, the Project Team selected forty (40) potential wetland and/or stream restoration/enhancement sites for field verification from the GIS data. Sites were selected based on their proximity to existing stream corridors, the presence of hydric soils, land use/land cover type and proximity to currently established conservation areas. The forty sites were also distributed more or less evenly over the entire study area. The week of December 10, 2007, the Consultant then took the mapping into the field in order to verify the various data layers for accuracy. After reviewing ten (10) sites that were scattered throughout the study area, field personnel were able to verify that the GIS data that had been plotted for land use/land cover type, stream locations, riparian buffer condition and the approximate location of floodplain boundaries were accurate (Figure 2-2). Based on these results, the Project Team determined that no further field verification would be necessary at this time and efforts could be refocused on field verifying the preliminary outcome of the GIS-based predictive model (see Section 2.4).

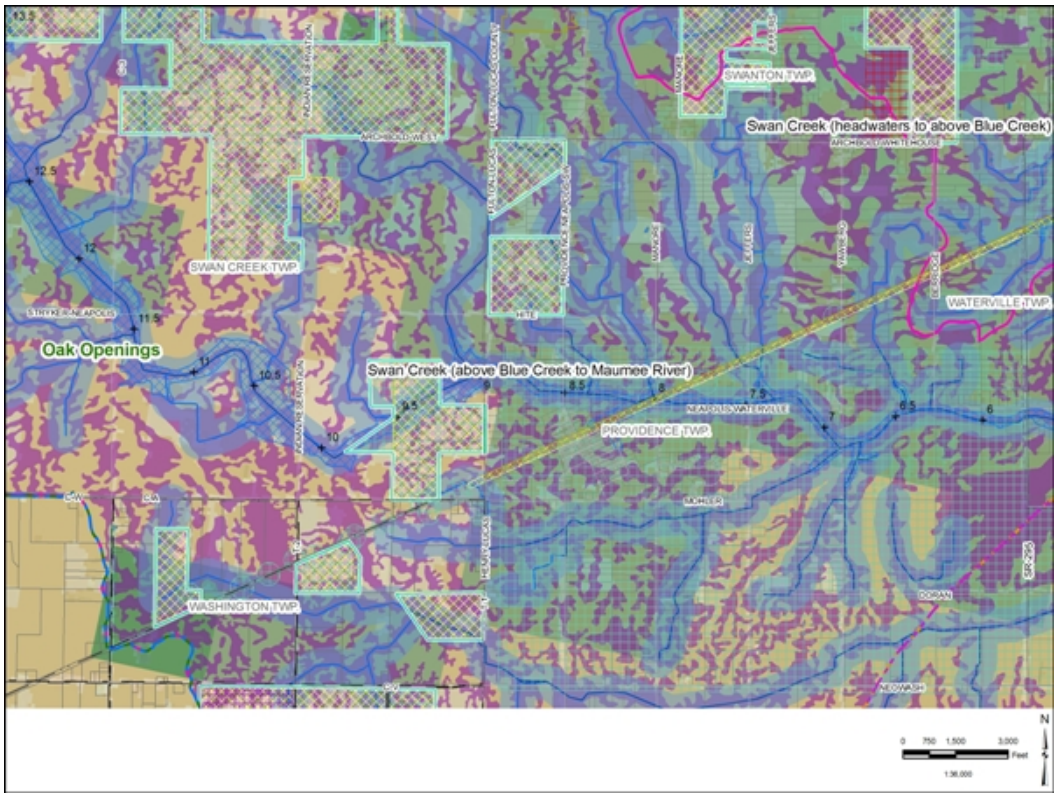

Figure 2-2: The "Everything" map: This showed the shading of all the layers that were used to verify the dependability of the data layers.

2.4 DEVELOPMENT OF GIS PREDICTIVE MODEL

In January 2008, the Project Team reviewed the data gathered to date and developed weighting schemes for the GIS-based predictive model. The intent of the model, once developed, was to identify sites for the restoration and enhancement of habitat in the following areas:

- In the stream channel;
- Along stream corridors, between 500 and 1000 feet away from the top of bank of the existing stream channel (a.k.a., isolated wetlands); and
- Along stream corridors, between 0 and 500 feet from the top of bank of the stream (a.k.a. non-isolated wetlands and adjacent stream channels).

The preliminary model was developed using the following parameters as primary indicators:

- Proximity to the stream channel
- Proximity to 100-year floodplain
- Land use/land cover type
- Presence/absence of hydric soils
- Percent existing canopy cover
- Presence/absence of impervious cover
- Presence of impervious surface
- Proximity to wetlands, as indicated by National Wetland Inventory Mapping or Section 319 Wetlands
- Proximity to rare species
- Slope
- Proximity to ODNR Sites
- Proximity to metropark lands
- Presence of agricultural lands

Each of the primary parameters was then assigned a weighting of high, medium or low, based on its ability to predict the restoration or enhancement potential for one of the three given areas (stream, isolated wetlands or streams with wetlands). The weighting system that was developed is presented in Table 2-2 below.

Table 2-2 Wetland and Riparian Inventory for Swan Creek and Ottawa River Watersheds Preliminary Weighting for GIS Model Developed on January 23, 2008				
Primary Parameter		Weighting[1]		
		Streams	Isolated Wetlands	Streams w/Wetlands
Distance from stream		0' - 50'	500' - 1000'	0' - 500'
Proximity to stream		High	High	High
Proximity to 100-yr floodplain		High	0	High
Land use/land cover		Medium	Medium	High
Presence of hydric soils		Low	High	High
Percent canopy cover		Low	High	High
Presence of impervious surface		Medium	High	High
Proximity to wetlands[2]	NWI	Medium	High	High
	319	Medium	High	High
Proximity to rare species		0	Medium	Medium
Slope		High[3]	High[4]	High[4]
Proximity to ODNR sites		0	Medium	Medium
Proximity to metropark lands		0	Medium	Medium
Presence of agricultural land		High	Medium	Medium

[1] High = 5, Medium =3, Low =1, no weight = 0
[2] 319 Wetland information supersedes NWI data
[3] For streams, the greater the slope, the higher the weighting
[4] For isolated wetlands and streams w/wetlands, the flatter the slope, the higher the weighting

The Project Team also identified a number of parameters as secondary factors that would be used to refine the search for enhancement and restorations sites, after the GIS-based model identified sites based on the primary parameters. These secondary factors included:

- **Metropark Priority Lands:** the closer the site to Metropark Priority Lands the higher the weight;
- **Development Pressures**: the presence of known or imminent development pressures excluded areas identified as good restoration or enhancement sites based on primary parameters;
- **Qualititive Habitat Evaluation Index (QHEI)/Headwater Habitat Evaluation Index (HHEI):** sites that are located in or adjacent to stream channels areas that have been previously monitored using QHEI or HHEI and have been shown to be of moderate quality (i.e., they have potential for restoration or enhancement) have greater weight than those sites that have been shown to be of low quality and thus are less restorable;
- **Parcel Size:** sites that occupy fewer, larger parcels will be more desirable than sites that occupy a large number of smaller parcels.

Using the above primary parameters, the Consultant then ran the GIS-based model to identify sites throughout the Ottawa River and Swan Creek watersheds that would be suitable for habitat restoration and/or enhancement. Three versions of the model were generated: one for stream locations, one for isolated wetland locations, and one for streams with adjacent wetlands, based on the weighting of parameters as identified in Table 2-2.

Model outputs were then mapped and evaluated by the Project Team in February 2008. At this time, the Project Team concluded that the top 30% of the sites, as defined by the predictive model score, should be mapped throughout the study area (Figure 2-3), and that those sites with the highest ranking would be selected for ground verification.

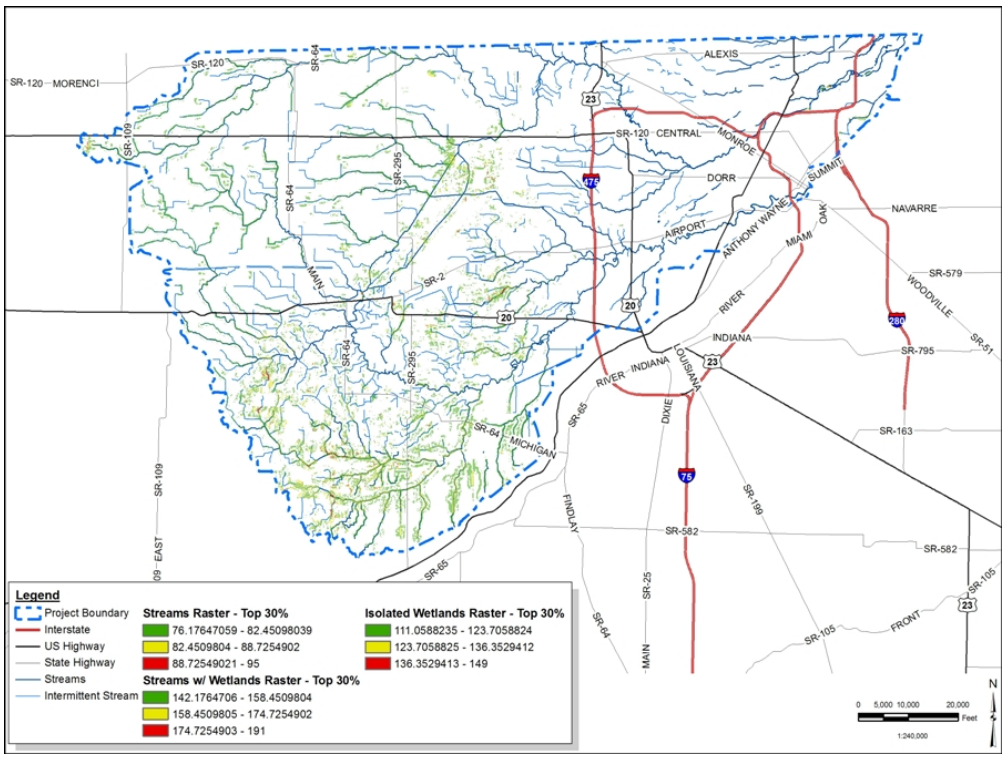

Figure 2-3: Map depicting the top 30% of all three potential restoration/enhancement sites (streams, streams with wetlands and isolated wetlands) within the watersheds.

After reviewing the top 30% of the sites throughout the Swan Creek and Ottawa River watersheds, it became evident that the GIS model identified the largest number of potential restoration and/or enhancement sites in the Oak Openings Subregion of the two watersheds, which occupies the middle third of the Ottawa River/Swan Creek study area. This resulted in a disproportionately large number of sites in this region. The next most abundant number of sites was observed in the western third, or Agricultural Subregion, outside of the Oak Openings; however the majority of sites in this region did not score as high as sites in the Oak Openings Subregion. The Urban Subregion was found to contain the fewest number of sites.

The Consultant then drew approximate boundaries for the Agricultural, Oak Openings and Urban Subregions, and reran the model to identify the top 30% of sites within each of these three subregions (i.e., as opposed to the top 30% of sites across the entire study area as previously run) (Figure 2-4). As expected, this approach identified a greater number of sites in the Agricultural and Urban Subregion, although the number of sites in the Urban Subregion were still low compared as compared to the number of sites in the other subregions.

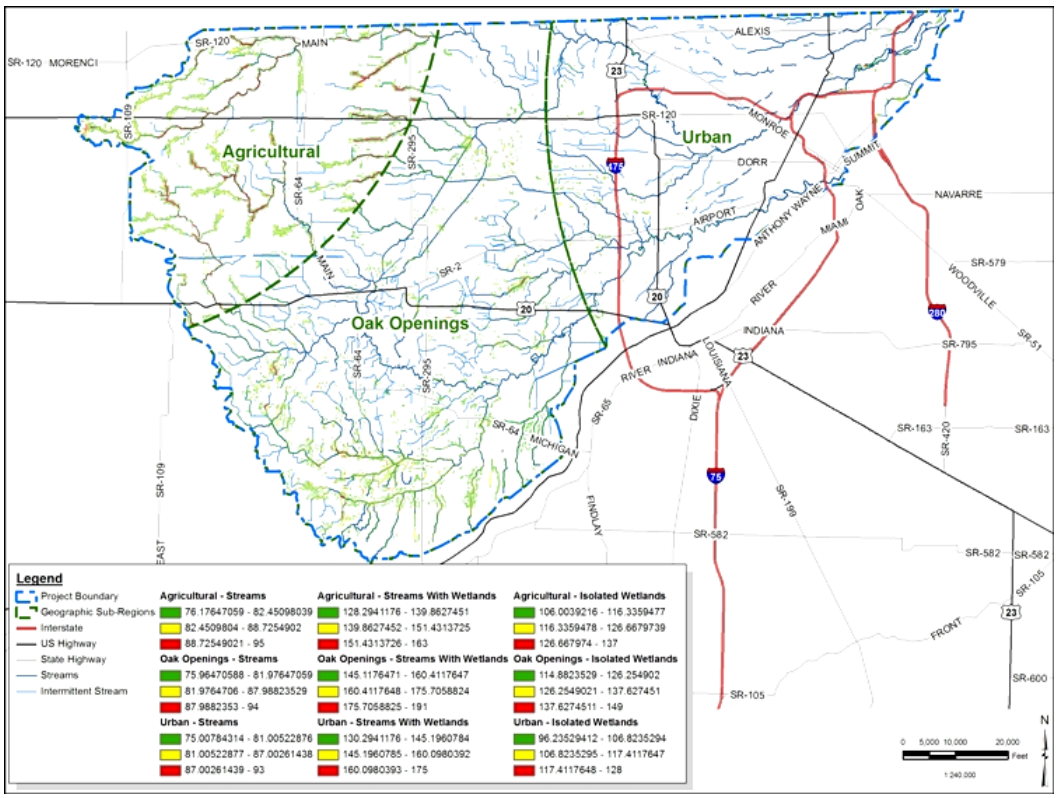

Figure 2-4: Map depicting the top 30% of each of the three types of restoration/enhancement sites (streams, streams with wetlands and isolated wetlands) within each of the three subregions (Agricultural, Oak Openings and Urban).

2.5 FIELD VERIFICATION OF GIS MODEL OUTPUT

Model outputs (mapping) for the three scenarios (stream, isolated wetlands and wetlands with streams) within each subregion were taken into the field by aquatic biologists for the Consultant for field verification. The model output and the findings of the field studies were then presented to the entire Project Team in April 2008.

Based on an evaluation of sites in all three subregions of the study area (Agricultural, Oak Openings, and Urban), the Project Team determined that the GIS model produced a sufficient number of sites that warranted further evaluation in the Oak Openings and Agricultural Subregions of the study area. However, the model still identified many fewer sites in the Urban Subregion of the two watersheds.

Next, the top 30 percent of the sites were then identified within each of the three subregions. This produced approximately 1300 sites. The Project Team determined that this was too many sites to access. It was also noted that based on the score, sites in the top 10 percent of the Urban Subregion had a similar score to sites found in the lower 1/3 of the top 30th percent of the Oak Openings Subregion. The 10th percentile of each subregion by type (stream, wetlands with streams or isolated wetlands) was then used for the Oak Opening and Agricultural Subregion (Figure 2-5). This was to eliminate the extraneous data. Due to the limited number of sites in the Urban Subregion, the top 20 percentile were taken for this region.

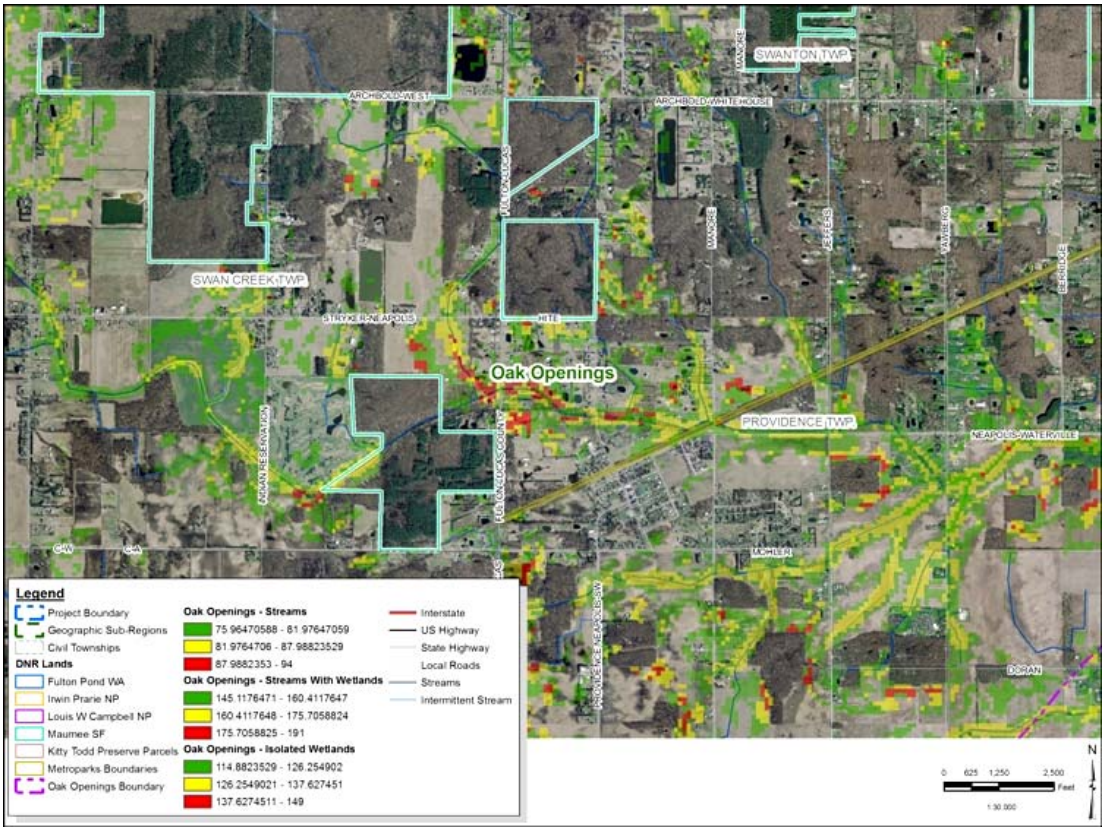

Figure 2-5: The top 30 percent within the Oak Openings Subregion that was broken into 3 categories; Red (top 10%), yellow (10-20%) and green (20-30%) are indicated.

The selection procedure described above yielded approximately 900 sites over the entire study area (two watersheds). Using GIS vector/ Hot Spot analysis, the 900 sites were then clustered into groups of adjacent sites and converted to a smaller number of central points or individual centroids. Based on the average score from the combined sites, each centroid was then assigned a score. The Hot Spot analysis attempted to identify areas of high concentrations of quality restoration locations. This method failed due to the detail of the resolution of the model.

Using an alternative approach, each cell within the top 10 percent was combined with all of its adjacent cells. These merged clusters were then assigned a score based on their centroid (Figure 2-6). The cell clusters were then ranked based on these scores. Tables were generated ranking all of the scores by cell cluster. The tables were examined for natural splits between the top several clusters. The top clusters were retained. At this time, the polygons were renamed based on the rank, type and subregion. This revised nomenclature distinguished which clusters had the highest relative ranking in each of the subregions and by type. For example, the isolated wetland in the agricultural subregion with the highest ranking was identified as IWA1. After reviewing the results of the model output, the Project Team decided that the three different types should be added to the same layer and clusters should include and be influenced by the presence of multiple types (Figure 2-7).

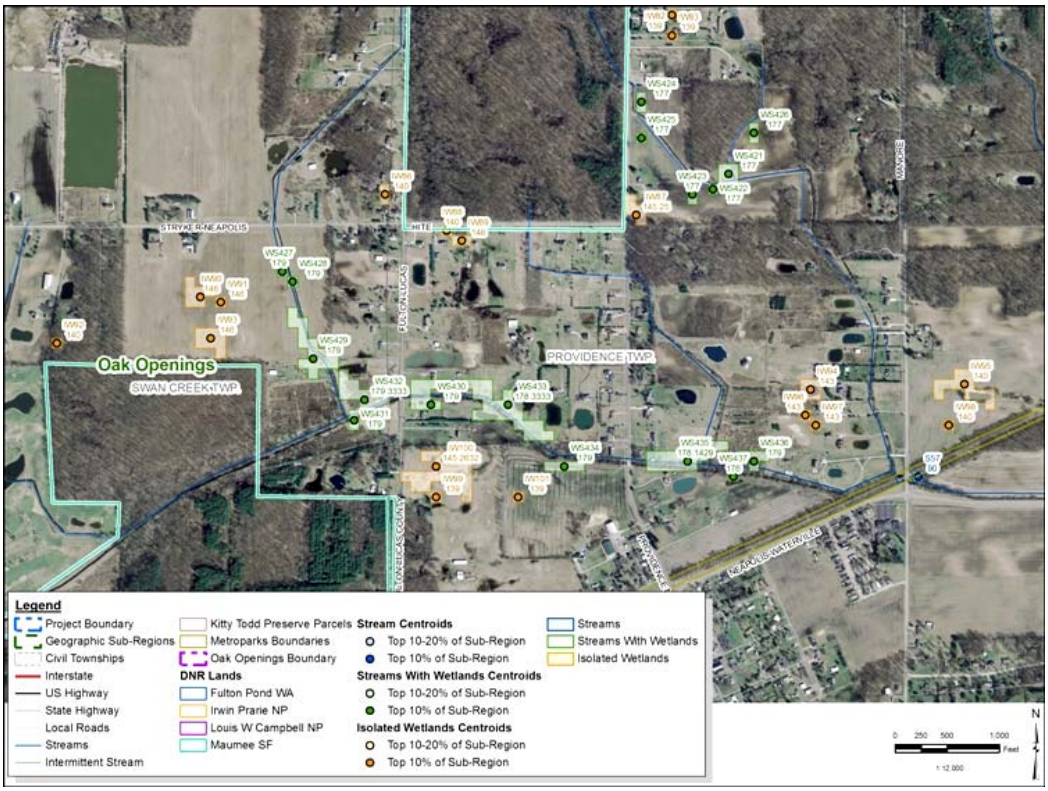

Figure 2-6: Centroid map within the Oak Openings Subregion; Depicting the top 10 percent for the three restoration types (stream, streams with wetlands and isolated wetlands).

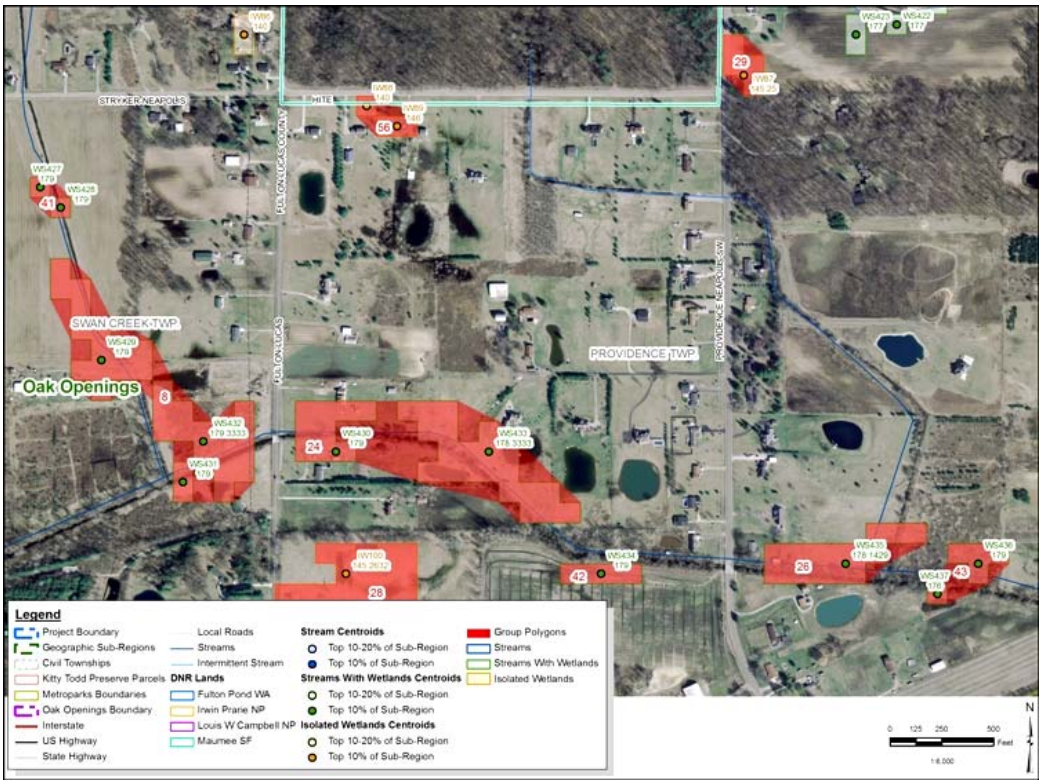

Figure 2-7: Example group polygon map within the Oak Openings Subregion; Depicting the top 10 percent (and scores) for the three restoration types (stream, streams with wetlands and isolated wetlands) that has been lumped into a group.

2.6 SELECTION OF SITES FOR DETAILED FIELD STUDIES

In May 2008, multiple-type polygon groups or areas that had been created through GIS modeling were individually evaluated by the Project Team. Each polygon group was evaluated for practicality and restoration potential using the Project Team's knowledge of the area. Areas were dropped from further study if they were located in an area that had been slated for future development, or if the area was comprised of too many small land parcels. A total of 33 ranked polygons, or sites, were selected for more detailed investigation.

The Consultant then identified property owners and sent letters to each land owner, requesting permission to access the site for detailed field investigations. Letters were sent out on July 7, 2008. After one week, property owners were then contacted by telephone to request their permission to enter their property

During the field investigations, the Consultant recorded dominant vegetation, land use/land cover and in-stream (if present) condition. Wetlands were delineated in accordance with the *1987 Corps of Engineers Wetland Delineation Manual* and soil types were confirmed. Streams were also evaluated for the possibility of quantitative fish and macroinvertebrate sampling. After the field sampling was completed, 21 sites were found to be acceptable for the development of

stream and/or wetland restoration/enhancement plans (Figure 2-8). Of these, eight sites were selected for quantitative fish and macroinvertebrate sampling.

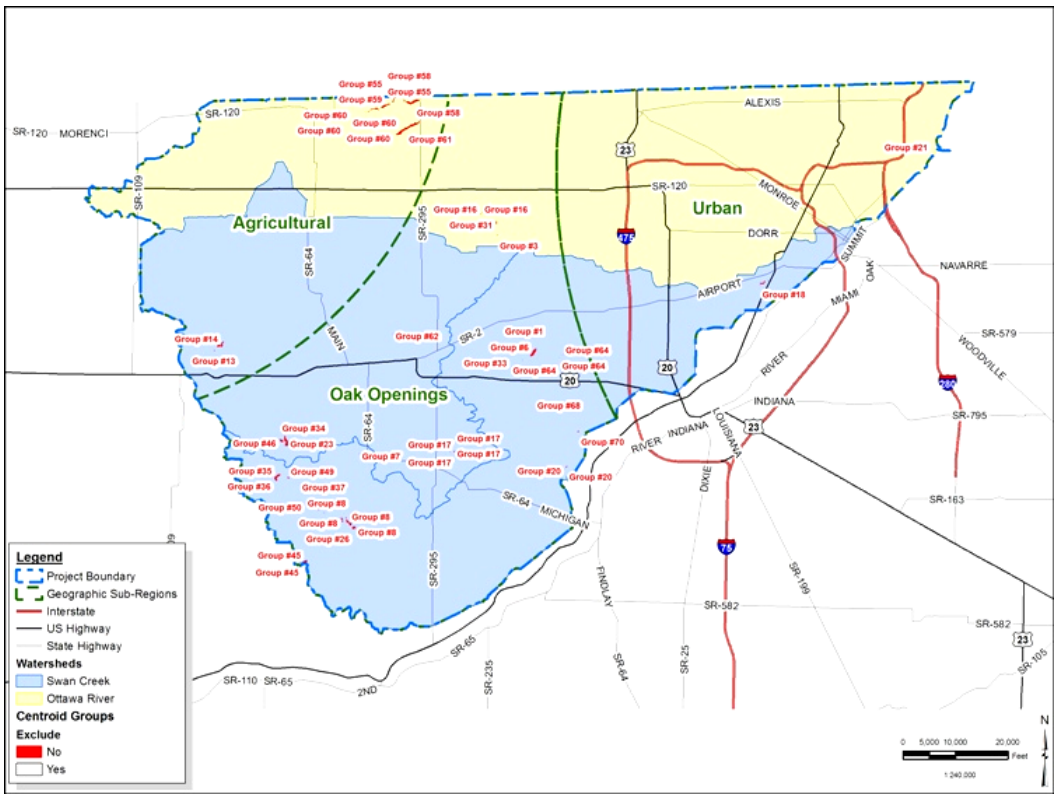

Figure 2-8: Map of the original 21 sites (groups) within the two watersheds.

On September 3, 2008, four additional stream/wetland sites in the Tenmile Creek/Ottawa River watershed were added for detailed field studies. These included: one area at the upstream end of the Tenmile Creek/Ottawa River watershed; the Camp Miakonda Boy Scout Camp, the City of Toledo's Jermain Park, and along Mud Creek, in Toledo, Ohio. The Camp Miakonda and Jermain Park sites had been selected for an earlier, smaller watershed inventory that was completed for a portion of the mainstem of the Ottawa River. Field studies followed the same procedures as those performed on the 21 sites that were selected using the GIS model.

2.7 SUPPLEMENTAL FISH AND MACROINVERTEBRATE SAMPLING

Following the field studies, the Consultant evaluated fish, macroinvertebrates and in-stream habitat at eight of the sites in the watersheds, from September 17 to September 19, 2008. The eight stream sampling locations were located using a handheld GPS, so that each site could be revisited at a later date, after construction of the habitat restoration/enhancement project. The location of each site is shown in Figure 2-1.

Fish data were collected at each site utilizing a barge-mounted electrofishing unit. Once collected, fish were identified to species, counted, weighed and then returned to the stream.

Data were then used to calculate the Index of Biotic Integrity (IBI) and Modified Index of Well Being (MIWB). Methodologies followed those specified in by Ohio EPA (1989).

Macroinvertebrates were collected at each site by qualitatively sampling natural substrates in the stream. Specimens were collected using forceps, and dip nets in order to sample all available habitats that are present in the stream reach (pool, riffle and run). Macroinvertebrates that were collected at each site were then counted and identified to family and if possible, genus. Each taxon's tolerance to pollution stress, its relative abundance, and the percentage of EPT taxa (Ephemeroptera, Plecoptera and Trichoptera) were also determined.

The information gathered in the field was then summarized and added to the final deliverable of the project. All field logs, forms, photos, and other data were provided to Partners for Clean Streams along with the other final deliverables.

2.8 DEVELOPMENT OF CONCEPTUAL AND SITE-SPECIFIC RESTORATION/ ENHANCEMENT PLANS

Following completion of field work, the Consultant then developed general recommendations for the restoration and/or enhancement of wetlands and streams under the following scenarios:

- Wetland Restoration/Enhancement on Clay Soils
- Wetland Restoration/Enhancement on Sandy Soils
- Restoration/Enhancement of Historically Channelized Waterways in Clay Soils
- Restoration/Enhancement of Historically Channelized Waterways in Sandy Soils
- Restoration/Enhancement of Large Streams
- Restoration/Enhancement of Riparian Buffers

These general recommendations are presented in Chapter 3 of this report. Using these recommendations, the Consultant then developed site-specific conceptual wetland and/or stream restoration/enhancement plans for each of the sites that are listed in Table 2-3. These can be found in Chapter 4.

Table 2-3
Summary of Conceptual Stream and/or Wetland Restoration Plans for the Ottawa River (OR) and Swan Creek (SC) Watersheds

Subregion	Site ID	Type of Project
Urban	OR-21	Non-Isolated Wetland Restoration
	OR-101	Non-Isolated Wetland Restoration
	OR-102	Stream and Non-Isolated Wetland Restoration
	SC-18	Stream Restoration/Enhancement
Oak Openings	OR-3	Non-Isolated Wetland Restoration
	OR-16	Stream and Non-Isolated Wetland Restoration
	OR-31	Non-Isolated Wetland Restoration
	SC-6	Non-Isolated Wetland Restoration
	SC-7	Non-Isolated Wetland Restoration
	SC-8	Non-Isolated Wetland Restoration
	SC-17	Stream Restoration/Enhancement
	SC-20	Stream Restoration/Enhancement
	SC-34	Non-Isolated Wetland Restoration
	SC-37	Non-Isolated Wetland Restoration
	SC-45	Isolated Wetland Restoration
	SC-49	Isolated Wetland Restoration
	SC-62	Stream Restoration/Enhancement
	SC-64	Stream Restoration/Enhancement
	SC-70	Stream Restoration/Enhancement
Agricultural	OR-58	Stream and Non-Isolated Wetland Restoration
	OR-59	Stream and Non-Isolated Wetland Restoration
	OR-60	Stream and Non-Isolated Wetland Restoration
	OR-61	Stream and Non-Isolated Wetland Restoration
	OR-100	Stream, Isolated Wetland and Non-Isolated Wetland Restoration
	SC-13	Stream and Non-Isolated Wetland Restoration
	SC-14	Stream and Non-Isolated Wetland Restoration

CHAPTER 3
GENERAL RESTORATION / ENHANCEMENT CONCEPTS

GENERAL RESTORATION / ENHANCEMENT CONCEPTS

WETLAND RESTORATION/ ENHANCEMENT ON CLAY SOILS

WETLAND RESTORATION/ ENHANCEMENT ON CLAY SOILS

Requirement

This wetland restoration/ enhancement concept can be used to restore and/or enhance wetlands in agricultural, fallow or invasive plant dominated areas that are located on hydric clay soils within the historic Black Swamp region of Northwest Ohio.

Emergent sedge meadow

Applicable Sites

OR-58, OR-59, OR-60, OR-61, OR-101, SC-13, SC-70

Objective

- To provide enhanced wetland functions for historic wetland areas in the clay-soiled areas of the historic Great Black Swamp (addresses BUIs #3 and #14).
- To reduce the amount of siltation running off into adjacent streams (addresses BUIs #6 and #14).

General Improvement Strategy

Prior to settlement, the Great Black Swamp area of Northwest Ohio contained some of the most extensive wetlands in the state. With the development of agricultural drainage, many of these wetlands were lost, being converted to agricultural lands. The hydrology of historic wetlands in this region were influenced primarily by rainfall or runoff and were found in depressions on Mermill loam, Fulton silty clay loam or Colwood loam soils.

Several types of wetland assemblages can be restored within the clay-soil areas of northwest Ohio. These wetland plant communities are defined by the dominant species found growing in them, which is dictated by the frequency and duration of soil saturation and/or inundation during the growing season. The wetlands that typify these areas are described below.

Wet Sedge Meadow

The most typical wet sedge meadow community on the clay flats of northwest Ohio is dominated by several carices (*Carex hyalinolepis, C. lacustris, C. aquatilis* and *C. atheroides*), bluejoint grass (*Calamagrostis canadensis*), fowl manna grass (*Glyceria striata*) and forbs such as swamp milkweed (*Asclepias incarnata*), joe-pye-weed (*Eupatorium maculatum*) and native species of loosestrife (*Lysimachia thyrsiflora* and *L. terrestris*). In more mesic situations, a wet meadow will have water depths from 0 to 6 inches with saturated ground situations during the growing season. These communites have a higher percent cover of forbs and less diversity and cover of

sedges. This community may be preferred in areas of higher visibility due to the greater number of brightly colored flowering species.

Deep Water Emergent Wetlands

Deep water emergent wetlands consist of permanently saturated, typically inundated emergent communities. Water depths usually range from 6 to 12 inches during the growing season. This community is typified by large, robust sedges (*Bolboschoenus fluviatilis, Schoenoplectus acutis, S, tabernaemontani,* and *Carex hyalinolepis*), pickerelweed (*Peltandra virginica*) and burweed (*Sparganium americanum* and *S. eurycarpum*) (Table 3.1). This community is important for macroinvertebrate communities and as a nursery for young fish.

Elm-ash forest with a shoreline sedge understory

Floating-leaved aquatic community

Floating-leaved Emergent Wetlands

Floating-leaved emergent wetlands are permanant water communities. Dominant plants of this community include floating leaved aquatics, such as fragrant water-lily (*Nymphaea odorata*), spatterdock (*Nuphar advena*), and water smartweed (*Polygonum amphibium*). This community, which grows in water depths between 12 to 24 inches, will also support a submergent community of pondweeds (*Potamogeton* sp.) and waterweeds (*Elodea* sp.).

WETLAND RESTORATION/ ENHANCEMENT ON CLAY SOILS

Deciduous Swamp Forest

Deciduous swamp forest can also be found within areas of saturated soils. In general, the trees of the swamp forest are usually rooted in shallower areas of inundation or on small hummocks that allow the collar of the trunk to be above water during the growing season. In deeper water areas (up to a foot or two deep), vernal pools will exist between the trees. These vernal pools, if vegetated, may contain buttonbush (*Cephalanthus occidentalis*), manna grasses (*Glyceria striata* and *G. septentrionalis*), and bog nettle (*Boehmerica cylindrica*). It should be noted that vernal pools are essential to many amphibian species, such as the wood frog (*Rana sylvatica*), chorus frog (*Pseudacris* spp.) and mole salamander (*Ambystoma* spp.), which require these seasonally inundated areas for breeding.

Deep water emergent dominated by arrowhead and iris

Upland prairies, savannas and upland forested areas create excellent buffers to the wetland areas described above. Creating upland areas within wetland complexes increase the overall diversity of the site. Many "wetland" organisms need the upland areas to exist or complete their life cycle.

Recommended Restoration/Enhancement Techniques

Before a wetland restoration/enhancement plan can be developed on clay-based soil areas, one must understand that the predominant source of hydrology will be through direct precipitation and runoff. As such, it will be important to understand the overall topography of the site and its surrounding areas, and to estimate the annual hydroperiod for the site. Once the topography and sources, relative contributions and seasonal amounts of water are understood, one can begin to develop an appropriate and feasible wetlands restoration plan for the site. It should also be noted that many of the agricultural lands in Northwest Ohio have been tiled to promote drainage. For this reason, a tile search should be conduced as a preliminary step in the construction of the wetland. All tiles that drain the site should be plugged, broken or removed to increase wetland hydrology on the site. Care should also be taken to ensure that tile drainage from adjacent parcels is not disrupted as a result of the cutting and plugging of tiles on the project site. Tiles from adjacent properties may need to be intercepted and rerouted around the wetland mitigation site to promote drainage on adjacent properties.

WETLAND RESTORATION/ ENHANCEMENT ON CLAY SOILS

If the parcel is overgrown with undesireable vegetation, the site should be treated by first spraying all undesired or invasive vegetation with a non-species specific herbicide, such as a glyphosate. The removal of invasive species is vitally important and may need to be repeated if particularly hardy species, such as purple loosestrife (*Lythrum salicaria*), reed canary grass (*Phalaris arundinacea*) or giant reed (*Phragmites australis* subsp. *australis*) are present.

As opposed to sand-based, groundwater restorations, the impermeability of clay may make the re-contouring of the site necessary. If significant re-contouring of the site is required or desired, then it will be necessary to strip and stockpile the A-horizon of the soil, and then reapply the stockpiled material to the wetland once it has been regraded to nine to twelve inches below the desired grade.

As opposed to sand or peat based systems, where the existing seed bank can remain viable for many decades, high quality seed banks do not typically last as long in heavy clay soils. As a result, it is not recommended that the existing seed bank be used solely for the establishment of a high quality wetland plant community. To enhance the quality of the wetland plant community, the use of seed mixes or plugs is often necessary.

The diversity and overall quality of the selected seed mix will be dependent on the desired outcome of the restored wetland. For example, regulatory permit conditions may specify that the mitigation wetland produce a minimum Vegetation of Biotic Integrity (VIBI), or Floristic Quality Assessment Index (FQAI) after three years of post-construction monitoring. To achieve this goal, it will be necessary to supplement the seed bank with a seed mix that contains high-quality, native species. On the other hand, if the intent of the wetland restoration project is to promote stormwater filtration in an area that exhibits flashy flows from a nearby stream, then a seed mix comprised of hardier species that are tolerant of a more erratic hydroperiod may be selected. Suggested seed mixes for several clay-based emergent communities are included in Table 3-1. Should shrubs or trees be desired, a suggested planting list of quality woody species is included in Table 3-2.

Forested wetlands require an extra step for restoration projects. For wetland mitigation projects, Ohio EPA generally requires that after three years, the site must contain at least 300 growing trees per acre. Tree stock can vary from bare-rooted whips (1 to 2 year-old plants) to 3-5 year old potted plants (1 to 3 gallon pots) to trees grown by the “root propagation method” (a.k.a. RPM trees), to 1-2 inch caliper balled and burlapped specimens. As a result, unit costs will vary greatly. A decision as to what types of trees to plant will have to be made based on the unit cost per tree and the desired survival rate. Younger seedlings/saplings are less expensive, but should be planted at a higher rate to account for an expected higher mortality.

Table 3-1 Herbaceous Planting List							
Species	Common Name	Coefficient of Conservation	Wetland Indicator	Wet Meadow	Sedge Meadow	Deep Water Emergent	Floating-leaved Bed
Acorus americanus	American sweet-flat	6	OBL	X	X	X	
Alisma subcordatum	Southern water-plantain	2	OBL	X			
Alisma triviale	Northern water-plantain	6	OBL	X	X	X	
Asclepias incarnata	Swamp milkweed	4	OBL	X	X		
Aster lanceolatus	Panicled aster	3	FACW	X			
Aster novae-angliae	New England aster	2	FACW-	X	X		
Aster puniceus	Fen aster	7	OBL	X			
Bidens cernua	Nodding Beggars'-ticks	3	OBL	X	X		
Boehmeria cylindrica	False nettle	4	FACW+	X	X		
Bolboschoenus fluviatilis	River bulrush	5	OBL		X	X	
Calamagrostis canadensis	Canada bluejoint	4	FACW+	X	X		
Caltha palustris	Marsh-marigold	6	OBL	X			
Carex aquatilis	Leafy tussock sedge	9	OBL		X	X	
Carex atherodes	Wheat sedge	7	OBL		X	X	
Carex comosa	Bearded sedge	2	OBL		X		
Carex cristatella	Crested sedge	3	FACW	X	X		
Carex lacustris	Lake sedge	5	OBL	X	X	X	
Carex lupulina	Hop sedge	3	OBL	X	X		
Carex lurida	Bottlebrush sedge	3	OBL	X			
Carex scoparia	Pointed broom sedge	3	FACW	X	X		
Carex stipata	Crowded sedge	2	OBL	X	X		
Carex stricta	Tussock sedge	5	OBL	X	X		
Carex vulpinoidea	Fox sedge	1	OBL	X	X		
Cephalanthus occidentalis	Buttonbush	6	OBL	X	X	X	

Table 3-1
Herbaceous Planting List

Species	Common Name	Coefficient of Conservation	Wetland Indicator	Wet Meadow	Sedge Meadow	Deep Water Emergent	Floating-leaved Bed
Cicuta maculata	Water-hemlock	3	OBL	X	X		
Decodon verticillatus	Swamp loosestrife	6	OBL	X	X	X	
Eleocharis erythropoda	Red-footed spike-rush	4	OBL	X		X	
Eleocharis obtusa	Blunt spike-rush	1	OBL	X	X	X	
Elodea canadensis	Common waterweed	3	OBL				X
Eupatorium maculatum	Spotted joy-pye-weed	6	FACW	X		X	
Eupatorium perfoliatum	Common boneset	3	FACW+	X	X		
Euthamia graminifolia	Flat-topped goldenrod	2	FAC	X			
Glyceria striata	Fowl manna grass	2	OBL	X	X		
Helenium autumnale	Common sneezeweed	4	FACW+	X			
Hibiscus laevis	Halbred-leaved rose-mallow	7	OBL		X	X	
Hibiscus moscheutos	Swamp rose-mallow	4	OBL		X	X	
Impatiens capensis	Spotted touch-me-not	2	FACW	X	X		
Iris virginica	Southern blue flag	6	OBL	X	X		
Juncus effusus	Soft rush	1	FACW+	X			
Juncus torreyi	Torrey's rush	3	FACW	X	X		
Justicia americana	Water-willow	9	OBL		X		
Leersia oryzoides	Rice cut grass	1	OBL	X			
Lobelia cardinalis	Cardinal-flower	5	FACW+	X			
Lobelia siphilitica	Great blue lobelia	3	FACW+	X			
Ludwigia alternifolia	Seedbox	3	FACW+	X			
Mimulus ringens	Common monkey-flower	4	OBL	X			
Nelumbo lutea	American lotus	7	OBL				X
Nuphar advena	Spatterdock	4	OBL				X

Table 3-1
Herbaceous Planting List

Species	Common Name	Coefficient of Conservation	Wetland Indicator	Wet Meadow	Sedge Meadow	Deep Water Emergent	Floating-leaved Bed
Nymphaea odorata	Fragrant water-lily	6	OBL				X
Panicum clandestinum	Deer's tongue panic grass	2	FAC+	X			
Peltandra virginica	Arrow-arum	5	OBL		X	X	
Polygonum amphibium	Water smartweed	4	OBL		X	X	
Pontederia cordata	Pickerel-weed	6	OBL		X	X	X
Potamogeton natans	Floating pondweed	8	OBL				X
Potamogeton nodosus	long-leaved pondweed	3	OBL				X
Pycnanthemum virginianum	Virginia mountain-mint	4	FAC	X			
Sagittaria latifolia	Common arrowhead	1	OBL		X	X	
Schoenoplectus acutus	Hard-stemmed bulrush	7	OBL	X	X	X	
Schoenoplectus tabernaemontani	Soft-stemmed bulrush	2	OBL	X	X		
Scirpus atrovirens	Dark green bulrush	1	OBL	X			
Scirpus cyperinus	Wool-grass	1	FACW+	X	X		
Scirpus pendulus	Drooping bulrush	2	OBL	X			
Silphium perfoliatum	Cup-plant	6	FACU	X			
Sium suave	Water-parsnip	6	OBL	X	X	X	
Solidago juncea	Plume goldenrod	2	UPL	X			
Sparganium americanum	American bur-reed	6	OBL		X	X	X
Sparganium eurycarpum	Giant bur-reed	4	OBL		X	X	
Spartina pectinata	Prairie cord grass	5	OBL	X			
Verbena hastata	Blue vervain	4	FACW+	X			
Verbesina alternifolia	Wingstem	5	FAC	X			

Table 3-2 Woody Planting List				
Species	Common Name	Coefficient of Conservation	Wetland Indicator	Life Form
Acer rubrum	Red maple	2	FAC	Tree
Acer saccharinum	Silver maple	3	FACW	Tree
Carya laciniosa	Shellbark hickory	7	FAC	Tree
Cephalanthus occidentalis	Button bush	6	OBL	Shrub
Cornus racemosa	Gray dogwood	1	FAC-	Shrub
Cornus sericea	Red-osier dogwood	3	FACW+	Shrub
Ilex verticillata	Winterberry	6	FACW+	Shrub
Physocarpus opulifolius	Ninebark	4	FACW-	Shrub
Quercus bicolor	Swamp white oak	7	FACW+	Tree
Quercus macrocarpa	Burr oak	6	FAC-	Tree
Quercus palustris	Pin oak	5	FACW	Tree
Salix discolor	Pussy willow	3	FACW	Shrub
Salix eriocephala	Heart-leaved willow	2	FACW	Shrub
Salix exigua	Sandbar willow	1	OBL	Shrub
Spiraea alba	Meadow-sweet	3	FACW+	Shrub
Ulmus americana	American elm	2	FACW-	Tree
Viburnum lentago	Nannyberry	5	FAC	Shrub

Potential Attainable Goals

Using the above techniques, it should be possible to restore an active or fallow agricultural field in the study area into a high quality Category 2, or even Category 3 emergent or forested wetland, depending on the goals of the wetland restoration project. VIBI scores for emergent wetland communities in the Huron-Erie Lake Plain have been as high as 70-85 (Mack, 2004). A FQAI (Andreas *et al.*, 2004) for a ten-acre plus, emergent wetland on clay soils can typically be as high as 22-30. Since the FQAI is a diversity driven calculation, the larger (and typically more diverse) the community that is evaluated, the higher the FQAI score.

Preliminary Cost Estimates

Based on the discussion above, it can be seen that the cost for restoring wetlands on clay soils can vary greatly and will depend on a number of factors, including:

- The size of the site
- The amount of grading required
- The desired plant community
- Types of outflow structures used (if any)
- Types of plantings (seed, plug, size of trees and shrubs).

Labor and material prices will also vary, depending on a myriad of factors that may change daily. For this reason, estimated costs for a given project should be developed early and be periodically refined as the design progresses from the conceptual to final stage. (see Table 3-3).

Table 3-3
Costs per acre

Project	Cost/Unit	Unit	Quantity	Total Cost/Acre
Herbicide	$100	Gallon	3	$300
Excavation	$ 25	Cubic Yard	variable	variable
Trees/shrubs (bare root; purchased in quantity)	$1.00	Each	If necessary	variable
Trees/ shrubs (1-3 gallon pot)	$15-20	Each	If necessary	variable
Trees/shrubs (1" caliper)	$70-100	Each	if necessary	variable
Emergent Seed Mix	$ 1,300	Acre	1	1,300

Potential Funding Mechanisms

Funding for the restoration/enhancement of wetlands on clay soils may be obtained from mitigation for wetland impacts, grant funding or through private donation.

References

Andreas, B. K., J. J. Mack and J. S. McCormac, 2004. Floristic Quality Assessment Index (FQAI) for vascular plants and mosses for the State of Ohio. Wetland Ecology Group, Division of Surface Water, Ohio Environmental Protection Agency.

Mack, J. J. 2007 Integrated Wetland Assessment Program. Part 9: Field Manual for the Vegetation Index of Biotic Integrity for Wetlands v. 1.4 Ohio EPA Technical Report WET/2007-6. Ohio Environmental Protection Agency, Wetland Ecology Group, Division of Surface Water, Columbus, Ohio.

WETLAND RESTORATION/ ENHANCEMENT ON SANDY SOILS

WETLAND RESTORATION/ ENHANCEMENT ON SANDY SOILS

Requirement

This wetland restoration/ enhancement concept can be implemented in agricultural, fallow or invasive plant-dominated areas on hydric sandy soils within the Oak Openings Region of Northwest Ohio for the restoration or enhancement of emergent, shrub/scrub or forested wetland communities.

Twig-rush dominated wet prairie in the Oak Openings Region

Applicable Sites

OR-3, OR-16, OR-31, OR-100, SC-6, SC-7, SC-8, SC-17, SC-20, SC-45, SC-49, SC-62, SC-64,

Objective

- Provide enhanced wetland functions for historic wetland areas in the Oak Openings Subregion (addresses BUIs #3 and #14)
- Reduce sedimentation to adjacent ditches improving downstream benthic communities (addresses BUIs #3 and #6).
- Provide increased diversity and wildlife habitat for rare species in a globally rare community (addresses BUIs #3 and #14)

General Improvement Strategy

Oak Openings wet prairies are some of the highest quality and most diverse wetland communities in the state of Ohio. Unlike clay-based wetlands which rely on direct precipitation and surface runoff for their hydrology, these sand-based communities are typified by seasonally high water-tables on Granby loamy fine sand or occasionally Gilford fine sandy loam. These areas are dominated primarily by sedges, grasses and a diverse assemblage of forbs. Several specific communities that can be restored in these areas are briefly described below.

Twig-rush/Sedge Community

The most typical wet prairie community in the Oak Openings Subregion is the twig rush/sedge community. Dominants include twig-rush (*Cladium mariscodes*), several carices (*Carex lasiocarpa, C. sartwellii, C. cryptolepis* and *C. atheroides*) and bluejoint grass (*Calamagrostis canadensis* and *C. stricta*). This fire-dependent community persists in large stands in historic Irwin Prairie with water depths from 0 to 18 inches. Water depth during the growing season is typically not more than 6 inches.

WETLAND RESTORATION/ ENHANCEMENT ON SANDY SOILS

Wet Meadow

In more mesic situations, a wet meadow will have water depths from 0 to 6 inches deep with saturated ground conditions during the growing season. These communites have a higher percent cover of forbs and a lower diversity and percent cover of sedges. This community is often preferred in areas of higher visibility due to the greater number of brightly colored flowering species.

Deciduous Swamp Forest

Also, within these saturated soil conditions, the swamp forest communitiy can be found. In general, the trees of the swamp forest are usually rooted in shallower water areas or on small hummocks that allow the collar of the trunk to be above water during the growing season. In deeper water areas (up to a foot or two deep in areas), vernal pools will exist between the trees. If vegetated, vernal pools may contain buttonbush (*Cephalanthus occidentalis*), foul manna grass (*Glyceria striata*), and bog nettle (*Boehmerica cylindrica*). The vernal pools are highly important for many amphibians, such as the wood frog (*Rana sylvatica*), chorus frog (*Pseudacris* spp.) and mole salamander (*Ambystoma* spp.), which need these areas for breeding.

Xeric communities that can thrive on better drained, upland soils typically surround these wetland areas. These upland prairies and savannas are like their wetland conterparts in that they are fire-dependent or management dependent systems. Such occasional disturbance allows for the high quality communities to remain free of invasive, non-native or shrubby species that would lower the diversity of the community.

Small pools in wetland increase heterogeneity and amphibian breeding

Recommended Restoration/ Enhancement Techniques

Restoration/Enhancement of Oak Openings Prairie on active or fallow agricultural land can be intiated by first spraying all undesired or invasive vegetation with a non-species specific herbicide, most likely a form of a glyphosate herbicide. The removal of the invasive species is vitally important and may need to be repeated if purple loosestrife (*Lythrum salicaria*), reed canary grass (*Phalaris arundinacea*) or giant reed (*Phragmites australis* subsp. *australis*) is present. If the site has been tiled for agriculture, a tile search should be conduced and all tiles that drain the site should be plugged to increase wetland hydrology on the site.

WETLAND RESTORATION/ ENHANCEMENT ON SANDY SOILS

Since these are typically ground-water dependent systems, understanding the seasonal water table is necessary. Any fill that may have historically been placed in the wetland should be removed. Reestablishing historic native hydric soils conditions are important to intercepting ground saturated conditions. If the level of the ground water has been severely modified, some water level sampling may be necessary to determine present water levels.

Wet meadow in the Oak Openings Region

Depending on existing topography, simple re-grading of the site may also be necessary to create subtle variations in microtopography that will then select for a more heterogeneous assemblage of wetland plant species. This may be accomplished by simply driving a small dozer or other piece of equipment randomly over the site to create ruts and small rises in the sandy soils. Once graded, the site can then be seeded with high-quality, native sedges, grasses and forbs that are adapted to this type of emergent community.

The diversity and overall quality of the selected seed mix should be dependent on the desired outcome of the restored wetland. For example, regulatory permit conditions may specify that the mitigation wetland produce a minimum Vegetation of Biotic Integrity (VIBI), or Floristic Quality Assessment Index (FQAI) after three years of post construction monitoring. This goal may be achieved by relying solely on the existing seed bank. However, it may also be necessary to supplement the seed bank with a seed mix that contains native species of high quality. On the other hand, if the intent of the wetland restoration project is to promote stormwater filtration in an area that exhibits flashy flows from a nearby stream, then a seed mix comprised of hardier species that are tolerant of a more erratic hydroperiod may be selected. Since the Oak Openings Region is a very rare community, care should be given to acquiring seed from local sources. The Metroparks of the Toledo Area, Division of Natural Areas and Preserves (Ohio Department of Natural Resources) and The Nature Conservancy at Kitty Todd are all active in collecting and replanting native genotype seeds on their land holdings. Arrangements may be made though these organizations to acquire native seed for restoration projects.

Seed mixes vary greatly depending on the diversity and rarity of the seeds within a mix. A suggested seeding mix for Oak Openings Region emergent prairies is included in Table 3-4. Should shrubs or trees be desired, a suggested planting list of quality woody species is included in Table 3-5. An upland seed mix is included for dry sandy areas that will not support wetlands.

WETLAND RESTORATION/ ENHANCEMENT ON SANDY SOILS

These areas can be used as buffer areas to the wetland areas and increase the diversity of the site.

Table 3-4 Herbaceous Planting List			
Species	Common Name	Coefficient of Conservation	Wetland Indicator
Alisma subcordatum	Southern water-plantain	2	OBL
Alisma triviale	Northern water-plantain	6	OBL
Asclepias incarnata	Swamp milkweed	4	OBL
Aster lanceolatus	Panicled aster	3	FACW
Aster praealtus	Vein-leaved aster	6	FACW
Boehmeria cylindrica	False nettle	4	FACW+
Calamagrostis canadensis	Canada bluejoint	4	FACW+
Calamagrostis stricta	Northern reed grass	7	FACW
Cicuta maculata	Water-hemlock	3	OBL
Carex albolutescens	Pale straw sedge	7	FACW
Carex bebbii	Bebb's sedge	7	OBL
Carex cristatella	Crested sedge	3	FACW
Carex cryptolepis	Little yellow sedge	9	OBL
Carex hystericina	Porcupine sedge	5	OBL
Carex lacustris	Lake sedge	5	OBL
Carex lasiocarpa	Quill-leaved sedge	8	OBL
Carex lupulina	Hop sedge	3	OBL
Carex sartwellii	Sartwell's sedge	8	OBL
Carex scoparia	Pointed broom sedge	3	FACW
Carex stipata	Crowded sedge	2	OBL
Carex stricta	Tussock sedge	5	OBL
Carex vulpinoidea	Fox sedge	1	OBL
Cladium mariscoides	Twig-rush	9	OBL
Eleocharis elliptica	Yellow-seeded spike-rush	7	FACW+
Eupatorium perfoliatum	Common boneset	3	FACW+
Euthamia graminifolia	Flat-topped goldenrod	2	FAC
Glyceria striata	Fowl manna grass	2	OBL
Impatiens capensis	Spotted touch-me-not	2	FACW
Iris virginica	Southern blue flag	6	OBL
Juncus brachycarpus	Short-fruited rush	5	FACW
Juncus effusus	Soft rusj	1	FACW+
Juncus torreyi	Torrey's Rush	3	FACW
Leersia oryzoides	Rice cut grass	1	OBL
Ludwigia alternifolia	Seedbox	3	FACW+
Lythrum alatum	Winged loosestrife	6	FACW+
Panicum clandestinum	Deer's tongue panic grass	2	FAC+
Polygonum amphibium	Water smartweed	4	OBL
Pycnanthemum virginianum	Virginia mountain mint	4	FAC
Schoenoplectus tabernaemontani	Soft-stemmed bulrush	2	OBL
Scirpus atrovirens	Dark green bulrush	1	OBL
Scirpus cyperinus	Wool-grass	1	FACW+
Scirpus pendulus	Drooping bulrush	2	OBL
Sium suave	Water-parsnip	6	OBL
Solidago juncea	Plume goldenrod	2	UPL
Verbena hastata	Blue vervain	4	FACW+
Veronica scutellata	Marsh speedwell	6	OBL

Table 3-5
Woody Planting List

Species	Common Name	Coefficient of Conservation	Wetland Indicator	Life Form
Acer rubrum	Red maple	2	FAC	Tree
Acer saccharinum	Silver maple	3	FACW	Tree
Cephalanthus occidentalis	Button bush	6	OBL	Shrub
Cornus racemosa	Gray dogwood	1	FAC-	Shrub
Cornus sericea	Red-osier dogwood	3	FACW+	Shrub
Ilex verticillata	Winterberry	6	FACW+	Shrub
Physocarpus opulifolius	Ninebark	4	FACW-	Shrub
Quercus bicolor	Swamp white oak	7	FACW+	Tree
Quercus palustris	Pin oak	5	FACW	Tree
Salix bebbiana	Bebb's willow	5	FACW	Shrub
Salix discolor	Pussy willow	3	FACW	Shrub
Salix eriocephala	Heart-leaved willow	2	FACW	Shrub
Salix exigua	Sandbar willow	1	OBL	Shrub
Salix petiolaris	Slender willow	8	OBL	Shrub
Spiraea alba	Meadow-sweet	3	FACW+	Shrub
Ulmus americana	American elm	2	FACW-	Tree
Viburnum lentago	Nannyberry	5	FAC	Shrub

Forested wetlands require an extra step for restoration projects. For wetland mitigation projects, Ohio EPA has required that after three years, the site must contain at least 300 growing trees per acre. Tree establishment options vary from bare-rooted whips (1 to 2 year-old plants) to 3-5 year old potted plants (1 to 3 gallon pots) to trees grown by the "root propagation method" (a.k.a. RPM trees), to 1-2 inch caliper balled and burlapped specimens. As a result, unit costs vary greatly. A decision as to what types of trees to plant will have to be made based on the unit cost per tree and the desired survival rate. Younger specimens will be less expensive, but will have to be planted at a higher rate to account for an expected higher rate of mortality.

Potential Attainable Goals

Using the above techniques, it should be possible to restore an active or fallow agricultural field in the Oak Openings Region of the study area into a high quality Category 2, or even Category 3 Oak Openings wetland. Established wet prairies in the Oak Openings Region hold some of the highest VIBI scores in the state. Potential scores for this emergent community in the Huron-Erie Lake Plain (Mack, 2004) have been as high as 70-85. A FQAI (Andreas *et al.*, 2004) for a ten-acre Oak Openings wet prairie can typically be as high as 30-35. Since the FQAI is a diversity driven calculation, the larger (and typically more diverse) the community is, the higher the FQAI score.

Preliminary Cost Estimate

The cost for restoring wetlands on sandy soils can vary greatly and will depend on a number of site and project-specific factors, including:

- The size of the site
- The amount of grading required
- The desired plant community
- Types of outflow structures used (if any)
- Types of plantings (seed, plug, size of trees and shrubs).

Table 3-6
Costs Per Acre

Project	Cost per Unit	Unit	Quantity	Total Cost for an Acre
Herbicide	$100	Gallon	3	$300
Small Excavator Rental	$400	Day	1	$400
Trees/shrubs (bare root; purchased in quantity)	$1.00	Each	If necessary	variable
Trees/Shrubs (1-3 gallon pot)	$15-20	Each	If necessary	variable
Trees (1" caliper)	$70-100	Each	if necessary	variable
Emergent Seed Mix	$1,300	Acre	1	$1,300

Labor and material prices will also vary, depending on a myriad of factors that may change daily. For this reason, estimated costs for a given project should be developed early but be periodically refined as the design progresses from the conceptual to final stage.

References

Andreas, B. K., J. J. Mack and J. S. McCormac, 2004. Floristic Quality Assessment Index (FQAI) for vascular plants and mosses for the State of Ohio. Wetland Ecology Group, Division of Surface Water, Ohio Environmental Protection Agency.

Mack, J. J. Integrated Wetland Assessment Program, 2007. Part 9: Field Manual for the Vegetation Index of Biotic Integrity for Wetlands v. 1.4 Ohio EPA Technical Report WET/2007-6. Ohio Environmental Protection Agency, Wetland Ecology Group, Division of Surface Water, Columbus, Ohio.

WETLAND RESTORATION/ ENHANCEMENT ON SANDY SOILS

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RESTORATION/ENHANCEMENT OF HISTORICALLY CHANNELIZED WATERWAYS IN CLAY SOILS

RESTORATION/ENHANCEMENT OF HISTORICALLY CHANNELIZED WATERWAYS IN CLAY SOILS

Requirement

This stream enhancement concept can be used for historically channelized watercourses (HCWCs) with watersheds less than 3.1 square miles (2,000 acres), in clay-dominated soils outside the Oak Openings Subregion.

Small, low gradient stream in clay soils.

Applicable Sites

OR-21, OR-61, SC-70

Objectives

- Provide enhancement approach for small streams in project area (addresses BUIs #3, #6 and #14)
- Provide wildlife habitat and migration corridors along waterways (addresses BUIs #3 and #14)
- Reduce sedimentation to adjacent ditches (addresses BUI #6)
- Provide regulatory, policy and land use context for enhancement of streams in project area that are constructed and maintained agricultural drainages with watersheds less than 3.1 square miles in area in clay soils.

General Condition Summary

The streams to which this concept is applicable are low-to-moderate gradient agricultural drainage ditches with small watersheds (<2,000 acres or 3.1 square miles) in clay soils. These streams likely formed as natural stream channels, but have been extensively hydrologically modified, and are maintained on a regular basis to remove accumulated sediments and restore sub-surface tile drainage from adjacent row-crop agriculture. These low-energy streams are typically not actively incising.

Row crops are typically planted up to the edge of low-quality, narrow (averaging 10 to 15 feet) riparian buffers on each bank. Gradient and stream power is insufficient to move silt and sand substrates which tend to dominate, resulting in the formation of instream mid-channel and transverse sediment bars. These sediment deposits can lead to streambank instability (e.g., erosion, slumping) as stream power is directed toward either bank. Channel and subsurface tile drainage flow capacity in these aggrading streams is maintained by periodic mechanical deepening at sufficient frequency (probably every three to five years) to eliminate most in-

stream habitat features important to fish and macroinvertebrates (riffles and runs) that may form during recovery periods. Pools occur as scour features downstream of sediment deposits or woody debris jams that function as grade-control features, which constrict and concentrate flow. These pools may be shaded, providing some fish refuge.

Recommended Restoration/Enhancement Techniques

The very low gradient, silt- and sand-dominated substrates and lack of sinuosity in these streams indicates that there is little opportunity for stream restoration through natural channel design. Improvements in water quality are best achieved by decreasing sediment and nutrient inputs from surrounding agricultural land uses, installing enhancements to improve the width and quality of the riparian buffers, and adopting Best Management Practices (BMPs) for agricultural ditches to be implemented during periodic ditch maintenance.

Ditch cleanout BMPs for historically channelized waterway courses with watersheds <3.1 square miles have been recently described by the Rural Drainage Advisory Committee (RDAC) in the Draft Ohio Drainage Manual (RDAC, 2008). The *Ohio Drainage Manual* was developed to support a broad consensus reached by the RDAC on how to perform needed agricultural drainage maintenance while minimizing impacts on water quality. Working with the RDAC, the Ohio EPA has proposed significant changes to the way rural drainage systems are regulated in Ohio in the form of proposed new water quality standards rules (Ohio Administrative Code 3745-1) in public review. As of Spring 2009, these proposed rules acknowledge the critical role of drainage in supporting agriculture, while proposing appropriate regulatory measures to reduce the impact of ditch maintenance on water quality.

Agricultural ditches have unique hydrologic and alluvial characteristics related to the extensive flow contribution of agricultural drain tiles. Unlike natural streams, agricultural ditches in Northwest Ohio are dominated by tile discharge and the channel-forming flow is different from the bankfull flow which has been described extensively for natural streams.

For example, a stream with a 1-square mile watershed yields an estimated bankfull cross-sectional area of 27.1 sq feet (Sherwood and Huitger, 2005), but an estimated 'benchfull' cross-sectional area of just 4.7 sq feet (Jayakaran *et al.*, 2005). The benchfull flow tends to form fluvial bench features in these small streams. Biological evidence from Ohio EPA suggests that these small agricultural ditches dominated by tile flow can have good aquatic communities when sediment is moved efficiently in small channels.

Work in these small, low-gradient agricultural drainages by Dr. Andrew Ward at The Ohio State University has lead to the development of a two-stage ditch concept and design procedure (USDA, 2007). In this concept, the smaller benchfull channel-forming flow is confined to a small channel constructed within the larger ditch alongside a small constructed floodplain. The two-stage channel concept meets the needs of agricultural producers for drainage while re-introducing some ecological habitat and restoring some of the stream's ability to move sediment.

RESTORATION/ENHANCEMENT OF HISTORICALLY CHANNELIZED WATERWAYS IN CLAY SOILS

Sediment is moved more efficiently in the smaller, benchfull channel than in an over-wide, traditional trapezoidal ditch, reducing the frequency of needed maintenance.

Partners for Clean Streams recommends implementing the BMPs recommended by RDAC (2007) for instream channel maintenance in historically channelized watercourses with watershed sizes <3.1 square miles, including two-stage channel design with creation of an instream bench, and one-sided construction. The two-stage channel will restrict the benchfull flow to a smaller channel, which will tend to move sediment more efficiently and reduce the embeddedness of sand and gravel areas. The bench will provide a functional vegetated floodplain to allow larger, more infrequent flows to spread laterally, reducing velocity and decreasing shear stress on banks. The vegetated floodplain will tend to intercept and process nutrients, sediments, pesticides, and other contaminants.

These streams can also be enhanced by widening and restoring the wooded riparian buffer to 25-50 feet from the top of each bank. It may also be necessary to incorporate a minimal-width maintenance access track along one bank to facilitate stream maintenance and monitoring activities.

Selective snag removal should also be implemented where necessary. Where woody debris has accumulated and is severely restricting flow, it should be removed where removal will significantly reduce bank instability. However, woody debris in small amounts has important ecological functions in the streams and should not be completely removed. Selective snag removal may have to be performed more often than sediment excavation, because the restored and widened wooded riparian buffer will result in a higher supply of woody debris.

Saturated-soil herbaceous or shrub wetlands may be incorporated into the constructed in-stream bench if hydrology allows.

Potentially Attainable Goals

- QHEI increase totaling 3 to 5 points in instream cover and riparian width metrics
- Increased streambank stability to meet specific sediment and nutrient reduction targets
- Reduce frequency of needed ditch cleanout to ten years or more, although selective snag removal may have to occur as frequently as every other year.

Preliminary Cost Estimate

Existing information obtained from previous projects suggests that two-stage channels can be constructed for approximately $30 - $50 per linear foot. Annual maintenance may cost approximately $2 - $5 per linear foot of channel. Wooded riparian buffer costs will be $7,000 to $10,000/acre depending on the types and maturity of trees and shrubs that are selected for the project.

Potential Funding mechanisms

Potential funding for these projects may be obtained from mitigation, grants or as a drainage assessment to landowners.

References

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RESTORATION/ENHANCEMENT OF HISTORICALLY CHANNELIZED WATERWAYS IN CLAY SOILS

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RESTORATION/ENHANCEMENT OF HISTORICALLY CHANNELIZED WATERWAYS IN SANDY SOILS

RESTORATION/ENHANCEMENT OF HISTORICALLY CHANNELIZED WATERWAYS IN SANDY SOILS

Requirement

This stream enhancement concept can be implemented in created agricultural drainages in sand-dominated soils inside the Oak Openings Subregion.

Wiregrass Ditch

Applicable Sites

OR-3, OR-6, OR-16, OR-31, OR-100, SC-6, SC-7, SC-8, SC-17, SC-49, SC-62

Objectives

- Provide enhancement approach for sand-dominated streams in project area (addresses BUIs #3, #6 and #14)
- Promote dominance by emergent wetland plan species (addresses BUIs #3 and #14)
- Provide wildlife habitat and migration corridors along waterways (addresses BUIs #3 and #14)
- Reduce sedimentation to adjacent ditches (addresses BUI #6)

General Condition Summary

The streams to which this concept is applicable are low-to-very low gradient agricultural drainage ditches with watersheds of widely varying size in sandy soils in the Oak Openings Subregion. These streams, which were not formerly natural stream channels, have been extensively hydrologically modified and are maintained on a regular basis to remove accumulated sediments and restore sub-surface tile drainage from adjacent row-crop agriculture. These low-energy streams are typically not actively incising.

The hydrology of these streams is dominated by groundwater, which is seasonally very close to the ground surface. Although saturated substrates or standing water are the norm, actual stream flow tends to be intermittent even in streams with watersheds comprising many square miles. Enhancement techniques applicable to headwaters streams may be successfully applied here to streams with watersheds of 20 square miles or more.

The larger streams in this category (e.g., Prairie Ditch) tend to form linear wetlands within their banks. These linear wetlands are dominated by emergent sedge, bulrush, rush and grass species, some of which are unique to the Oak Openings Region. These linear wetlands in constructed ditches constitute a unique wetland type of considerable ecological value.

Row crops are planted up to the edge of low-quality, narrow (averaging 10- to 15-foot) riparian buffers on each bank. Gradient and stream power is insufficient to move silt and sand substrates which dominate, resulting in the formation of instream mid-channel and transverse sediment bars. These sediment deposits can lead to streambank instability (e.g., erosion, slumping) as stream power is directed toward either bank. Channel and subsurface tile drainage flow capacity in these aggrading streams is maintained by periodic mechanical deepening at sufficient frequency (probably every three to five years) to eliminate most in-stream habitat features that are important to fish and macroinvertebrates (riffles and runs) that may form during recovery periods. Pools may occur as scour features downstream of sediment deposits or woody debris jams that function as grade-control features, which constrict and concentrate flow. These pools are often shaded, providing some fish refuge.

A major problem in these streams is unstable streambanks. Streambanks in sandy soils with slopes greater than about 3:1 are not stable, and streambanks with slopes of 6:1 or less are necessary for stability when woody vegetation is absent. Adjacent to agricultural operations, however, these banks often have severely eroding slopes ranging from 1:1 to nearly vertical as a result of regular mechanical deepening, farming equipment running on or near the streambanks, and poor coverage by vegetation with deep root systems.

Recommended Restoration/Enhancement Techniques

The very low gradient, silt- and sand-dominated substrates and lack of sinuosity in these streams indicates little opportunity for stream restoration through natural channel design to create habitat (particularly needed riffles and runs) and increase efficiency in moving sediments to slow or eliminate aggradation. In addition, the sandy soils have little structural integrity for maintaining constructed instream features such as floodplains or benches. Improvements in water quality are best approached by decreasing sediment and nutrient inputs from surrounding agricultural land uses, reducing bank slopes, installing enhancements to improve the width and quality of the riparian buffers, and adopting best management practices (BMPs) for agricultural ditches to be implemented during periodic ditch maintenance.

Ditch-cleanout BMPs for historically channelized water courses are described by the Rural Drainage Advisory Committee in the draft *Ohio Drainage Manual* (RDAC, 2008). Although these BMPs were designed for streams with watersheds less than 3.1 square miles in size, many of these BMPs are applicable to streams throughout the Oak Openings Region regardless of watershed size. The *Ohio Drainage Manual* was developed to support a broad consensus reached by the RDAC on how to perform needed agricultural drainage maintenance while minimizing impacts on water quality. Working with the RDAC, the Ohio EPA has proposed significant changes to the way rural drainage systems are regulated in Ohio in the form of

proposed new water quality standards rules (Ohio Administrative Code 3745-1) currently in public review. These proposed rules acknowledge the critical role of drainage in supporting agriculture, while proposing appropriate regulatory measures to reduce the impact of ditch maintenance on water quality.

The primary enhancement component for these streams is streambank slope reduction and stabilization. After first establishing a 50-foot wide riparian protection corridor on each bank, the streambanks should be graded back to a 6:1 or 7:1 slope and revegetated with native Oak Openings vegetation. In order to ensure that the linear wetland community within the stream receives sufficient sunlight, tree planting should be a part of the riparian enhancement mix on the north side of streams only, while the south riparian zone should be planted with herbaceous and shrub vegetation.

Two-stage channel construction (as described in *Historically Channelized Waterways in Clay Soils* concept) is not feasible in sandy soils in the Oak Openings Region due to insufficient soil integrity to retain a constructed channel shape. However, other BMPs are applicable, such as one-sided construction access, targeted sediment and woody debris removal, and riparian buffer enhancement.

Partners for Clean Streams recommends implementing BMPs recommended by RDAC (2007) for instream channel maintenance in historically channelized water courses including one-sided construction and targeted sediment and woody debris removal.

These streams can also be enhanced by widening and restoring the wooded riparian buffer to 50 feet from the top of each bank. It may also be necessary to incorporate a minimal-width maintenance access track along one bank to facilitate stream maintenance and monitoring activities.

Selective snag removal should also be implemented where necessary. Where woody debris has accumulated and is severely restricting flow, it should be removed to significantly reduce bank instability. However, woody debris in small amounts serves important ecological functions in the streams and should not be completely removed. Selective snag removal may have to be performed more often than sediment excavation, because the restored and widened wooded riparian buffer will result in a higher supply of woody debris.

Potential Attainable Goals

By implementing the above recommendations, it should be possible to:

- Increase the QHEI by 3 to 5 points in instream cover and riparian width metrics
- Increase streambank stability to meet specific sediment and nutrient reduction targets
- Increase diversity and nativity of vegetation within riparian zone
- Reduce frequency of needed ditch cleanout to ten years or more, although selective snag removal may have to occur as frequently as every other year.

RESTORATION/ENHANCEMENT OF HISTORICALLY CHANNELIZED WATERWAYS IN SANDY SOILS

Preliminary Cost Estimate

Initial bank reshaping may be accomplished for $15 to $25 per linear foot. Annual maintenance may cost between $2 to $5 per linear foot per year. Wooded riparian buffer costs will be $7,000 to $10,000/acre depending on the maturity of the propagules.

Potential Funding Mechanisms

Potential funding for these projects may be obtained from mitigation, grants or as a drainage assessment to landowners.

References

Ohio DNR, Ohio Drainage Manual, draft. 2008.

Rural Drainage Advisory Committee (RDAC), 2007. Rural Drainage Systems: Agencies and Organizations Reach Consensus on Ways Forward. 12 pp.

RESTORATION/ENHANCEMENT OF HISTORICALLY CHANNELIZED WATERWAYS IN SANDY SOILS

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RESTORATION/ENHANCEMENT OF LARGE STREAMS

RESTORATION/ENHANCEMENT OF LARGE STREAMS

Requirement

This stream restoration/ enhancement concept can be implemented in streams of natural origin, with watersheds greater than 3.1 square miles (2,000 acres), in clay-dominated soils outside the Oak Openings Subregion.

Tenmile Creek: 29 sq. mi. watershed

Applicable Sites

OR-58, OR-59, OR-60, OR-61, OR-102, SC-8, SC-13, SC-14, SC-18, SC-20, SC-64

Objectives

- Provide enhancement approach for large streams in project area (addresses BUIs #3, #6 and #14)
- In select streams, provide natural channel design approach for stream restoration (addresses BUIs #3, #6 and #14)
- Provide wildlife habitat and migration corridors along waterways (addresses BUIs #3 and #14)
- Reduce sediment inputs from severe streambank erosion (addresses BUI #6)

Stone Ditch: 7.9 sq. mi. watershed

General Condition Summary

The streams to which this concept is applicable are low-to-moderate gradient streams with large watersheds (> 2,000 acres or 3.1 square miles) in clay soils. These streams formed as natural stream channels, and typically have well-developed stream channel morphology including riffle/run/pool/glide sequencing, sorted mineral substrates with particles ranging from silt, sand and gravel to cobble sizes, cross sections that include floodplain areas, and landscape patterns that reflect a sinuous course. The great

majority of these streams have been channelized or straightened. These streams typically have sufficient power to move sediments effectively, and as a result they are not routinely excavated to maintain agricultural drainage. Instead, maintenance is conducted to remove significant obstructions such as log jams.

The sources of instability in these streams are diverse and may involve: hydrograph changes resulting from agricultural drainage in headwaters areas and stormwater inputs in residential and urban areas; channel deepening and straightening to increase storm flow capacity; creation of levies that restrict access of flood flows to floodplain areas; creation of fords for crossing of agricultural equipment; filling of floodplains for development; *ad hoc* streambank reinforcement using available materials; and restrictions of flow created by undersized or improperly designed road crossings.

Severe streambank erosion, right bank of Ottawa River at Camp Miakonda (127.5 sq. mi. watershed)

The sources of instability enumerated above have resulted in a variety of functional problems within the streams that adversely affect biological and chemical water quality. These problems include excessive siltation, streambank erosion, poor morphological sequencing, stream incision, stream entrenchment, poor oxygenation and poor-quality or nonexistent riparian buffers.

In addition, some of these streams have significant pollutant inputs that should be controlled as part of planned restoration or enhancement. Particularly in rural areas, failing on-site septic systems are a major contributor of nutrients, oxygen-demanding substances and bacteria.

Recommended Restoration/Enhancement Techniques

The recommended approach to correcting instability in these streams depends on many variables, including the magnitude and severity of the instability, the degree of degradation of instream habitat, flood flow access to adjacent floodplains, the vegetative quality and size of the riparian and floodplain areas, and equipment access for construction.

RESTORATION/ENHANCEMENT OF LARGE STREAMS

In some cases, full restoration of the stream channel may be indicated to restore the channel. In such cases, a new stable stream channel is designed and constructed based on geomorphological data obtained from stable reference streams. In many cases, however, full stream restoration is not necessary, and instead, stream enhancement techniques, such as streambank stabilization, may be sufficient to mitigate observed instability.

Severe Streambank Erosion

Natural Channel Design

In certain stream reaches (e.g., SC-20, OR-58, OR-61, and SC-64), full stream channel and floodplain restoration is indicated. These sites have significant instability over large segment lengths that cannot be adequately addressed through improvements in land management in the watershed or through spot application of less expensive and less invasive techniques, such as streambank stabilization (see below). These stream reaches exhibit severe streambank erosion particularly at the outside of meanders in pool and glide areas, but moderate to severe erosion can be observed anywhere along the stream reach. These stream channels are moderately to deeply incised, and few have access to their floodplains even at twice bankfull depth. In addition, these stream reaches have good potential equipment access.

J-hook/logvane/root wad structure under construction

The overall goal of natural channel design is to restore some degree of stability to a stream's dimension (or cross sectional profile), landscape pattern (also known as platform), and longitudinal profile. Stream channel restoration should begin with a fluvial geomorphology survey as described by several stream hydrologists, including Derrick and Rosgen, with special attention to identifying the origin and nature of observed channel and streambank instabilities. In addition, an appropriate stable

reference stream reach (or several such reaches in the same region) should be identified and subjected to a fluvial geomorphology survey. These survey data will provide the basis for identifying departures from stability in the project reach, and identifying specific restoration design goals to be employed in the stream design phase.

In most cases in this region of Ohio, full stream restoration will involve creating a new floodplain and stream platform with the stream bed remaining at its present elevation. In all cases, the focus of the restoration is improving water quality and in-stream habitat while maintaining an overall aesthetic appeal.

Stream design should focus on meeting the identified restoration design goals while minimizing the amount of existing stream channel that needs to be reconfigured or moved, and minimizing the amount of material that needs to be placed in the stream channel. Based on general observation, it appears that much can be accomplished in the design by reshaping existing meanders (including such Derrick techniques as Abrupt Platform Modifiers: Angle Slams, Grand Slams, Boil-Up Pools, Wrong-Way Boil-Up Pools, and Twin-Spin Boil-Up Pools), excavating new floodplains, and introducing in-stream flow-redirecting techniques to mitigate the effects of high shear stress on streambanks, such as rock vanes,

Live staking of streambank through jute mat, with grass established

Live staking of streambank through small rip rap

J-hooks, bendway weirs, or combinations of these techniques constructed using available natural materials (e.g., a 'J-hook/log vane/root wad combo). Viffles or Loose Stone Engineered Rocked Riffles with all stones in compression (either end to end or imbricated) might need to be employed to raise the stream to reconnect it with its historic floodplain.

To dissipate energy vertically, pools could be created using Derrick techniques such as Contraction Stones, Stone "Squeezers", Log "Squeezers", "Kink" Kickers, Missing Tooth Smiles, Missing Tooth Smiles with downstream Hydraulic Cover Stone Splitters, Constructed Transverse Oblique Bars, Missing Tooth Transverse Oblique Bars, Missouri River Kickers for small streams, Log Point Bar Enforcers, and Stone Point bar Enforcers with integrated Living Dikes.

The natural stream channel design will be implemented with the *Restoration/Enhancement of Riparian Buffer* concept, which can include Derrick's Willow Curtain and Willow Pole bioengineering methodologies, Living Dikes, Live Siltation; Joint Staking; Slit Brush Layering, and Two-Stage Slit Trench Plantings.

Streambank Stabilization

In many of the large streams sites in the project area (i.e., SC-18 and OR-102), overall channel stability is fair to good and the stream is not badly incised, but severe streambank erosion is a common problem concentrated at the outside of meanders.

In other large stream sites, localized streambank erosion in meanders may be encountered along with permanent obstructions to movement of sediment (i.e., SC-8), levies created to protect low-lying cropland from flooding (i.e., OR-60), equipment fords (i.e., Site OR-60 and OR-61), lack of good riparian buffers (i.e., SC-20, OR-61, OR-64) or other problems. Where good riparian buffers exist (i.e., OR-102) or the site is heavily urbanized (i.e., SC-18), site access will restrict what can be accomplished.

In general, streambank stabilization is approached in three steps. First the factors that are causing the erosion must be identified and addressed; second, the progress of the erosion must be stopped; and third, the streambank must be repaired.

The causes of the streambank erosion are typically identified and quantified through a fluvial geomorphology survey, and this cause may be at some distance from the eroded streambank. It is important to view and understand the stream reach as a whole or the streambank stabilization techniques used may be inadequate. Addressing the source of the streambank erosion may involve reconfiguring flow patterns in the stream using the placement of flow diversion structures such as rock vanes and bendway weirs, J-hook, or J-hook/log vane/root wad combinations. Other streambank stabilization measures may include Derrick's Locked-Logs, Fuzzy Locked Logs, "Instant Shade", "Corner Lunker", "Hydraulic Cover Stones", Traffic Control Stones, "Wiggle" shoreline deflectors, "Align & Catch" log revetment pairings, "Squeezers", "Missing Toot Smiles", Stone Transverse bars, Missouri River Kickers, Living Log Corner Crossers, Living Half-Drowned Bushes, Tree Down Bank Flops, Duck Resting Rocks, and "Kink" Kickers.

RESTORATION/ENHANCEMENT OF LARGE STREAMS

Stabilization methods can be combined with the following Derrick techniques to improve in-channel and riparian habitat: Extreme Instant Shade; “California” style Lunkers; “Dense Fibrous Root Replication”; Half-drowned bushes; and “Pushed Trees”.

In order to stop the progression of the erosion, and absorb and disperse shear stress to allow time for streambank repair and revegetation to occur, techniques such as streambank toe protection (e.g., longitudinal peaked stone toe protection or LPSTP, “Smooshed” riprap, Align and Catch Log revetment per Derrick) or sod mat/woody debris structures placed at bankfull elevation can be implemented depending upon availability and affordability of materials.

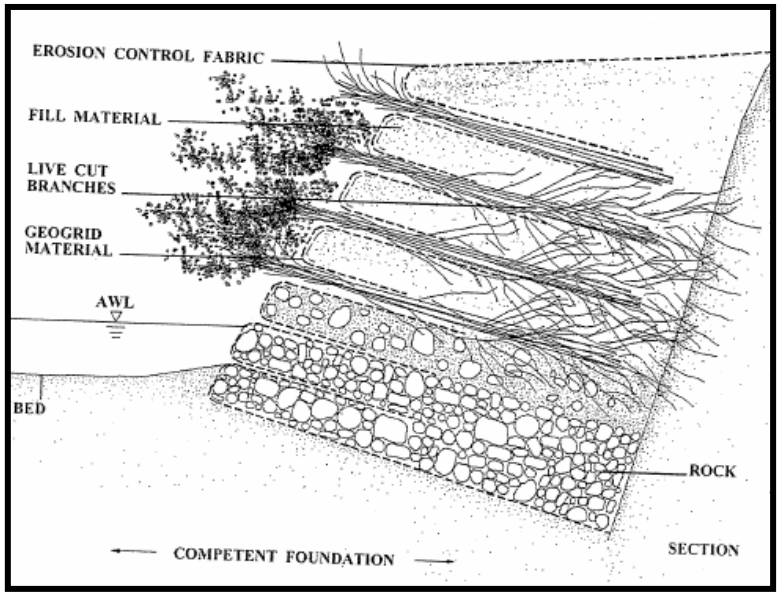
It is important that streambank stabilization be accomplished in a way that is as aesthetically appealing as possible and that provides ecological value by creating new habitat. Natural-looking streambank stabilization techniques with high habitat value that may be implemented at large stream sites include installation of lunker structures, which provide undercut bank habitat, to instream structures designed to redirect stream flow that also create pools and undercut banks streambanks (e.g., J-hook/log vane/root wad combination). Before designing and installing these structures, it is important to determine bankfull elevation with a reasonable degree of certainty so that the structures can be placed at the correct elevation. Bankfull elevation is determined through a fluvial morphology survey.

Prior to implementation of these techniques, all *ad hoc* streambank stabilization measures (e.g., dumped concrete slabs and woody debris) must be removed. Recommended methods to stabilize the banks above the ordinary high water mark include reducing slopes, use of geotextile fabric and live stakes of woody vegetation (see attached drawing), or installation of bioengineered soil lifts (see attached drawing).

Potential Attainable Goals

By implementing the above recommendations for National Channel Design it should be possible to:

- Increase QHEI by 10 to 14 points in siltation, embeddedness, instream cover, channel morphology, erosion, riparian width, channel width and current velocity metrics;
- Increase Index of Biotic Integrity (IBI) by 3 to 6 points;



Bioengineered soil lifts for streambank stabilization

- Increase Invertebrate Community Index (ICI) by 3 to 6 points;
- Increase streambank stability to meet specific sediment and nutrient reduction targets; and
- Increase diversity and nativity of vegetation within riparian zone.

By implementing the above recommendations for streambank stabilization it should be possible to:

- Increase QHEI by 3 to 5 points in instream cover and riparian width metrics; and
- Increased streambank stability to meet specific sediment and nutrient reduction targets.

Preliminary Cost Estimate

Natural channel restoration costs range from $160 to $275 per linear foot including initial survey, restoration design, construction and materials. Streambank stabilization costs depend upon the technique used, but can typically be implemented for $2,500 to $5,000 per 100 linear feet of bank.

Potential Funding Mechanisms

Potential funding for these projects may be obtained from mitigation, grants or as a drainage assessment to landowners.

References

Derrick, D., 2009 ftp://chlguest:3bit5map@134.164.34.99:21/DERRICK-LECTURES - This site contains 13 lectures covering a wide range of topics and includes hundreds of pictures. There are many detailed PowerPoint presentations of specific projects (case studies) with many innovative techniques with step by step photos of construction.

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RESTORATION/ENHANCEMENT OF OF RIPARIAN BUFFERS

RESTORATION/ENHANCEMENT OF RIPARIAN BUFFERS

Requirement

This concept is recommended for the creation of forested riparian buffers on agricultural, fallow or invasive plant dominated areas along streams on clay or sandy soils in northwest Ohio.

Unbuffered headwater stream

Applicable Sites

OR-3, OR-58, OR-59, OR-60, OR-61, OR-100, OR-101, SC-6, SC-8, SC-13, SC-20, SC-34, SC-62, SC-64, SC-70

Objective

- Provide habitat and migration corridors for wildlife along riparian waterways (addresses BUIs #3 and #14).
- Increase habitat diversity through plant life along riparian waterways (addresses BUIs #3 and #14).
- Reduce the amount of siltation running off into adjacent streams (addresses BUI #6).

General Improvement Strategy

Healthy forested riparian buffers along streams and ditches are vitally important because the dense vegetation anchors the soils, which in turn minimizes siltation in streams. By shading the water, temperature and dissolved oxygen concentrations are also stabilized. The vegetation also traps nutrients before they enter the stream and provides much needed habitat for wildlife.

Coir –fiber matting (image from website)

Within the two watersheds, riparian corridors may be established on well-drained, non-hydric soils. Trees that are associated with these areas are typically species that require dry conditions during the majority of the year, but can survive seasonal flooding. Inundation of the root zone usually occurs in the early spring, but may last until the start of the growing season. Species associated with these better drained riparian corridors are black walnut (*Juglans nigra*), eastern cottonwood (*Populus deltoides*), American elm

RESTORATION/ENHANCEMENT OF RIPARIAN BUFFERS

Grassy buffered corridor of channelized ditch

(*Ulmus americana*), hackberry (*Celtis occidentalis*), American sycamore (*Platanus occidentalis*) and box-elder (*Acer negundo*). Many of these trees can survive a variety of hydrological circumstances.

Within the two watersheds that were studied, riparian corridors may also be found on more poorly drained and sometimes hydric soils. Typical soils along streams in these areas may include Eel silt loam, Shoals silt loam and Sloan silty clay loam. Eel silt loam and Sloan silty clay loam are hydric and with proper hydrology will support forested wetland communities. In these areas it may be possible to restore deciduous swamp forests in accordance with the general concepts that are presented in the earlier sections of this report (see *Restoring/Enhancing Wetlands on Sandy Soils* concept and recommendations for *Restoring/Enhancing Wetlands on Clay Soils* concept).

In periodically flooded riparian floodplains, vernal pools can be added to create amphibian breeding pools. In general, the trees of the riparian forest are rooted in shallower water areas that allow the collar of the trunk to be above water during the growing season. In deeper water areas (up to a foot or two deep in areas), vernal pools will exist between the trees. This small sub-community, if vegetated, is typified by buttonbush (*Cephalanthus occidentalis*), water buttercup (*Ranunculus flabellaris*), manna grasses (*Glyceria striata* and *G. septentrionalis*), and bog nettle (*Boehmerica cylindrica*). These vernal pools are highly important for many amphibian (e.g. wood

Open pasture along Swan Creek, Fulton County

frog (*Rana sylvatica*), chorus frogs (*Pseudacris* spp.) and mole salamander (*Ambystoma* spp.) breeding (see *Wetland Restoration/Enhancement on Sandy/Clay Soils* concept for more information).

Recommended Restoration/Enhancement Techniques

As indicated above, the specific techniques for riparian buffer restoration will vary, depending on the types of soils that are present. However, to be effective as wildlife habitat and to maximize their effectiveness in anchoring soils and moderating water temperatures and oxygen concentrations, buffer widths should be maximized to the extent possible. Typically, buffers need to be at least 35 to 180 feet wide (NRCS, 2003).

Forested corridor along Swan Creek through Oak Openings Metropark, Lucas County

The existing condition of the riparian corridor should be characterized to determine what measures need to be implemented for restoration. For example, if undesirable or invasive species make up a major component of the riparian corridor, it will be necessary to treat the undesirable vegetation with a non-species specific herbicide, most likely a form of a glyphosate. This is especially important if highly invasive species such as purple loosestrife (*Lythrum salicaria*), reed canary grass (*Phalaris arundinacea*), giant reed (*Phragmites australis* subsp. *australis*) or multiflora rose (*Rosa multiflora*) are present along the streambank. Left unchecked, these species will have a tendency to outcompete more highly valued vegetation that is planted in the area.

Until soils on the site have been stabilized, areas prone to erosion should be covered with some type of fiber matting (e.g., Suncoir). The mat should consist of a biodegradable, low maintenance fiber matting that can be easily installed. The fiber matting generally comes in rolls and can be imbedded with seed or seed can be applied over it. The matting has a high moisture retaining capacity and a low heat absorption rate, which promotes germination. Seed mixes can vary depending on the diversity and scarcity of the seeds within a mix. Individual seed mixes for riparian buffers are listed in Table 3-7. Seed should be selected based on the general soil type and moisture regime of the area.

Table 3-7 Herbaceous Planting List			
Species	Common Name	Coefficient of Conservation	Wetland Indicator Status
Aster lanceolatus	Panicled aster	3	FACW
Aster praealtus	Vein-leaved aster	6	FACW
Boehmeria cylindrica	False nettle	4	FACW+
Calamagrostis canadensis	Canada bluejoint	4	FACW+
Campanula americana	Tall bellflower	4	FAC
Carex cristatella	Crested sedge	3	FACW
Carex lurida	Sedge	3	OBL
Carex vulpinoidea	Fox sedge	1	OBL
Elymus virginicus	Virginia wild-rye	3	FACW-
Glyceria striata	Fowl manna grass	2	OBL
Helenium autumnale	Sneezeweed	4	FACW+
Impatiens capensis	Spotted touch-me-not	2	FACW
Panicum clandestinum	Deer's tongue panic grass	2	FAC+
Pycanthemum virginianum	Virginia mountain mint	4	FAC
Solidago juncea	Plume goldenrod	2	UPL
Rudbeckia laciniata	Green-headed coneflower	6	FACW
Verbesina alternifolia	Wingstem	5	FAC

Shrubs and trees should be the main component of the riparian corridor restoration. A good mix of open growing species along with shade tolerant species should be included in the restoration plan (Table 3-8). Assuming that many pioneer species (box-elder, eastern cottonwood, green ash (*Fraxinus pennsylvanicus*), red and silver maple (*Acer rubrum* and *A. saccharinum*) and several dogwoods (*Cornus racemosa,* and *C. amomum*) will become established on their own, purchased trees should consist of higher quality species. ODNR has recommended stocking rates as high as 600 to 1000 seedlings per acre or 500 containerized plants per acre.

Additionally, certain techniques developed by David Derrick may be applicable, including: Willow Curtain and Willow Pole bioengineering methodologies; Living Dikes; Live Siltation; Joint staking; Slit Brush Layering; and Two-Stage Slit Trench Plantings.

Table 3-8 Woody Planting List				
Species	Common Name	Coefficient of Conservation	Wetland Indicator	Life Form
Acer rubrum	Red maple	2	FAC	Tree
Acer saccharinum	Silver maple	3	FACW	Tree
Carya laciniosa	Shellbark hickory	7	FAC	Tree
Cephalanthus occidentalis	Button-bush	6	OBL	Shrub
Cornus racemosa	Gray dogwood	1	FAC-	Shrub
Cornus sericea	Red-osier dogwood	3	FACW+	Shrub
Crateagus sp.	Hawthorn	-	-	Tree
Ilex verticillata	Winterberry	6	FACW+	Shrub
Juglans nigra	Black walnut	5	FACU	Tree
Physocarpus opulifolius	Ninebark	4	FACW-	Shrub
Platanus occidentalis	Sycamore	7	FACW-	Tree
Quercus bicolor	Swamp white oak	7	FACW+	Tree
Quercus macrocarpa	Burr oak	6	FAC-	Tree
Quercus palustris	Pin oak	5	FACW	Tree
Salix discolor	Pussy willow	3	FACW	Shrub
Salix eriocephala	Heart-leaved willow	2	FACW	Shrub
Salix exigua	Sandbar willow	1	OBL	Shrub
Spiraea alba	Meadow-sweet	3	FACW+	Shrub
Ulmus americana	American elm	2	FACW-	Tree
Viburnum acerifolium	Maple-leaved viburnum	6	UPL	Shrub
Viburnum lentago	Nannyberry	5	FAC	Shrub
Viburnum prunifolium	Black-haw	4	FACU	Shrub

Potential Attainable Goals

The establishment of riparian buffers along stream channels will have a positive impact on the overall quality of the stream channel. This can be demonstrated by an observed increase in the QHEI score at a given site (Rankin, 2006). Depending on the overall width and quality of the newly restored riparian corridor, QHEI score may increase by 1-4 points. The shading of the stream will lower stream temperatures, increase oxygen concentrations and improve macroinvertebrate and fish quality. With time, these positive changes should be demonstrated by an increase in the Invertebrate Community Index (ICI), Index of Biotic Integrity (IBI) and Modified Index of Well Being (MIWB) (Ohio EPA, 1989). The Floristic Quality Assessment Index (FQAI) (Andreas et al., 2004) should also increase along the improved riparian corridor, by the establishment of a larger and more diverse plant community.

Preliminary Cost Estimate

Ultimately the overall cost of a riparian restoration project will depend on the size of the site. However, unit costs for some typical materials that may be necessary for restoring for materials are presented in Table 3-9.

Table 3-9
Costs per acre

Project	Cost per Unit	Unit	Quantity	Total Cost for an Acre
Herbicide	$100	Gallon	3	$300
Coir Matting	$5	Foot*	43560	$217,800*
Trees/Shrubs (bare root; purchased in quantity)	$1	Each	If necessary	variable
Trees/Shrubs (1-3 gallon pot)	$15-20	Each	If necessary	variable
Trees/Shrubs (1" caliper)	$70-100	Each	if necessary	variable
Emergent Seed Mix	$800	Acre	1	$800

Potential Funding Mechanisms

Funding for these projects may be obtained from mitigation for wetland impacts or through private donation. Riparian buffers can also be partially funded through state and county grants or tax concessions. Many programs are in place to help decrease the effect of wind and water erosion on the area's farmlands.

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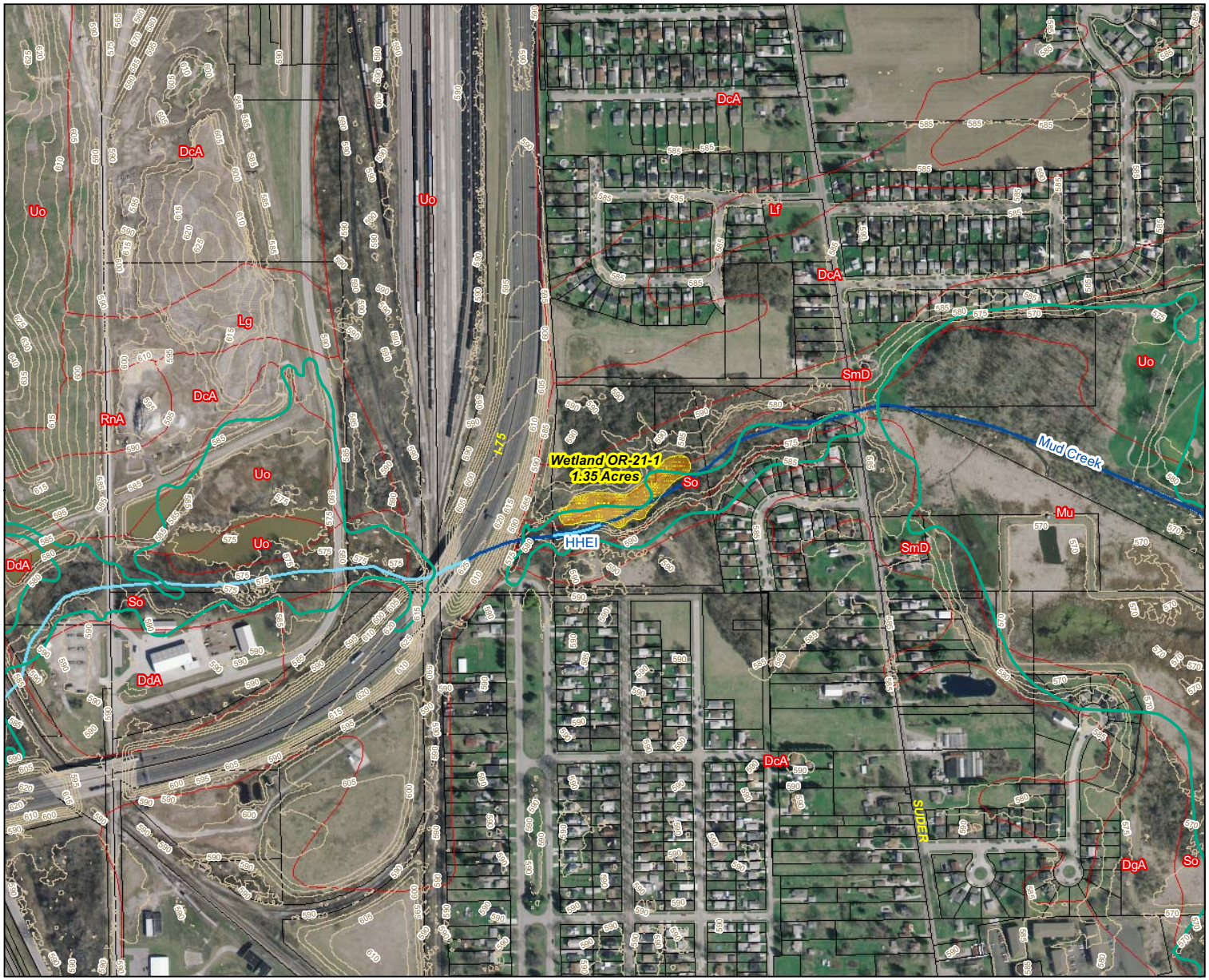
CHAPTER 4
SITE SPECIFIC RECOMMENDATIONS

SITE SPECIFIC RECOMMENDATIONS

SITE OR-21



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

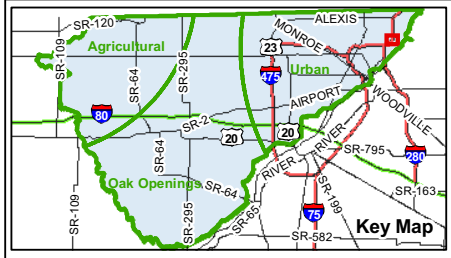
Prepared for:

Partners for Clean Streams, Inc.
P.O. Box 822
Bowling Green, Ohio 43402
www.PartnersForCleanStreams.org

Prepared by:

Mannik & Smith Group, Inc.

Hull & Associates, Inc.



Legend

- Project Boundary
- Parcels
- Existing Wetlands
- Wetland Restoration Areas
- Ditch/Linear Wetland Restoration
- Emergent Zone
- Deep Water Emergent Zone
- Floating-leaved Bed Zone
- Forested Zone
- Riparian Buffer Zone
- 100 year Floodplain
- 2005 Soil Classification
- Access Road/Trail
- 5' Contour
- Streams
- QHEI
- HHEI
- Severe Bank Erosion
- Ohio Rivers and Streams
- Streams
- Intermittent Stream

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-1
Restoration/Enhancement Plan for OR-21
Washington Township, Lucas County, Ohio

County Map of Ohio

0 200 400 800 Feet

1:4,800

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: DAO002
File Name: DAO002_Concept2_Fig4-1_SiteOR-21.mxd
Date: March, 2009

SITE OR-21
NON-ISOLATED WETLAND RESTORATION

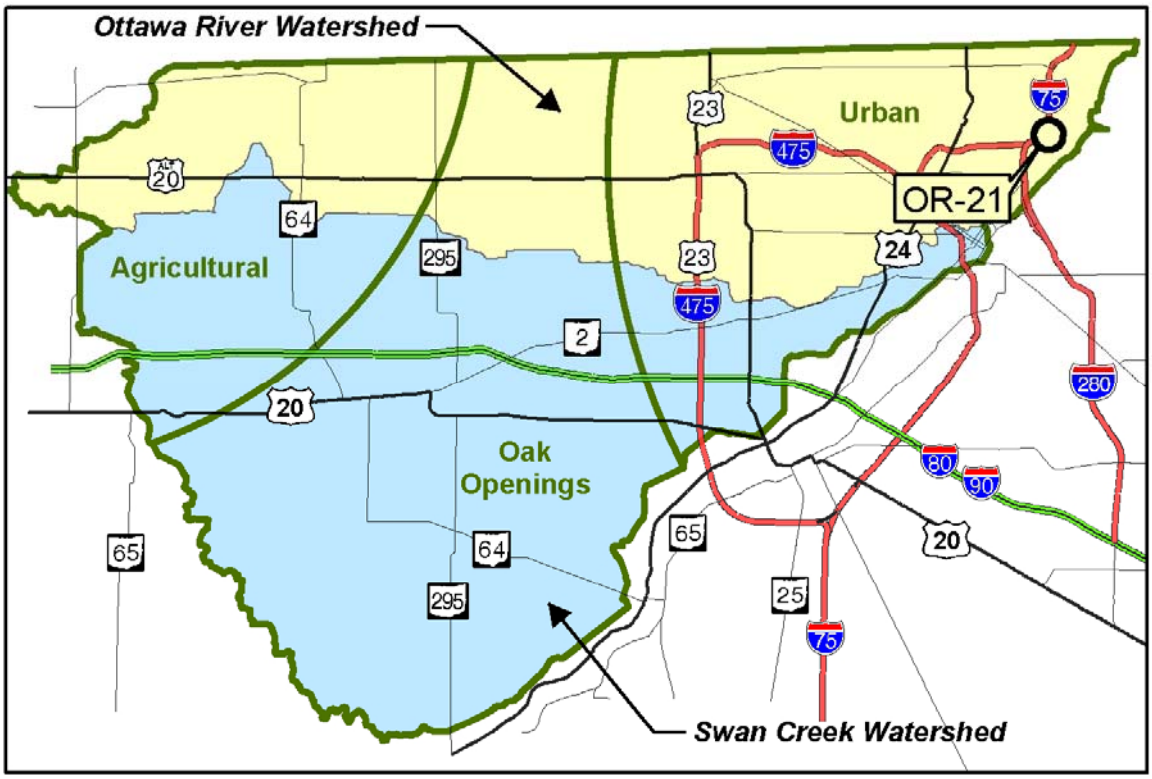
Urban Subregion

Project Description:
Remove accumulated sediments and create 2-Stage Channel over 1,250 feet of stream
Enhance 1.35 acre of existing wetland

General Restoration/Enhancement Concept:
Restoration/Enhancement of Historically Channelized Waterways in Clay Soils

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 0.52 sq. mi.
County: Lucas **Municipality**: City of Toledo **Location:** 83°30' 0.14"W 41°41' 42.82N
Stream: Mud Creek
Watershed: Maumee Bay HUC 0410000103 (Frontal Lake Erie)
Wetland: Wetland OR-21-1 (palustrine emergent) on left bank
Stream buffers: Wide, low quality scrub/young woods
Surrounding land use: Urban and residential
Field-estimated gradient: <0.1%
Ohio Gazetteer published average gradient: 0.1% (5.9 feet per mile)



SITE OR-21
NON-ISOLATED WETLAND RESTORATION

Site Description

The site consists of two parcels comprising 11.49 acres, located east of Interstate 75 and west of Suder Avenue in the City of Toledo, Lucas County, Ohio (Figure 4-1).

Existing Site Conditions

Mud Creek is a low-gradient stream with a small drainage area (<2,000 acres or 3.1 square miles). This stream may have formerly been an agricultural ditch that over the years has been extensively modified to facilitate drainage in the area; however, there are no longer agricultural fields adjoining the stream anywhere in its watershed. The stream has been extensively hydrologically modified. On the west side of Interstate 75, the stream appears to exist in a backwater condition and there is extensive siltation overwhelming the channel. It is located downstream of an active landfill and receives discharge from sedimentation ponds located on the landfill property. Gradient and stream power are insufficient to move the dominant silt substrates. Since this stream is not maintained, the silt deposits have become several feet deep. The HHEI score for Mud Creek was 34, resulting in an existing beneficial use of perennial Modified Class II PHWH.

View of Mud Creek, facing upstream

View of Mud Creek, facing downstream

SITE OR-21
NON-ISOLATED WETLAND RESTORATION

A young, wooded scrub/shrub community is present on the sloped south bank of Mud Creek and an estimated Category 2 wetland is present on the north bank. There is one existing wetland located on the north streambank. This wetland was dominated by reed canary grass (*Phalaris arundinacea*) and giant reed (*Phragmites australis*), and is likely to be classified an Ohio Category 2 wetland by Ohio EPA.

The majority of the soils at Site OR-21 are mapped as the non-hydric Sisson loam, 12-18% slopes (SmD). However, this soil may contain unmapped inclusions of hydric Colwood loam (Co) and the non-hydric Del Rey-Urban land complex, 0-3% slopes (DcA) which may contain unmapped inclusions of hydric Lenawee silty clay loam (Lf) and hydric Mermill loam (Mf), and hydric Sloan loam, occasionally flooded (So).

Existing wetland on left bank of Mud Creek

Recommended Stream and Wetland Enhancement Strategy

The following measures can be implemented to enhance the quality of the Mud Creek at this location. First, ongoing sediment export problems should be addressed in the watershed upstream of Interstate 75. The culverts that pass beneath Hoffman Road and Interstate 75 should also be inspected to determine if the backwater situation is being caused by blockages. If blockages are inhibiting flow, they should be removed.

In the section of Mud Creek downstream of Interstate 75, heavily silted portions of the channel should be excavated to remove accumulated and expose the stream channel. Where the stream channel is overly broad, it should be narrowed to provide a low flow or benchfull channel to improve sediment while creating an instream bench. The areas adjacent to the channel should then be planted with native, palustrine emergent vegetation. Detailed surveying and design should be in accordance with USDA, 2007 (see *Restoration/ Enhancement of Historically Channelized Waterways in Clay Soils* concept).

The low gradient of Mud Creek suggests negligible opportunity for full stream restoration through natural channel design to create habitat (particularly needed riffles and runs) and increase efficiency in moving sediments to slow or eliminate aggradation. Improvements in water quality can best be achieved by decreasing sediment and nutrient inputs from upstream and surrounding land uses, and narrowing the stream channel to increase its competence to move its bedload of sediment.

SITE OR-21
NON-ISOLATED WETLAND RESTORATION

Wooded slope on right bank of Mud Creek

Wetland enhancement can be accomplished by improving the plant communities within the existing wetland (Wetland OR-21-1). The invasive wetland vegetation should be sprayed with a non-species specific herbicide, most likely a form of a glyphosate. The removal of the invasive species should then be paired with the seeding of herbaceous species that are adapted to this type of emergent community. A diverse emergent seed mix can be placed in this marsh (see *Wetland Restoration/Enhancement on Clay Soils* concept).

This site also provides an opportunity to restore upland wildlife habitat adjacent to Mud Creek. Wooded areas can be maintained, while invasive species can managed with a glyphosate herbicide application as necessary. Additional mechanical harvesting of Amur honeysuckle and grape vines would help to reduce shading of native species, and native shrubs can be planted.

Potential Stream and Wetland Enhancement Goals

Implantation of the measures described above will improve the quality of Mud Creek and the adjacent riparian habitat by:

- Removing excess sediments that have built up in the channel; and
- Increasing the diversity of native plant species in Wetland OR-21 and adjacent uplands.

These measures should be reflected in:

- An increase in the HHEI score by 15 to 20 points; and
- An increase in the quality of fish and macroinvertebrate communities in the creek.

SITE OR-21
NON-ISOLATED WETLAND RESTORATION

Preliminary Cost Estimate

The estimated cost to construct the proposed projects is summarized in Table 4-1. These projects can be constructed in phases as funding opportunities become available.

Table 4-1
Estimated Cost Summary for Site OR-21

Project	Quantity	Unit	Unit Cost	Total Cost
Channel Cleanout & Two-Stage Channel	1250	linear foot	$50	$62,500
Wetland Enhancement of 1.35-Acre Wetland	1.35	acre	$14,000	$18,900
			Total Estimated Construction Cost	**$81,400**

SITE OR-21
NON-ISOLATED WETLAND RESTORATION

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SITE OR-101

Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

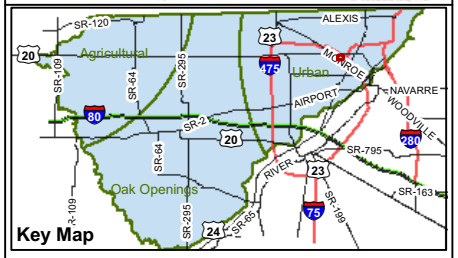
Prepared for:

Partners for Clean Streams, Inc.
P.O. Box 822
Bowling Green, Ohio 43402
www.PartnersForCleanStreams.org

Prepared by:

Mannik & Smith Group, Inc.

Hull & Associates, Inc.



Legend

- Sample Plot
- 2005 Soils Classification
- Parcel Line
- Existing Wetland
- QHEI
- HHEI
- 5' Contour

Proposed Wetland Enhancement

- Wildlife Enhancement
- Ditch Restoration
- Emergent
- Deep Water Emergent
- Floating-leaved Emergent
- Forested
- Riparian Buffer
- Trail/Access Road

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-2
Restoration/Enhancement Plan for OR-101
City of Toledo, Lucas County, Ohio

County Map of Ohio

0 100 200 400 Feet

1:2,400

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: P163A1A
File Name: P163A1A_LucasSites.mxd
Date: January 19, 2009

SITE OR-101
NON-ISOLATED WETLAND RESTORATION

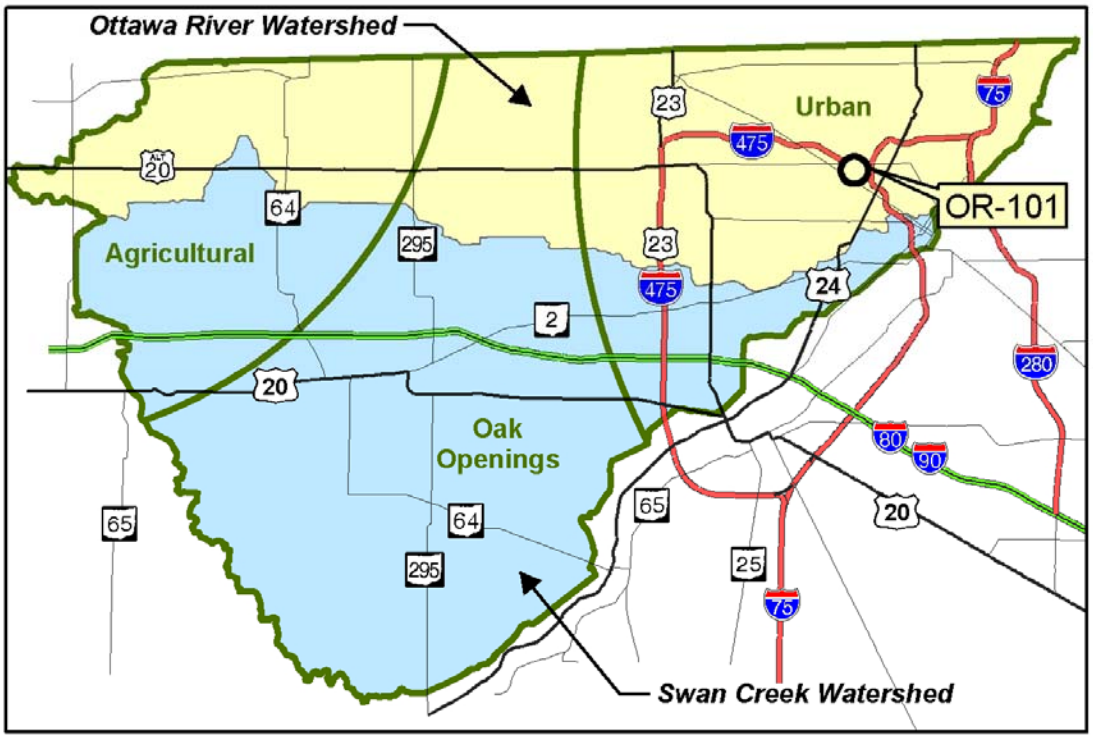
Urban Subregion

Project Description:
Create 16.3 acres of palustrine wetland on hydric soil
Enhance 0.29 acre of emergent wetland
Enhance 400 feet (0.52 ac.) of riparian corridor

General Restoration/Enhancement Concept:
Wetland Restoration/Enhancement on Clay Soils
Restoration/Enhancement of Riparian Buffers

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 156 sq. mi.
County: Lucas **Municipality**: City of Toledo **Location:** W 83°34' 58.74 N 41°40' 24.72N
Stream: Ottawa River (QHEI = 67)
Watershed: Ottawa River HUC 0410000103 (Frontal Lake Erie)
Wetland: OR-101-1 (forested/emergent), ORAM = 67;
OR-101-2 (palustrine emergent), ORAM = 32.5
Stream buffers: Narrow, quality woodland or large old field
Surrounding land use: Residential and urban
Field-estimated gradient: 5 feet per mile, low



SITE OR-101
NON-ISOLATED WETLAND RESTORATION

Site Description

Site OR-101 is located in Jermain Park, which is owned by the City of Toledo (Figure 4-2). This is a large undeveloped site that contains a young wooded riparian corridor, a central old field area, and large forested wetland. The site is bordered to the southeast by Monroe Street, to the west by Auburn Avenue, to the south by South Cove Boulevard and to the north by North Cove Boulevard and I-475. The site can be accessed by a drive that is located off North Cove Boulevard just east of Monroe Street.

Patch of Carex hyalinolepis *within the forested portion of Wetland OR-101-1.*

Existing Site Conditions

Two wetlands currently exist on the property: a large, 5.1-acre forested/emergent wetland located in the northeastern portion of the site and a small, 0.29-acre reed canary-grass/sedge dominated emergent marsh located in the central region of the site. The Ottawa River runs along the southern border of the site, parallel to South Cove Boulevard. A separate, isolated portion of floodplain is found on the eastern side of the River, just west of Auburn Avenue. Historical documents indicate that an amusement park used to exist on this site.

The majority of soils on the site are mapped as non-hydric units that may have hydric inclusions in lows spots and along drainage ways. These are Shoals loam, occasionally flooded (Sh) and Eels loam, occasionally flooded (Ee). Hydric Sloan loam, occasionally flooded, also is reported, but to a lesser extent, on the property.

The Ottawa River attained a QHEI score at this location of 67. Although this is a relatively straight portion of the river, the QHEI score indicates the presence of a relatively good section of stream. The high score was due to the presence of several higher quality substrates in the stream, a fair amount of instream cover (undercut banks, root wads, overhanging vegetation etc.), good development of run/riffle/pool complexes and decent buffers. Moderate amounts of stream further enhancement may be possible, but not necessary at this location.

SITE OR-101
NON-ISOLATED WETLAND RESTORATION

Two wetlands were identified on the site: a 5.1-acre forested/emergent wetland (Wetland OR-101-1) with some large shrubby patches located in the northern portion of the site; and a 0.29-acre reed canary-sedge emergent wetland located in the central region of the site. The larger forested/emergent wetland was dominated by sandbar willow (*Salix exigua*), Virginia wild-rye (*Elymus virginica*) and tall fescue (*Festuca pratense*). Positive indicators of wetland hydrology included water-stained leaves, a positive FAC-neutral test, water marks and sediment deposits.

Soil pit depicting concrete steps found at 6 inches deep.

Soils were comprised of five inches of very dark grayish brown (10YR 3/2) silty clay underlain by at least twelve inches of grayish brown (10YR 5/2) silty clay with brownish yellow (10YR 6/6) mottles. It should be noted that at one soil plot, buried concrete was found below the surficial soil horizon. This illustrates the point that at least a portion of this area was historically disturbed and/or filled. Despite this buried material, the wetland produced an ORAM score of 67, which correlates to a Category 3 wetland. This high score is due to the wetland's large size, the presence of hydrological connections to the Ottawa River, an apparent lack of recent past disturbance and the presence of several different types of vegetation communities (i.e., good interspersion).

Small Phragmites *population in Wetland OR-101-1*

SITE OR-101
NON-ISOLATED WETLAND RESTORATION

Wetland OR-101-2 (0.29 acre) is an isolated, palustrine emergent wetland dominated by shoreline sedge (*Carex hyalinolepis*) and reed canary grass (*Phalaris arundinacea*). Soils in this wetland consisted of very dark gray (10YR 3/1) loamy clay. Positive indicators of wetland hydrology included water marks on vegetation, sediment deposits, water-stained leaves, and a positive FAC-neutral test. The ORAM score for this wetland was a 32.5, which correlates to the gray zone between a Category 1 and Category 2 wetland. This low score was based on the wetland's small size, indications of recent past disturbance and the unremarkable quality of the vegetation community.

Fish species observed at this location are listed Table 4-2.

Table 4-2
Fish Samples at Site OR-101 (Ottawa Creek)

Common Name[1]	Species[1]	Feed Guild[2]	Tol.[3]	# of Fish	Avg. Wt. (grams)
Yellow Bullhead	*Ameiurus natalis*	I	T	1	105.6
Stoneroller	*Campostoma anomalum*	H	N/A	92	2.2
Goldfish*	*Carassius auratus*	O	T	1	2075.0
White Sucker	*Catostomus commersonii*	O	T	9	95.4
Gizzard Shad	*Dorsoma cepadianum*	O	N/A	47	2.2
Northern Pike	*Esox lucius*	P	N/A	1	57.5
Johnny Darter	*Etheostoma nigrum*	I	N/A	3	2.3
Green Sunfish	*Lepomis cyanellus*	I	T	4	7.5
Pumpkinseed Sunfish	*Lepomis gibbosus*	I	P	20	7.5
Bluegill Sunfish	*Lepomis macrochirus*	I	P	78	7.5
Largemouth Bass	*Micropterus salmoides salmoides*	C	M	15	72.2
Round Goby*	*Neogobius melanostomus*	I	M	49	8.9
Emerald Shiner	*Notropis atherinoides*	I	N/A	124	2.2
Silver Shiner	*Notropis photogenis*	I	I	3	2.2
Spotfin Shiner	*Notropis spilopterus*	I	N/A	2	1.9
Yellow Perch	*Perca flavescens*	N/A	N/A	18	55.0
Logperch Darter	*Percina caprodes*	I	M	21	2.3
Blackside Darter	*Percina maculata*	I	N/A	1	2.3
Bluntnose Minnow	*Pimephales notatus*	O	T	41	1.3
White Crappie	*Pomoxis annularis*	N/A	N/A	1	15.6
Creek Chub	*Semotilus atromaculatus*	G	T	13	2.2

** Non-native*
[1] according to ODNR, Division of Wildlife guide http://www.dnr.state.oh.us/tabid/17913/Default.aspx
[2] Feeding Guild: P - Piscivore, F - Filter Feeder, V - Invertivore, I - Specialist Insectivore, O - Omnivore, G - Generalist, H - Herbivore, C - Carnivore, N/A = Not assigned.
[3] Tolerance Guild: R - Rare Intolerant, S - Special Intolerant, I - Common Intolerant, M - Moderately Intolerant (Headwaters), T - Highly Tolerant, P - Moderately Tolerant, N/A = Not assigned.

Macroinvertebrates observed in this location are listed in Table 4-3.

Table 4-3
Macroinvertebrate Samples at Site OR-101 (Ottawa Creek)

Elevated Taxa	Lowest Taxa	Common Name	Tolerance	Number Collected
Crustacea	*Asellus* sp.	isopod	8	3
Ephemeroptera	Hydropysche	mayfly	-	3
Gastropoda	*Physa* sp.	snail	8	1
Gastropoda	*Helisoma*sp.	snail	6	1
Pelecypoda	Pelecypoda	clam	6 to 8	2
Odonata	*Enallagna* sp.	damselfly	8	1

Recommended Restoration/Enhancement Strategy

Jermain Park presents a significant opportunity to create or restore a large palustrine wetland adjacent to the Ottawa River within the City of Toledo (Urban Subregion). The quality of the riparian buffer can also be restored, but given the high quality the Ottawa River at this location, as demonstrated by the QHEI score of 67, in-stream enhancements are for the most part unnecessary.

While Wetland OR-101-2 could be enhanced on its own, the best enhancement strategy for this 0.29-acre wetland would be to include it within the much larger, 15.24-acre wetland restoration that is proposed for the central portion of the site, as shown in Figure 4-2. Within this larger restoration project, several wetland vegetation zones can be developed. As drawn, approximately 1.8 acres can be converted to palustrine forested wetland, 6.4 acres can be restored to palustrine emergent wetland, 4.9 acres can be constructed as palustrine, deep water emergent wetland and 2.14 acres can be converted to a palustrine floating leaved wetland system. This breakdown would maximize the diversity of wetland plant communities on the site, which would increase wildlife use, create more flood storage and nutrient retention capacity. If desired, the restoration plan can be altered to create fewer wetland habitats.

Old field area growing on fill.

SITE OR-101
NON-ISOLATED WETLAND RESTORATION

The main source of water for the wetland restoration at Jermain Park would be from seasonal and occasional flooding of the Ottawa River. A topographic survey and detailed hydrologic modeling should be completed at the site to determine how frequently the area floods in its current state. The frequency of flooding can then be altered if necessary, by regrading the site to provide pathways for surface water to enter the wetland restoration area. Water from the Ottawa River can be retained to hydrate the wetland area. An outflow structure, placed at the northeast corner of the site can be used to regulate the maximum water level on the site and release water at a controlled rate to maintain wetland hydrology. A clay berm or dike might be required around the wetland to ensure that the water remains in the desired areas. Being located in a city-owned park, the restoration plan could also include the construction of an interpretive nature trail and observation decks that would allow people to view the wetland from a number of locations. Educational signage could also be added to educate visitors about the benefits of wetlands in urban environments.

One concern with this site is its historic use as an amusement park and the likely disturbance and/or placement of fill on the property. Prior to designing the wetland restoration project, PCS recommends that a Phase I and possibly Phase II Environmental Site Assessment be completed to better understand the nature and extent of disturbance/fill material on the property. Based on the results of these studies, appropriate decisions can then be made regarding the condition of soils on the property.

The smaller wetland restoration area located on the east side of the Ottawa River is approximately 1.9 acres in size. This area can be restored to a sedge-dominated emergent or forested wetland area that would allow for high water to flow and inundate the wetland before rejoining the river. Once constructed, this wetland would help to temper the flood pulses that occur along the Ottawa River and help to relieve some of the serious downstream flooding. This wetland would contain species tolerant of pulsed water flow and have some smaller vernal pools that would encourage amphibian breeding (see *Wetland Restoration/Enhancement on Clay Soils* concept).

Riparian buffers enhancement can also be installed along an approximately 400-foot long by 75 to 100-foot wide linear corridor along the eastern edge of the Ottawa River, adjacent to the 1.9 acre wetland restoration site. This area encompasses approximately 0.52 acre. Planting deciduous trees and shrubs in the area will help shade the river and slow the sedimentation and erosion problems observed in the field. In addition to the tree species included in the *Restoration/Enhancement of Riparian Buffers* concept, it is expected that other trees and shrubs will come into the area naturally on their own. These include American elm (*Ulmus americana*), eastern cottonwood (*Populus deltoides*), and several species of dogwoods (*Cornus* spp.) and willows (*Salix* spp.).

SITE OR-101
NON-ISOLATED WETLAND RESTORATION

Potential Restoration Goals

Implementation of the measures described above will improve the quality of the Ottawa River and the adjacent riparian habitat by:

- Restoring up to 17 acres of Category 2 or Category 3 wetlands on the site; and
- Enhancing the quality of the riparian buffer.

These measures should be reflected in:

- An increase in the QHEI Score by 4 to 6 points; and
- An increase in the quality of fish and macroinvertebrate communities in the creek.

Preliminary Cost Estimate

The estimated cost to construct all three of the proposed projects (400-foot buffer enhancement, wetland enhancement, and wetland restorations) would be approximately $262,930. The restoration/enhancement of the wetland on the west side of the river can be highly variable. This is due primarily to the unknown quality and quantity of fill to be removed. The amount and type of fill placed into the floodplain should be verified through an environmental phase 1 and 2 environmental site assessment. Assuming that approximately two feet of fill/soil would be removed or relocated in the floating-leaved emergent areas, one foot would be removed within the deep water emergent area and six inches of fill would be removed in the emergent area, a total of 21,000 cubic yards of fill could be removed as drawn in Figure 4-2. This fill removal could cost an additional $530,000. Seeding and planting plugs in the wetland areas would be an additional cost of 1,800 per acre plus labor. A notched weir with a stop log structure would cost approximately $2,000. A summary of the estimated costs for this site are provided in Table 4-4.

Table 4-4
Estimated Cost Summary for Site OR-101

Project	Quantity	Unit	Unit Cost	Total Cost
Emergent (Area A)	6.4	acre	$14,000	$89,600
Deep Water Emergent (Area A)	4.9	acre	$15,000	$73,500
Floating-leaved Emergent (Area A)	2.1	acre	$18,000	$37,800
Forested Wetland (Area A)	1.82	acre	$16.000	$28,120
Wetland Enhancement	0.29	acre	$3,000	$870
Emergent Wetland (Area B)	1.88	acre	$14,000	$26,320
Riparian Buffers (Area B)	0.52	acre	$11,000	$5,720
Total Estimated Construction Cost				**$262,930**

SITE OR-101
NON-ISOLATED WETLAND RESTORATION

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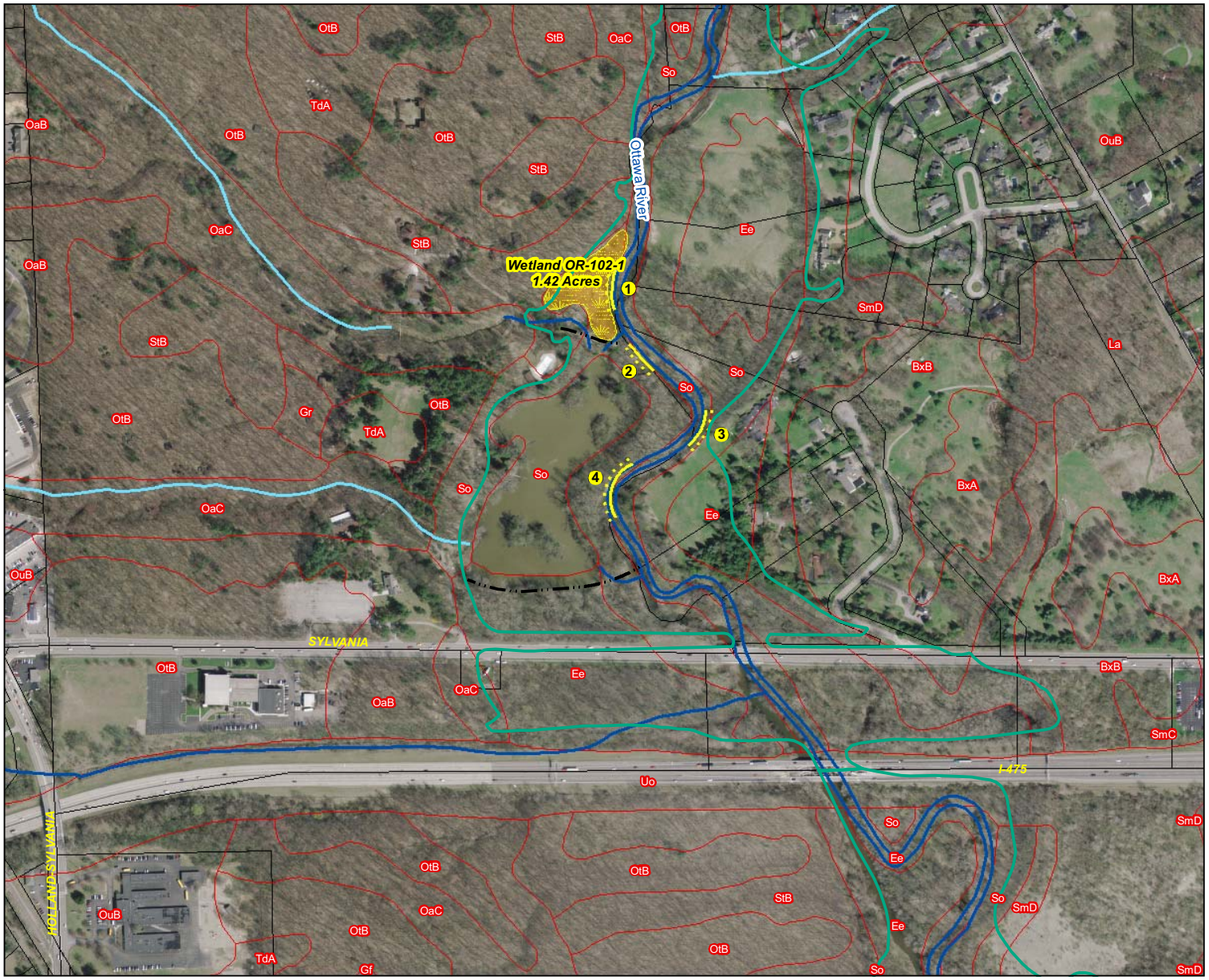
SITE OR-102



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

Prepared for:

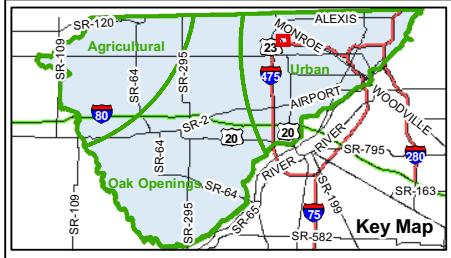
Partners for Clean Streams

Partners for Clean Streams, Inc.
P.O. Box 822
Bowling Green, Ohio 43402
www.PartnersForCleanStreams.org

Prepared by:

Mannik & Smith Group, Inc.

Hull & Associates, Inc.



Legend

- Project Boundary
- Parcels
- Existing Wetlands
- Wetland Restoration Areas
- Ditch/Linear Wetland Restoration
- Emergent Zone
- Deep Water Emergent Zone
- Floating-leaved Bed Zone
- Forested Zone
- Riparian Buffer Zone
- 100 year Floodplain
- 2005 Soil Classification
- Cross Section Line
- Access Road/Trail
- Streams
- QHEI
- HHEI
- Severe Bank Erosion
- Ohio Rivers and Streams
- Streams
- Intermittent Stream

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-3
Restoration/Enhancement Plan for OR-102
Sylvania Township, Lucas County, Ohio

County Map of Ohio

0 200 400 800 Feet

1:4,800

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: DAO002
File Name: DAO002_Concept2_Fig4-3_SiteOR-102.mxd
Date: March, 2009

SITE OR-102
STREAM AND NON-ISOLATED WETLAND RESTORATION

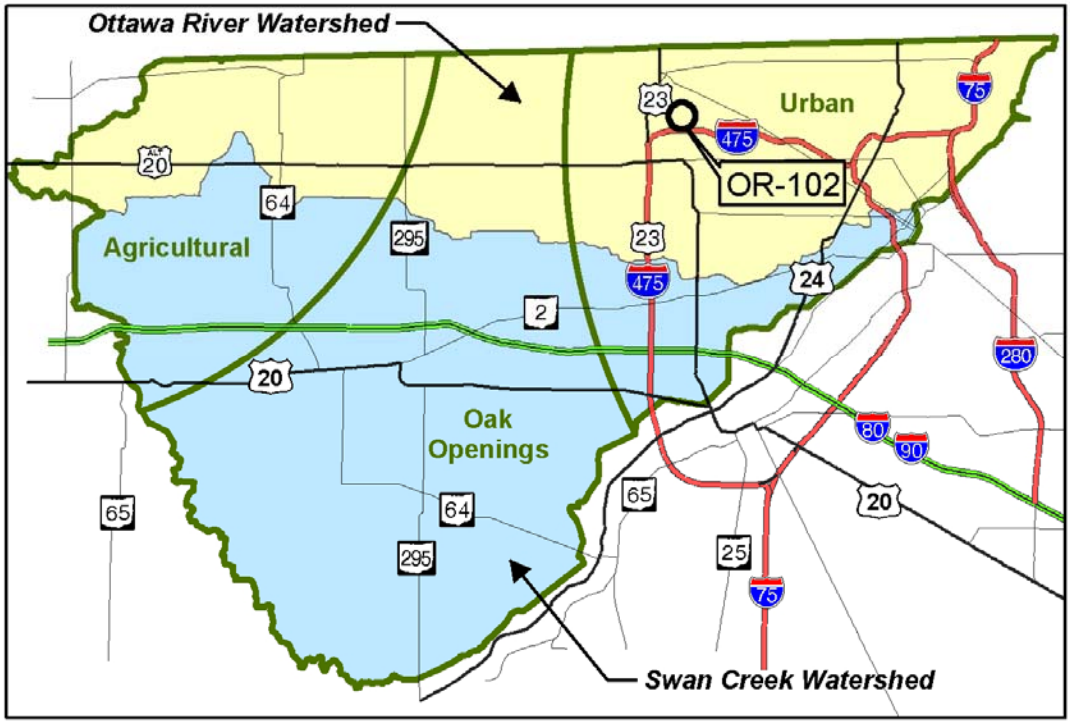
Urban Subregion

Project Description:
Restore and stabilize 800 feet of streambank to prevent river breaking through to lake
Enhance 1.4 acres of existing wetlands by modifying hydrology with weir

General Restoration/Enhancement Concept:
Restoration/Enhancement of Large Streams
Wetland Restoration/Enhancement on Clay Soils

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 127.46 sq. mi.
County: Lucas **Municipality**: Sylvania Township **Location:** 83°41' 33.13" W 41°41' 42.16"N
Stream: Ottawa River
Watershed: Ottawa River HUC 0410000103 (Frontal Lake Erie)
Wetland: Wetland OR-102-1 (palustrine emergent wetland)
Stream buffers: Wide to very wide; good to excellent quality (wooded)
Surrounding land use: Camp Miakonda - Boy Scout Camp and residential
Field-estimated gradient: 0.1%
Ohio Gazetteer published average gradient: 0.07% (4 feet per mile)



SITE OR-102 STREAM AND NON-ISOLATED WETLAND RESTORATION

Site Description

The site consists of one parcel which is located on the Camp Miakonda Boy Scout Camp comprising 153.17 acres, located north of Sylvania Avenue in Springfield Township, Lucas County, Ohio (Figure 4-3).

Ottawa River Large Erosion Area

Existing Site Conditions

Within the Camp Miakonda Boy Scout Camp, the Ottawa River is a medium-gradient stream with significant upstream agricultural and urban influence. This site has a large watershed (126.5 square miles) and its hydrology and channel formation processes are driven by bankfull (not benchfull) flows. A wide, forested riparian buffer (averaging more than 150 feet) is present on each bank. Gradient/stream power is sufficient to move silt, sand and gravel substrates. The resulting substrates in riffles are moderately stable and are dominated by sand, gravel and cobble with low embeddedness.

The most noticeable instability and degrading influence on habitat quality at this location of the Ottawa River is evidence of periodic torrential/flashy flows that are causing extensive erosion on the outside of meander bends. At bank erosion locations 1 and 2, (see Figure 4-3) an approximately 25-35 foot width of the west bank has eroded away, and the river is threatening to connect to an existing lake on the Boy Scout property. The QHEI score for this sample reach of the Ottawa River was 64.5. The QHEI score was influenced by sparse to moderate amounts of instream cover and fair to moderate channel morphology quality.

The existing Wetland OR-102 is a non-isolated palustrine emergent wetland with some scattered trees and shrubs. It is dominated in the canopy by green ash (*Fraxinus pennsylvanica*) and American elm (*Ulmus americana*) and in the herb layer by reed canary grass (*Phalaris arundinacea*). Wetland OR-102 is located in an area mapped as Sloan loam, occasionally flooded (So). This hydric soil occurs on the majority of the site. Positive indicators of hydrology at the time of evaluation included soil saturation and wetland drainage patterns. Based on the wetland's small size, low vegetation diversity and minimal interspersion, it appears that it would be classified as an Ohio Category 1 or Modified Category 2 wetland by Ohio EPA.

SITE OR-102 STREAM AND NON-ISOLATED WETLAND RESTORATION

Fish species observed at this location are listed in Table 4-5.

Table 4-5
Fish Samples at Site OR-102 (Ottawa River)

Common Name[1]	Species[1]	Feed Guild[2]	Tol.[3]	# of Fish	Avg. Wt. (grams)
Yellow Bullhead	*Ameiurus natalis*	I	T	1	105.6
Stoneroller	*Campostoma anomalum*	H	N/A	44	2.2
White Sucker	*Catostomus commersonii*	O	T	6	95.4
Carp*	*Cyprinus carpio*	O	T	2	2075.0
Rainbow Darter	*Etheostoma caeruleum*	I	M	3	2.3
Johnny Darter	*Etheostoma nigrum*	I	N/A	22	2.3
Mosquitofish*	*Gambusia affinis*	I	N/A	1	8.9
Green Sunfish	*Lepomis cyanellus*	I	T	7	7.5
Green x Bluegill Sunfish	*Lepomis cyanellus* x *gibbosus*	N/A	N/A	3	7.5
Pumpkinseed Sunfish	*Lepomis gibbosus*	I	P	7	7.5
Bluegill Sunfish	*Lepomis macrochirus*	I	P	19	7.5
Largemouth Bass	*Micropterus salmoides salmoides*	C	M	10	72.2
Spotfin Shiner	*Notropis spilopterus*	I	N/A	1	1.9
Bluntnose Minnow	*Pimephales notatus*	O	T	5	1.3
Creek Chub	*Semotilus atromaculatus*	G	T	7	2.2

** Non-native*
[1] according to ODNR, Division of Wildlife guide http://www.dnr.state.oh.us/tabid/17913/Default.aspx
[2] Feeding Guild: P - Piscivore, F - Filter Feeder, V - Invertivore, I - Specialist Insectivore, O - Omnivore, G - Generalist, H - Herbivore, C - Carnivore, N/A = Not assigned.
[3] Tolerance Guild: R - Rare Intolerant, S - Special Intolerant, I - Common Intolerant, M - Moderately Intolerant (Headwaters), T - Highly Tolerant, P - Moderately Tolerant, N/A = Not assigned.

Macroinvertebrates observed in this location are listed in Table 4-6.

Table 4-6
Macroinvertebrate Samples at Site OR-102 (Ottawa River)

Elevated Taxa	Lowest Taxa	Common Name	Tolerance	Number Collected
Crustacea	*Orconectes*	crayfish	6	1
Crustacea	*Asellus* sp.	isopod	8	1
Ephemeroptera	*Caenis* sp.	mayfly	7	6
Gastropoda	*Ferrissia* sp.	limpet	6	1
Hemiptera	Hemiptera	water bug	-	1

SITE OR-102 STREAM AND NON-ISOLATED WETLAND RESTORATION

Recommended Stream Enhancement and Wetland Restoration Strategy

To enhance this section of the Ottawa River, PCS recommends installing appropriately sized root wad/log vane/J-hook combination structures (see detail in Figure 4-3) just upstream of bank erosion areas 1 and 2. These structures will divert the flow back to the center of the channel, thereby providing stability to the bank. The area of streambank that has eroded away should then be replaced with appropriate soil material and stabilized with geotextile and woody vegetation. Detailed surveying and design should be conducted in accordance with methods described and referenced in the *Restoration/Enhancement of Large Streams* concept.

In addition to the above enhancement measures, PCS recommends the installation of appropriately sized J-hook or combination structures in other eroded areas (bank erosion areas 3 and 4) located downstream from the large erosion area.

Wetland OR-102 (1.43 acres) can also be enhanced in the following manner. Since the wetland is situated on the landscape with higher slopes on all sides away from the river, enhancement efforts could be accomplished by increasing inundation over the area by utilizing the small stream that currently flows through the wetland and discharges into the Ottawa River on the site (see *Wetland Restoration/Enhancement on Sandy Soils* concept). The most feasible and cost-effective way to complete the wetland enhancement would be installation of a stop-log weir structure near the mouth of the small stream, so that water could be held back and flood the wetland area. Flooding the area and keeping water within the wetland should help control invasive plant species and enhance the wetland by increasing plant diversity and quality. Surveying conducted in conjunction with the Rosgen stream survey could determine the elevation at which the stop-log structure should be installed.

Potential Stream Enhancement and Wetland Restoration Goals

Implementation of the measures described above will improve the quality of Ottawa River and adjacent riparian habitat by:

- Reducing the frequency of flood flows that enter Lake Sawyer from the Ottawa River; and
- Stabilizing the streambank.

These measures should be reflected in:

- An increase in the ORAM score for Wetland OR-102;
- A reduction in sediment and nutrient loading to the river; and
- An improvement in the quality of fish and macroinvertebrate communities in the river.

SITE OR-102 STREAM AND NON-ISOLATED WETLAND RESTORATION

Preliminary Cost Estimate

The estimated cost to construct the proposed projects is summarized in Table 4-7. These projects could be constructed independently of one another as the budget and opportunities become available.

Table 4-7
Estimated Cost Summary for Site OR-102

Project	Quantity	Unit	Cost per unit	Total Cost
Root Wad/Log Vane/J-Hook Installation	2	each	$5,000	$10,000
Bank Restoration and Vegetation	1	each	$1,500	$1,500
Design/Install J-Hooks	4	each	$1,500	$6,000
Stop-log Structure	1	each	$2,000	$2,000
Wetland Enhancement	1.42	acre	$3,000	$4,260
			Total Estimated Cost	$23,760

SITE OR-102
STREAM AND NON-ISOLATED WETLAND RESTORATION

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SITE SC-18

Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

Prepared for:

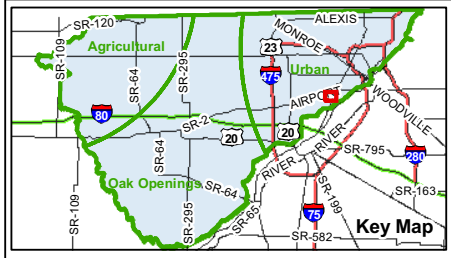
Partners for Clean Streams

Partners for Clean Streams, Inc.
P.O. Box 822
Bowling Green, Ohio 43402
www.PartnersForCleanStreams.org

Prepared by:

Mannik & Smith Group, Inc.

Hull & Associates, Inc.



Legend

- Project Boundary
- Parcels
- Existing Wetlands
- Wetland Restoration Areas
  - Ditch/Linear Wetland Restoration
  - Emergent Zone
  - Deep Water Emergent Zone
  - Floating-leaved Bed Zone
  - Forested Zone
  - Riparian Buffer Zone
- 100 year Floodplain
- 2005 Soil Classification
- Access Road/Trail
- Streams
  - QHEI
  - HHEI
  - Severe Bank Erosion
- Ohio Rivers and Streams
  - Streams
  - Intermittent Stream

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-4
Restoration/Enhancement Plan for SC-18
City of Toledo, Lucas County, Ohio

County Map of Ohio

0 200 400 800 Feet

1:4,800

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: DAO002
File Name: DAO002_Concept2_Fig4-4_SiteSC-18.mxd
Date: March, 2009

SITE SC-18
STREAM RESTORATION / ENHANCEMENT

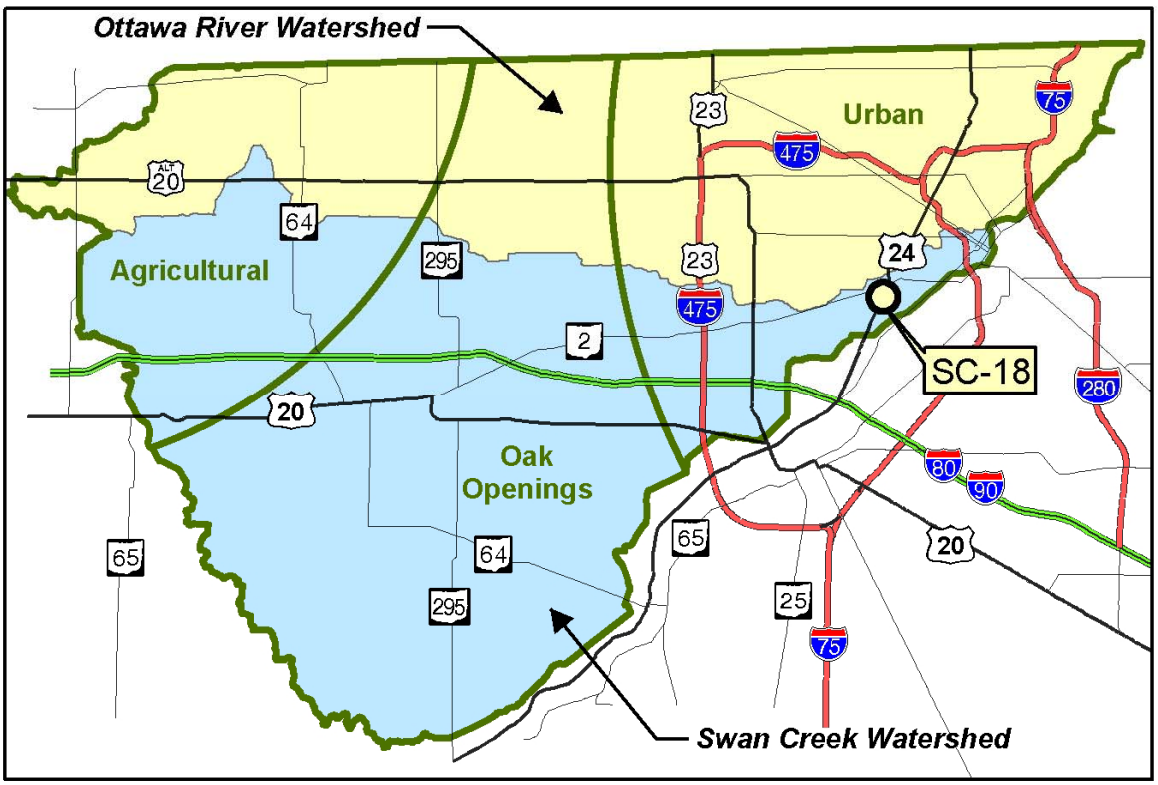
Urban Subregion

Project Description:
Stabilize 150 linear feet of streambank on outside of left bank meander
Hydrologic enhancement of 4 acres of wooded wetlands by notching levies

General Restoration/Enhancement Concept:
Restoration/Enhancement of Large Streams

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 190 sq. mi.
County: Lucas **Municipality**: City of Toledo **Location:** 83°35' 51.47"W 41°37' 36.85"N
Stream: Swan Creek
Watershed: Swan Creek HUC 0410000908 (Lower Swan Creek)
Wetland: Wetland SC-18-1 and Wetland SC-18-2
Stream buffers: Moderate to wide, wooded
Surrounding land use: Urban and residential
Field-estimated gradient: 0.05%
Ohio Gazetteer published average gradient: 0.07% (3.8 feet per mile)



SITE SC-18
STREAM RESTORATION / ENHANCEMENT

Site Description

The site consists of two parcels comprising 210.9 acres, located west of US Route 24 (Detroit Avenue) and south of Airport Highway (State Route 2) in the City of Toledo, Lucas County, Ohio (Figure 4-4). This site overlaps and is adjacent to Priority Agricultural Areas that have been identified by the Swan Creek Technical Committee.

Swan Creek, facing downstream

Existing Site Conditions

At this location, Swan Creek is a moderate-gradient stream with significant urban pollution influences. This stream has a large watershed and its hydrology and channel formation processes are driven by bankfull (not benchfull) flows. In some portions of the site, residential parcels extend up to the north bank of the creek, while the south bank consists of a steep embankment which contains a young wooded community. Gradient/stream power appears to be insufficient to move silt and sand substrates. Resulting substrates in riffles are unstable and dominated by fine gravel and sand with moderate embeddedness. Fair to good channel morphology and riffle/run/pool/glide sequencing dominates this section of the stream. The depth of the pools is sufficient to support predatory fish species. The QHEI score for this sample reach of Swan Creek was 60.5.

Swan Creek, facing upstream

SITE SC-18
STREAM RESTORATION / ENHANCEMENT

There are two existing wetlands at Site SC-18. Wetlands SC-18-1 and SC-18-2 are palustrine forested wetlands that are dominated by boxelder (*Acer negundo*) and green ash (*Fraxinus pennsylvanica*) in the canopy, river grape (*Vitis riparia*) in the vine layer, and false nettle (Boehmeria cylindrica), fowl mannagrass (*Glyceria striata*), and Virginia knotweed (*Polygonum virginianum*) in the herb layer. Wetland SC-18-1 is in an area that is mapped as Sloan loam, occasionally flooded (So), which is a hydric soil unit. This soil type was confirmed in the field, as soils were found to be hydric. Positive indicators of wetland hydrology that were observed during the evaluation include water marks on trees, drainage patterns, water stained leaves, and a positive FAC neutral test.

The majority of the soils are mapped as the hydric Sloan loam (So); Eel loam, occasionally flooded (Ee) which is non-hydric but may contain unmapped inclusions of the hydric Sloan loam; and Sisson loam, 2-6% slopes (SmB), which is non-hydric but may contain unmapped inclusions of the hydric Colwood loam (Co) and they hydric Lenawee silty clay loam (Lf).

Fish species observed at this location are listed in Table 4-8.

Table 4-8
Fish Samples at Site SC-18 (Swan Creek)

Common Name[1]	Species[1]	Feed Guild[2]	Tol.[3]	# of Fish	Avg. Wt. (grams)
Rock Bass	*Ambloplites rupestris*	C	N/A	14	87.2
Yellow Bullhead	*Ameiurus natalis*	I	T	2	160.0
White Sucker	*Catostomus commersonii*	O	T	11	12.0
Gizzard Shad	*Dorsoma cepadianum*	O	N/A	2	2.2
Grass Pickerel	*Esox americanus*	P	P	2	1775.00
Northern Pike	*Esox lucius*	P	N/A	1	57.5
Johnny Darter	*Etheostoma nigrum*	I	N/A	4	1.0
Orangespotted Sunfish	*Lepomis humilis*	I	N/A	2	10.00
Bluegill Sunfish	*Lepomis macrochirus*	I	P	3	10.00
White Bass	*Morone chrysops*	P	N/A	1	66.3
Shorthead Redhorse	*Moxostoma macrolepidotum*	I	M	2	113.5
Round Goby*	*Neogobius melanostomus*	I	M	1	25.0
Emerald Shiner	*Notropis atherinoides*	I	N/A	30	2.2
Tadpole Madtom	*Noturus gyrinus*	I	N/A	1	49.3
Blackside Darter	*Percina maculata*	I	M	4	2.8
Bluntnose Minnow	*Pimephales notatus*	O	T	5	1650.0
Creek Chub	*Semotilus atromaculatus*	G	T	4	29.5

** Non-native*
[1] according to ODNR, Division of Wildlife guide http://www.dnr.state.oh.us/tabid/17913/Default.aspx
[2] Feeding Guild: P - Piscivore, F - Filter Feeder, V - Invertivore, I - Specialist Insectivore, O - Omnivore, G - Generalist, H - Herbivore, C - Carnivore, N/A = Not assigned.
[3] Tolerance Guild: R - Rare Intolerant, S - Special Intolerant, I - Common Intolerant, M - Moderately Intolerant (Headwaters), T - Highly Tolerant, P - Moderately Tolerant, N/A = Not assigned.

Macroinvertebrates observed at this location are listed in Table 4-9.

Table 4-9
Macroinvertebrate Samples at Site SC-18 (Swan Creek)

Elevated Taxa	Lowest Taxa	Common Name	Tolerance	Number Collected
Gastropoda	*Lymnaea* sp.	snail	6	2
Pelecypoda	Pelecypoda	clam	6 to 8	3
Odonata	*Enallagna* sp.	damselfly	8	1

Recommended Wetland Enhancement and Streambank Stabilization Strategy

In order to enhance the quality of the wetlands and stream at this site, PCS recommends excavating notches in sidecast levies that border existing wetlands on the north bank of the stream. The levies are 2 to 3 feet in height and significantly restrict flooding of these wetland areas. Severe bank erosion should also be repaired along the north bank across from Wetland SC-18-1. An existing headwall that is no longer functional can also be removed on the south bank, just downstream from Wetland SC-18-1.

Wetland enhancement opportunities on this site are confined to two wetland areas located along the south bank of Swan Creek. Notches cut into the sidecast levies will allow floodwaters from Swan Creek to flow freely into and out of the wetlands, restoring the natural hydrology and increasing the quality of the habitat found there. The presence of natural hydrology will allow additional native floodplain species to become established, and may prevent the invasion of undesirable plant species. Streambank stabilization can best be accomplished by installing root wad/log vane/J-hook combination structures to reduce shear stress on the eroding right streambank, followed by reshaping the bank slope and stabilizing with native shrub plantings.

Potential Stream Enhancement and Wetland Restoration Goals

Implementation of the measures described above will improve the quality of Swan Creek and adjacent riparian habitat by:

- Providing a better hydrologic connection between the main channel of the creek and its floodplain;
- Increasing the diversity of native plant species in the floodplain; and
- Stabilizing the streambank.

These measures should be reflected in:

- An increase in the ORAM score by 2 to 3 points for Wetlands SC-18-1 and SC-18-2;
- A reduction in sediment and nutrient loading to the stream;
- An increase in tie QHEI of the stream; and
- An improvement in the quality of fish and macroinvertebrate communities in the creek.

SITE SC-18
STREAM RESTORATION / ENHANCEMENT

Preliminary Cost Estimate

The estimated cost to construct the proposed projects is summarized in Table 4-10. These projects can be constructed in phases as funding opportunities become available.

Table 4-10
Estimated Cost Summary for Site SC-18

Project	Quantity	Unit	Cost per unit	Total Cost
Root Wad/Log Vane/J-Hook Installation	1	each	$5,000	$5,000
Bank Restoration and Vegetation	1	each	$1,500	$1,500
Design/Install J-Hooks	4	each	$1,500	$6,000
Wetland Enhancement	2	each	$1,000	$2,000
Remove Old Headwall	1	each	$2,000	$2,000
			Total Estimated Construction Cost	**$16,500**

SITE SC-18
STREAM RESTORATION / ENHANCEMENT

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SITE OR-3

Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

Prepared for:

Partners for Clean Streams

Partners for Clean Streams, Inc.
P.O. Box 822
Bowling Green, Ohio 43402
www.PartnersForCleanStreams.org

Prepared by:

Mannik & Smith Group, Inc.

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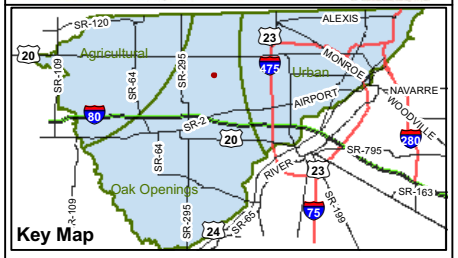


Legend

- Sample Plot
- 2005 Soils Classification
- Parcel Line
- Existing Wetland
- QHEI
- HHEI
- 5' Contour

Proposed Wetland Enhancement

- Wildlife Enhancement
- Ditch Restoration
- Emergent
- Deep Water Emergent
- Floating-leaved Emergent
- Forested
- Riparian Buffer
- Trail/Access Road

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-5
Restoration/Enhancement Plan for OR-3
Spencer Township, Lucas County, Ohio

County Map of Ohio

0 50 100 200 Feet

1:1,200

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: P163A1A
File Name: P163A1A_LucasSites.mxd
Date: January 19, 2009

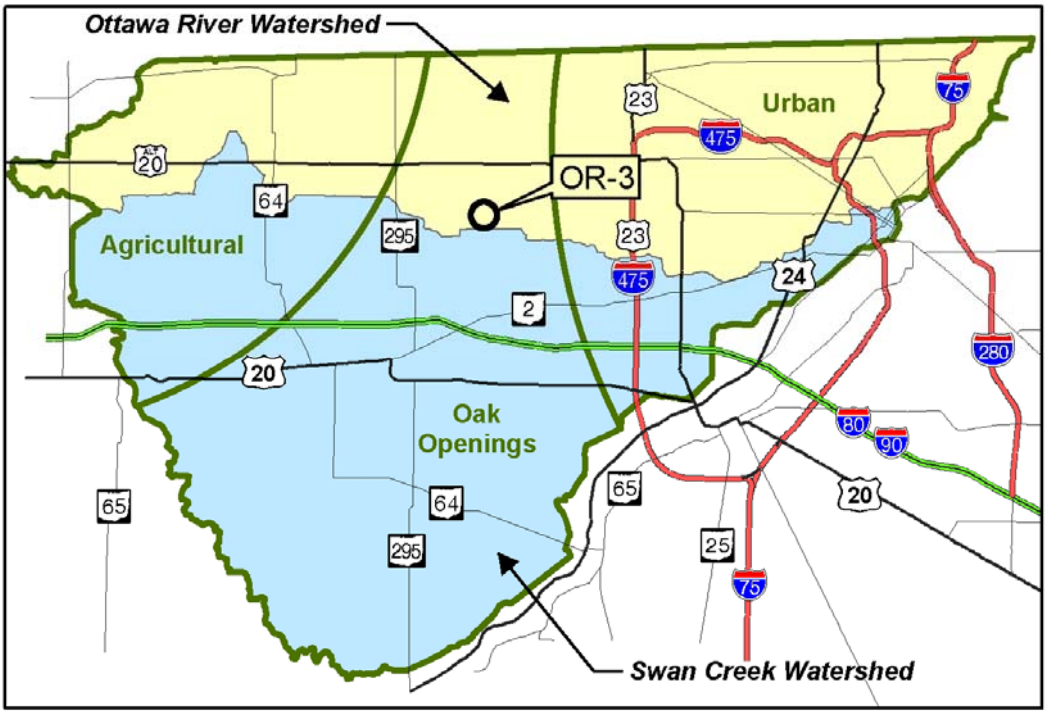
SITE OR-3
NON-ISOLATED WETLAND RESTORATION

Project Description:
Restore 3.37 palustrine wetland on hydric soil
Enhance 1.09 acres of open wetland
Restore native vegetation to 700 feet of watercourse
Restore 0.33 acre of buffer to ditch
Enhance 0.54 acre upland area

General Restoration/Enhancement Concept:
Restoration/Enhancement of Historically Channelized Waterways in Sandy Soils
Wetland Restoration/Enhancement on Sandy Soils
Restoration/Enhancement of Riparian Buffers

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of Benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 0.37 sq. mi.
County: Lucas **Municipality**: Spencer Township **Location:** 83°47' 04.22"N 41°39' 00.86"W
Stream: Wiregrass Ditch (QHEI = 41.5)
Watershed: Ottawa River HUC 0410000103 (Frontal Lake Erie)
Wetland: OR-3-1 (palustrine scrub/shrub and emergent) (ORAM 86)
Stream buffers: Narrow, low to moderate (wooded) quality
Surrounding land use: Residential to west; high quality wetland to south; vacant land to east
Field-estimated gradient: 0.1% (0.1 feet per hundred feet), low



SITE OR-3
NON-ISOLATED WETLAND RESTORATION

Site Description

The site is divided into six primarily undeveloped parcels located at 10115, 10175, 10051, 10039, 10025 and 10011 Dorr Street in Spencer Township, Lucas County, Ohio (Figure 4-5). All but one parcel are owned by the Metroparks of the Toledo Area.

Channel of Wiregrass Ditch facing south

Existing Site Conditions

The southern portion of the site contains a diverse, 74-acre plus, palustrine forested/shrub/ emergent marsh that abuts the east bank of Wiregrass Ditch. Wiregrass Ditch is a large intermittent, low gradient swale that functions as a palustrine emergent wetland. The ditch continues north under Dorr Street and connects with the Irwin Prairie State Nature Preserve. At times, seasonally high water will completely fill the ditch and saturate soils in the surrounding area. Historically, fill has been placed along the south side of Dorr Street to accommodate residential development.

According to the Lucas County Soil Survey (Stone *et al.* 1980), all of the parcels contain hydric soils or non-hydric soils that may contain hydric inclusions in shallow depressions or drainage ways. Tedrow (TdA) and Ottokee fine sands (OtB) are two of the predominant non-hydric soils that may have hydric inclusions (LCSWD, 1998). The vast majority of the site is mapped as Granby fine sand (Gr), which is hydric. When investigating the site, wetland soil plots contained black (Munsell color 10YR 2/1) loamy sand in the upper 6-10 inches that was underlain by very dark gray (10YR 4/1) sand. These colors are typical of hydric Granby soil. These areas also exhibited positive signs of wetland hydrology, including a positive FAC-neutral test, watermarks on tree trunks, agreement with the mapped wetland soil type, sediment deposits, water-stained leaves and inundation up to 3 feet deep.

Several large, distinct plant communities were observed in the wetland that exists on site. Brief descriptions of all of the dominant wetland community types found within the parcels are presented below:

- Oak Openings Sand Prairie: dominated by several sedges (*Carex lasiocarpa, C. cryptolepis, C. stricta,* and *C. atheroides*), great lakes goldenrod (*Euthamia remota*), twig-rush (*Cladium mariscoides*), dogwood (*Cornus* spp), and occasional pin oak and frequently dominated by European buckthorn (*Rhamnus frangula*).

- Pin oak (*Quercus palustris*)-silver maple (*Acer saccharinum*) swamp forest with buttonbush (*Cephalanthus occidentalis*) and spicebush (*Lindera benzoin*).
- Young elm (*Ulmus americana*)-red maple (*Acer rubrum*)-silver maple (species) swamp forest with a dense shrub/sapling layer and few canopy-sized trees.
- Wet old field/scrub-shrub; early successional areas dominated by asters (*Aster praealtus, A. lanceolatus, A. novae-angliae*), goldenrods (*Euthamia graminifolia, Solidago gigantea*), dogwoods, European buckthorn, sedges (*Carex vulpinoidea, C. cristatella, Scirpus pendulus*) and grasses (*Calamagrostis canadensis, Glyceria striata, Agrostis gigatanea*).

The most important of these is the Oak Openings Sand Prairie, which, due to its rare occurrence in the state of Ohio, automatically elevates the existing wetland on the property to Category 3 status.

The existing wetland attained an ORAM score of 86. This value also elevates the wetland to Category 3 status. The principal factors that influence this score are the presence of rare species/plant communities, the large size of the wetland, the presence of multiple vegetation community types within the wetland, the presence of high quality protective buffers and a natural (unaltered) hydrologic regime.

Wiregrass Ditch exhibited a QHEI score of 41.5. This low score is due in large part to the presence of narrow riparian buffers and little instream cover.

Recommended Restoration/Enhancement Strategy

Both wetland and stream restoration and enhancement opportunities exist at Site OR-3. These opportunities are shown in Figure 4-5.

Wetland OR-3-1 can be enhanced by removing the invasive glossy buckthorn (*Rhamnus frangula*), which currently exists on the site. Currently, the Metroparks is managing this area by cutting and applying herbicide on much of this species.

Wiregrass Ditch already functions as a high quality wetland, containing a portion of Wetland OR-3-1. However, some areas of the ditch bank currently exhibit signs of erosion. Undisturbed portions of this ditch bank support variegated horsetail (*Equisetum variegatum*), a state-endangered species. In order to reduce the amount of erosion that is occurring along the banks, the slope of the embankments should be reduced. After recontouring the ditch banks, exposed soils can then be seeded with a high quality seed mix of native perennial species, to anchor the soils. This type of bank stabilization can be accomplished along approximately 700-feet of the ditch, creating a well vegetated, 100-foot wide linear corridor that is approximately 1.1 acres in areal extent. Establishing various sedges, such as (*Carex stricta, Carex lacustris*) will hold the soil in place, preventing erosion, but also have a more open growth pattern to increase species richness (see *Restoration/Enhancement of Historically Channelized Waterways in Sandy Soils* concept).

SITE OR-3
NON-ISOLATED WETLAND RESTORATION

Between 0.2 and 3.4 acres of newly restored wetland can also be created on this site by expanding Wetland OR-3-1 to the north towards Dorr Street (Figure 4-5). Due to the past land use, some amount of fill material will have be removed from the historic wetland areas on the site. The test pits should be excavated to determine the type, depth and lateral extent of fill that should be removed. After removing this fill, wetland hydrology should be restored naturally, as the native soils are exposed. Due the presence of a hydrologically connected, Category 3 wetland to the south and a newly exposed potential seed bank, seeding of the site should not be necessary. After three years, the vegetation community should be evaluated for quality. Augmenting the existing plant community with additional species can be accomplished, if the evaluation shows that the plant community that has originated from the seed bank is of relatively low quality. Depending on the amount of invasive weeds, a glyphosate herbicide may be needed. The wetland should be monitored for the presence of the establishment of invasive plant species. Two species of particular concern are glossy buckthorn and giant reed (*Phragmites australis*). Several patches of giant reed are found in Wiregrass Ditch (see *Wetland Restoration on Sandy Soils* concept).

Potential Restoration Goals

Implementation of the measures described above will improve the quality of Wiregrass Ditch and adjacent riparian habitat by:

- Removing non-native, invasive species from Wetland OR-3-1;
- Stabilizing the streambank;
- Creating up to 3.8 acres of newly restored Category 3 Wetland on the property; and
- Increasing flood retention at the site.

These improvements should be reflected in:

- An increase in the ORAM and VIBI score for Wetland OR-3-1;
- A reduction in sediment and nutrient loading to the stream;
- An increase in the QHEI of the stream by 2 to 3 points; and
- An improvement in the quality of fish and macroinvertebrate communities in Wiregrass Ditch.

The wetland restoration sites would restore a former residential property to a Category 3 wetland. These wetlands would extend the acreage of the existing Category 3 wetland. This would also increase flood retention in this area. The presence of perennially vegetated wetlands would also reduce wind-caused soil erosion.

Preliminary Cost Estimate

The estimated cost to construct all five of the proposed projects (700-foot buffer enhancement, wetland enhancement, and wetland restorations) would be approximately $69,930. These projects can easily be constructed independently of one another as the budget and opportunities become available. A summary of the estimated costs for this site are provided in Table 4-11.

SITE OR-3
NON-ISOLATED WETLAND RESTORATION

Table 4-11 Estimated Cost Summary for Site OR-3				
Project	Quantity	Unit	Unit Cost	Total Cost
Wiregrass Ditch Enhancement (1.09 acres)	700	linear foot	$25	$17,500
Emergent Wetland Areas A, B & C	3.37	acre	$14,000	$47,180
Riparian Enhancement	0.33	acre	$11,000	$3,630
Wildlife Enhancement (upland)	0.54	acre	$3,000	$1,620
Total Estimated Construction Cost				**$69,930**

SITE OR-3
NON-ISOLATED WETLAND RESTORATION

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SITE OR-16

Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

Prepared for:

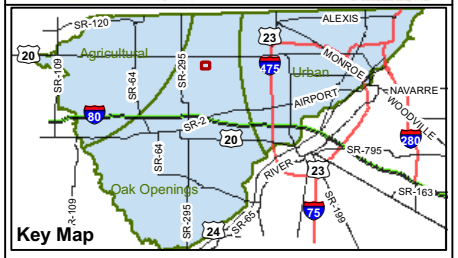
Partners for Clean Streams

Partners for Clean Streams, Inc.
P.O. Box 822
Bowling Green, Ohio 43402
www.PartnersForCleanStreams.org

Prepared by:

Mannik & Smith Group, Inc.

Hull & Associates, Inc.



Legend

- Sample Plot
- 2005 Soils Classification
- Parcel Line
- Existing Wetland
- QHEI
- HHEI
- 5' Contour

Proposed Wetland Enhancement

- Wildlife Enhancement
- Ditch Restoration
- Emergent
- Deep Water Emergent
- Floating-leaved Emergent
- Forested
- Riparian Buffer
- Trail/Access Road

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-6
Restoration/Enhancement Plan for OR-16
Richfield Township, Lucas County, Ohio

County Map of Ohio

0 150 300 600 Feet

1:3,600

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: P163A1A
File Name: P163A1A_LucasSites.mxd
Date: January 19, 2009

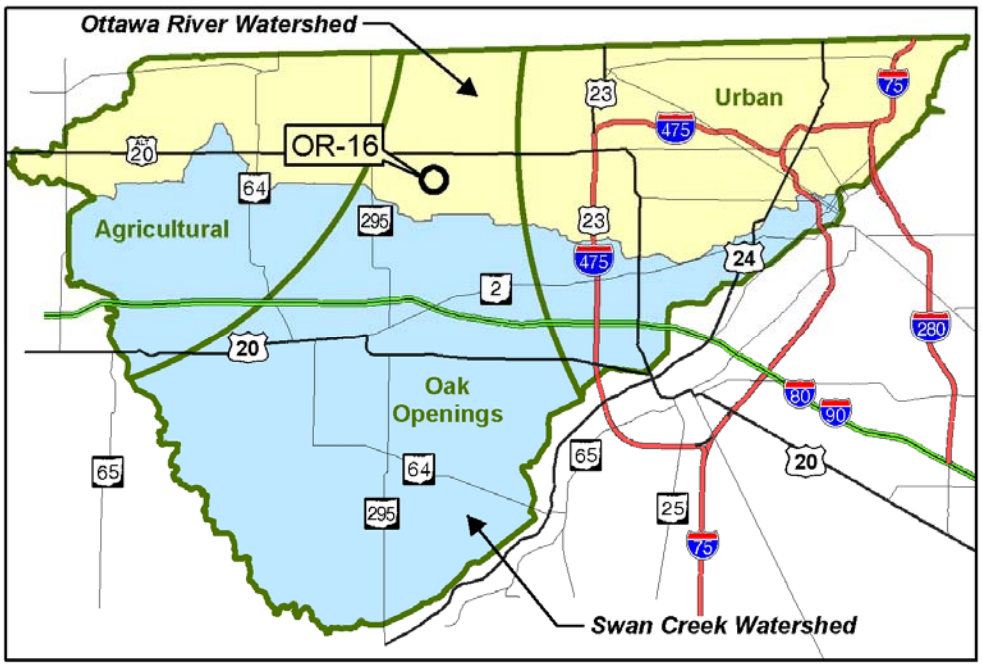
SITE OR-16
STREAM AND NON-ISOLATED WETLAND RESTORATION

Project Description:
Create 27.33 acres palustrine of wetland on hydric soil
Enhance 1 acre of pastured wetland
Plant 645 feet of riparian corridor
Enhance 1500 feet of Prairie Ditch

General Restoration/Enhancement Concept:
Restoration/Enhancement of Historically Channelized Waterways in Sandy Soils
Wetland Restoration/Enhancement on Sandy Soils
Restoration/Enhancement of Riparian Buffers

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 10.6 sq. mi.
County: Lucas **Municipality**: Richfield Township **Location:** 83°47' 52.36"W 41°39' 38.71"N
Streams: Hughes Ditch & Prairie Ditch (QHEI = 21.5)
Watershed: Tenmile Creek HUC 0410000103 (Frontal Lake Erie)
Wetland: OR-16-1 (linear drainage swale);
OR-16-2 (palustrine emergent); combined ORAM 27.5
Stream buffers: Narrow, low to moderate (wooded) quality
Surrounding land use: Row crop, horse pasture, Secor Metropark to east
Field-estimated gradient: 0.1% (0.1 feet per hundred feet), low



SITE OR-16 STREAM AND NON-ISOLATED WETLAND RESTORATION

Site Description

The site is divided into two primarily agricultural parcels that together occupy 71 acres located on the north side of Bancroft Street, approximately 3000 feet east of Langenderfer Road (Figure 4-6). The western property, which occupies 35.0 acres, is an active agricultural field while the eastern property, which occupies 25.9 acres, contains a residence and horse farm. This property is currently for sale.

Prairie Ditch unbuffered through agricultural fields

Existing Site Conditions

Two palustrine wetlands exist on the property. One wetland, identified as Wetland OR-16-1, which occupies 0.84 acre on Figure 4-6, is a reed canary-grass dominated emergent system that currently functions as an open pasture. This wetland drains into an intermittent swale that drains into Prairie Ditch to the north. Hughes Ditch, which borders the site to the north, also flows into Prairie Ditch at the northeast corner of the site. This wetland was dominated by water-plantain (*Alisma triviale*), water parsnip (*Siam suave*), reed canary grass (*Phalaris arundinacea*) and box-elder (*Acer negundo*) along the banks. Positive indicators of wetland hydrology included water-stained leaves, drainage patterns and sediment deposits up to 5 feet above the saturated soil.

Wetland OR-16-2, which occupies only 0.06 acre, is dominated by reed canary grass and had black soils under an inch of fill. Signs of wetland hydrology in this wetland included water marks on vegetation, sediment deposits, water-stained leaves, and a positive FAC-neutral test. The ORAM score for this wetland was a 27.5, which correlates to a Category 1 wetland. This would be a low quality wetland based on its size and vegetation community.

Seasonally high water will saturate the soils throughout much of the site. Heavy rains that have occurred in the past several years have increased flooding in the area, and caused surface water to occasionally flow over Bancroft Road at this location. Areas that lie below 667 feet in elevation also become inundated.

SITE OR-16 STREAM AND NON-ISOLATED WETLAND RESTORATION

The majority of existing soils in the area are mapped as hydric Gilford fine sandy loam (Go). Other soils types present include Ottokee fine sand, 0 to 6 percent slopes (Otb) and Tedrow (TdA) fine sand, 0 to 3 percent slopes. These other soils are soils are listed as non-hydric but may contain inclusions of hydric soils in low depressions and along drainage ways. This site is on the western edge of the Oak Openings Region.

The QHEI of Prairie Ditch was 21.5. This low score was due to the narrow to non-existent buffers through the pasture and agricultural fields, the lack of in-stream cover and the occurrence of moderate bank erosion.

Bank erosion along Prairie Ditch

Recommended Restoration/Enhancement Strategy

Site OR-16 provides both wetland restoration and enhancement opportunities.

Wetland enhancement opportunities can be achieved by improving the quality of Wetlands OR-16-1 and OR-16-2. The swale (Wetland OR-16-1) can be re-contoured to lessen the slope and allow the establishment of perennial species. The two primary species that do well in these drainage swales in northwestern Ohio are hummock sedge (*Carex stricta*) and lakeshore sedge (*Carex lacustris*).

Prairie Ditch through narrow wooded corridor

These species are known to hold the soil in place, preventing erosion, but also have a more open growth pattern to increase species richness (see *Restoration/Enhancement of Historically Channelized Waterways in Sandy Soils* concept).

Wetland OR-16-2 can be enhanced by spraying the vegetation with a non-species specific herbicide, most likely a form of a glyphosate. The treated area can then be over seeded with a mix of higher quality sedges and grasses that are adapted to this type of emergent community. (see *Wetland Restoration/Enhancement on Sandy Soils* concept). The exclusion of horses from this area is also recommended to prevent herbivory.

Approximately two to ten acres of palustrine, Oak Openings wet meadow can also be restored on the site. This restoration can be planned in a manner similar to that of Wetland OR-16-2. Prior to construction, the contractor should conduct a tile search and plug any agricultural tiles that are found on the site. Care should be taken to ensure that tile flows from adjacent properties are not impeded as a result of this process. A shallow berm may also need to be constructed around the perimeter of the property to prevent flooding on adjacent properties. If agricultural weeds are present on the site, they should be treated with a glyphosate herbicide. After this application, the site can be mildly recontoured by driving a piece of construction equipment over the site in a random manner prior to planting. This will create shallow mounds and swales that will increase both floral and faunal diversity (see *Wetland Restoration/ Enhancement on Sandy Soils* concept). Once grading is complete, the site can be seeded with one of the wet meadow seed mix that is specified in the concept.

Approximately 900 feet of riparian corridor restoration can also be implemented on the property, along Prairie Ditch. The restoration of this approximately 1.78-acre stream buffer would require the installation of a 100-foot wide forested/shrub boundary to shade the stream surface, slow surface runoff and prevent soils from being transported by air into the ditch. The neighboring agricultural field (Figure 4-6) distinctly shows the effects of wind erosion and the initial stages of dunal formation in the agricultural field to west of the ditch. In addition to the species of trees and shrubs that are recommended in the General Recommendations for *Restoration/ Enhancement of Riparian Buffers* concept, it is expected that species such as American elm (*Ulmus americana*), eastern cottonwood (*Populus deltoides*), and several species of dogwoods (*Cornus* spp.) and willows (*Salix* spp.) would become established naturally along this corridor.

Potential Restoration Goals

Implementation of the measures described above will improve the quality of Prairie Ditch and adjacent riparian habitat by:

- Stabilizing the streambank;
- Enhancing Wetlands OR-16-1 and OR-16-2 to Category 3 status;
- Restoring up to 10 acres of Category 3, palustrine, Oak Openings wet meadow; and
- Restoring 900 feet of riparian corridor.

SITE OR-16 STREAM AND NON-ISOLATED WETLAND RESTORATION

These measures should be reflected in:

- An increase in the ORAM and VIBI score for Wetland OR-16-1 and OR-16-2;
- A reduction in sediment and nutrient loading to the stream;
- An increase in the flood retention in the floodplain;
- An increase in the QHEI of the stream by 5 to 7 points; and
- An improvement in the quality of fish and macroinvertebrate communities in Prairie Ditch.

Preliminary Cost Estimate

The estimated cost to construct all three of the proposed projects (900-foot buffer enhancement, wetland enhancement, and wetland restorations) would be approximately $502,830 depending primarily on the number of projects that would be undertaken. These projects could easily be constructed in phases, or in its entirety, depending on available funding. A summary of the estimated costs for this site are provided in Table 4-12.

Table 4-12
Estimated Cost Summary for Site OR-16

Project	Quantity	Unit	Unit Cost	Total Cost
Wetland OR-16-1 Ditch Enhancement	600	linear foot	$25	$15,000
Wetland Enhancement OR-16-2	0.84	acre	$14,000	$11,760
Wetland Restoration: Site OR-16-A	1.53	acre	$14,000	$21,420
Wetland Restoration: Site OR-16-B	2.67	acre	$14,000	$37,380
Riparian Buffers Enhancement	6.45	acre	$11,000	$70,950
Wetland Restoration: Site OR-16-C	23.13	acre	$14,000	$323,820
Prairie Ditch Enhancement	900	linear foot	$25	$22,500
Total Estimated Construction Cost				**$502,830**

SITE OR-16
STREAM AND NON-ISOLATED WETLAND RESTORATION

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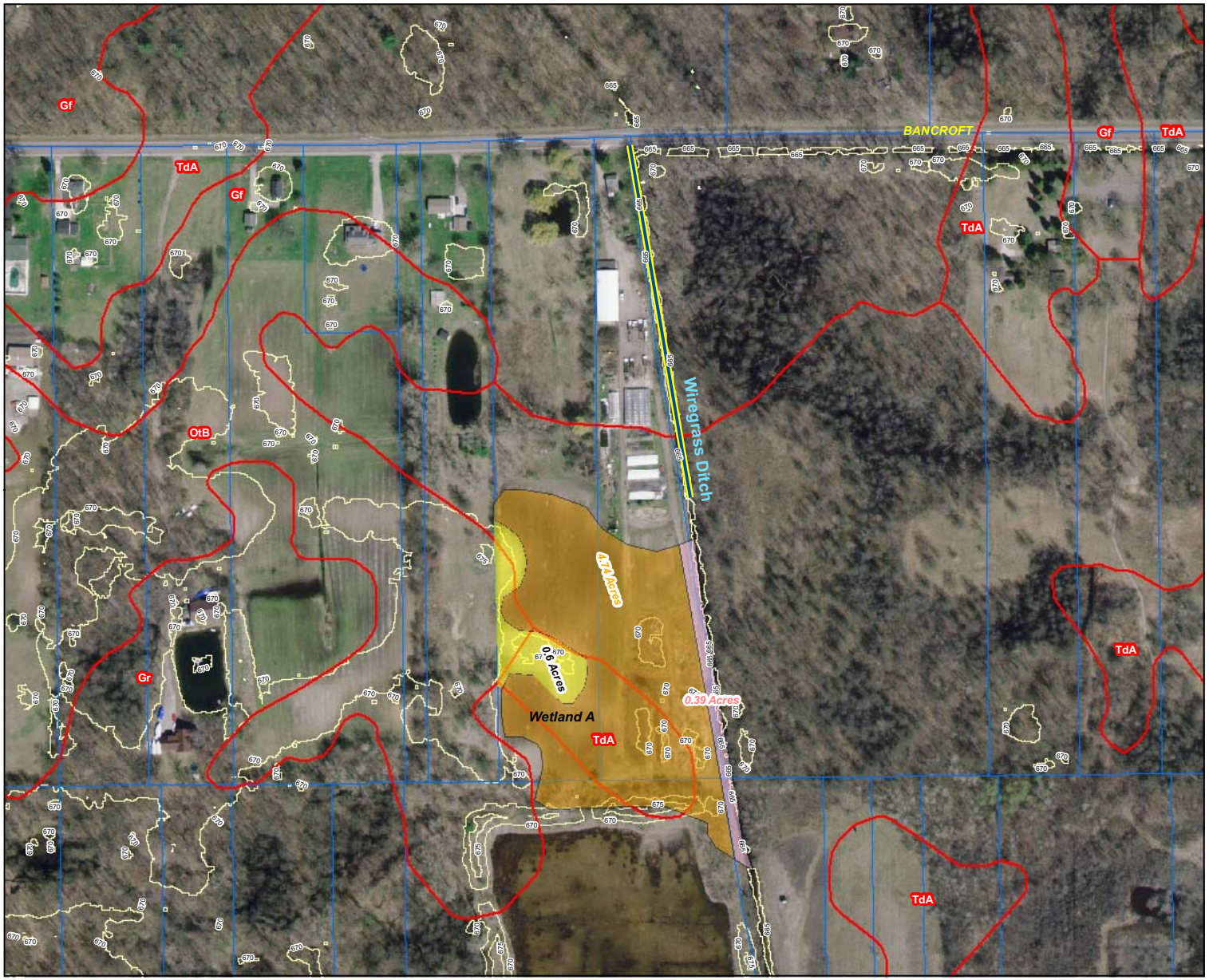
SITE OR-31



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

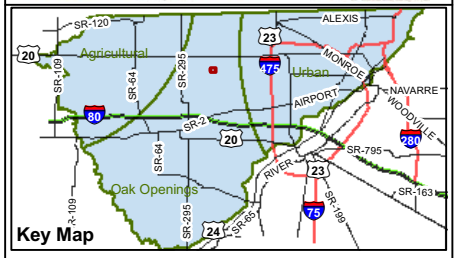
Prepared for:

Partners for Clean Streams, Inc.
P.O. Box 822
Bowling Green, Ohio 43402
www.PartnersForCleanStreams.org

Prepared by:

Mannik & Smith Group, Inc.

Hull & Associates, Inc.



Legend

- Sample Plot
- 2005 Soils Classification
- Parcel Line
- Existing Wetland
- QHEI
- HHEI
- 5' Contour

Proposed Wetland Enhancement

- Wildlife Enhancement
- Ditch Restoration
- Emergent
- Deep Water Emergent
- Floating-leaved Emergent
- Forested
- Riparian Buffer
- Trail/Access Road

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-7
Restoration/Enhancement Plan for OR-31
Spencer Township, Lucas County, Ohio

County Map of Ohio

0 100 200 400 Feet

1:2,400

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: P163A1A
File Name: P163A1A_LucasSites.mxd
Date: January 19, 2009

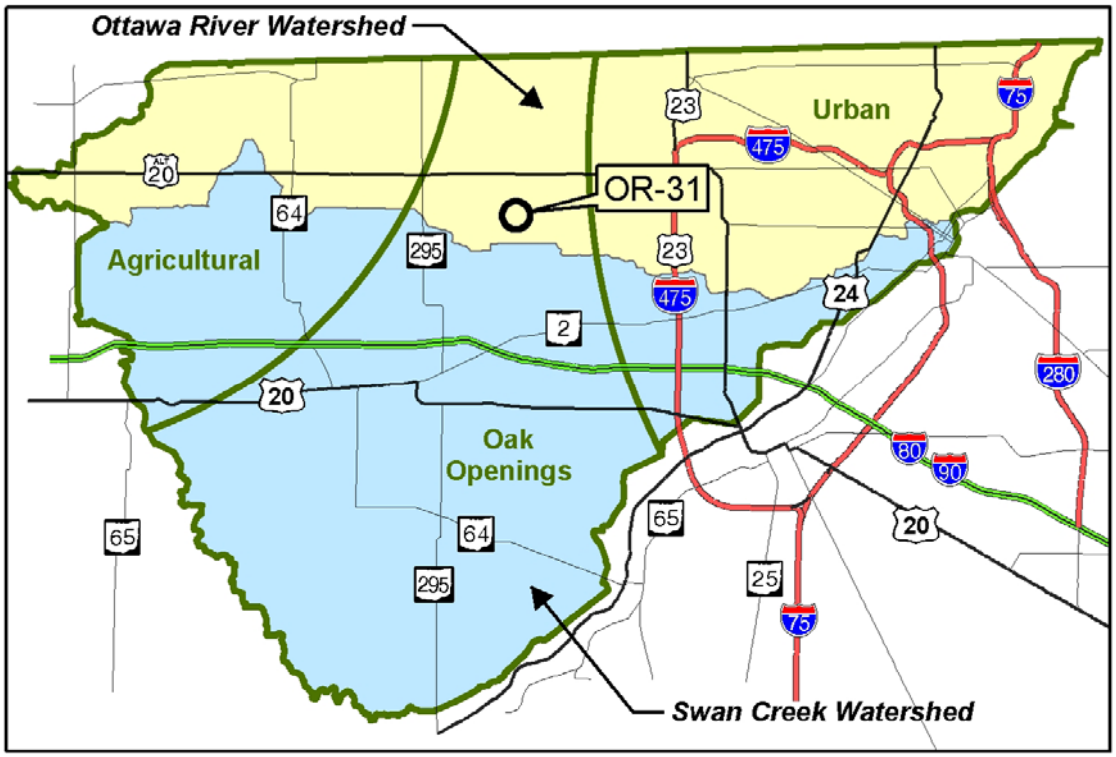
SITE OR-31
NON-ISOLATED WETLAND RESTORATION

Project Description:
Create 4.74 acres of palustrine wetland on hydric soil
Plant 650 (0.39 acre) feet of riparian corridor
Enhance 0.6 acre of wildlife habitat

General Restoration/Enhancement Concept:
Restoration/Enhancement of Historically Channelized Waterways in Sandy Soils
Wetland Restoration/Enhancement on Sandy Soils

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 0.61 sq. mi.
County: Lucas **Municipality**: Richfield Township **Location:** 83°47' 08.05"W 41°39' 18.67"N
Stream: Wiregrass Ditch (QHEI = 26)
Wetland: None
Watershed: Ottawa River and Swan Creek HUC 0410000103 (Frontal Lake Erie)
Stream buffers: Narrow, low to moderate (wooded) quality
Surrounding land use: Row crop, commercial property,
Irwin Prairie State Nature Preserve to east
Field-estimated gradient: 0.1% (0.1 feet per hundred feet), low



SITE OR-31
NON-ISOLATED WETLAND RESTORATION

Site Description

The site is found on two parcels. The eastern parcel located at 10063 Bancroft Street is the western portion of Irwin Prairie State Nature Preserve. The western parcel is located at 10121 Bancroft Road along the western edge of Irwin Prairie. This area of the site is an undeveloped portion of the property behind the commercial business.

Existing Site Conditions

Wiregrass Ditch runs between the two properties. This ditch is driven by seasonally high water and will saturate the soils yearly throughout much of the site. The eastern portion of the site, Irwin Prairie is already a mature swamp forest. No wetlands were located on the west side of Wiregrass Ditch.

The majority of the existing soil is mapped as the hydric Granby loamy fine sand (Gr). Other soils types present were the Ottokee fine sand, 0 to 6 percent slopes (OtB) and Tedrow (TdA) fine sand, 0 to 3 percent slopes. These other soils are listed as non-hydric but with hydric inclusions according to Lucas County (LSWCD, 1998). This site is on the western edge of the Oak Openings Region.

Wiregrass Ditch facing north

The QHEI was very low, but typical for a low gradient drainage ditch. The score of 26 was due to the narrow buffers along the west side, very little instream cover, no channel morphology and moderate erosion.

SITE OR-31
NON-ISOLATED WETLAND RESTORATION

Proposed Restoration/ Enhancement Strategy

Wet swamp forest along western side of Wiregrass Ditch, Irwin Prairie State Nature Preserve

Site OR-31 provides both wetland restoration (see *Wetland Restoration/Enhancement on Sandy Soils* concept) and ditch enhancement opportunities. Because of the several possibilities that are present within these parcels, the restoration/ enhancement plan was divided into several smaller portions that can be implemented individually or as one large project.

Enhancement opportunities can be achieved in Wiregrass Ditch by re-contouring the banks to lessen the slope and allow the establishment of perennial species. The two primary species that thrive in these drainage swales in northwest Ohio are hummock sedge (*Carex stricta*) and lakeshore sedge (*Carex lacustris*). These species are known to hold the soil in place, preventing erosion, but also have a more open growth pattern to increase species richness (see *Restoration/Enhancement of Historically Channelized Waterways in Sandy Soils* concept).

Potential Restoration Goals

Implementation of the measures described above will improve the quality of Wiregrass Ditch and adjacent riparian habitat by:

- Increasing the quality and width of the buffer along the ditch;
- Planting more vegetation along the edges of the ditch; and
- Restoring the old field/waste land to a Category 3 wetland.

These measures will be reflected in:

- An increase in the QHEI of the stream by 5 to 7 points;
- A reduction in erosion and silt loading into the ditch; and
- An improvement in the quality of fish and macroinvertebrate communities in Prairie Ditch.

SITE OR-31
NON-ISOLATED WETLAND RESTORATION

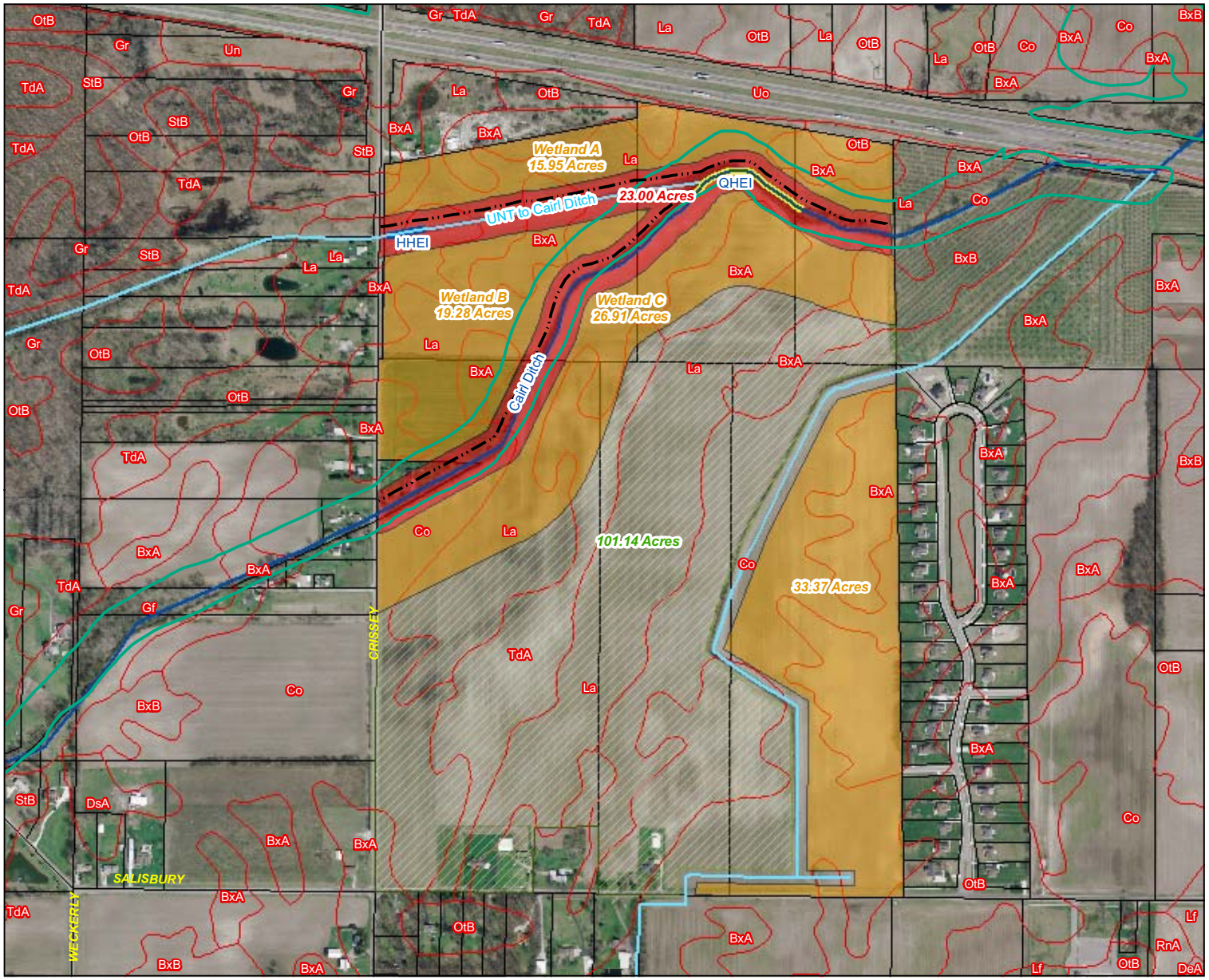
Preliminary Cost Estimate

The estimated cost to construct the two proposed projects (650-foot (0.39 acre) ditch enhancement, wildlife enhancement and wetland restoration) would be approximately $72,450 depending primarily on the number of projects that would be undertaken at the site. These projects could easily be constructed in phases, as funding opportunities become available. A summary of the estimated costs for this site are provided in Table 4-13.

Table 4-13
Estimated Cost Summary for Site OR-31

Project	Quantity	Unit	Unit Cost	Total Cost
Wetland Restoration	4.74	acre	$14,000	$66,360
Wildlife Enhancement (upland)	0.6	acre	$3,000	$1,800
Wiregrass Ditch Enhancement	0.39	acre	$11,000	$4,290
Total Estimated Construction Cost				**$72,450**

SITE SC-6



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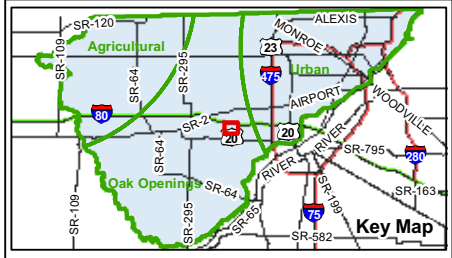


Legend

- Project Boundary
- Parcels
- Existing Wetlands

Wetland Restoration Areas

- Wildlife Enhancement
- Ditch/Linear Wetland Restoration
- Emergent Zone
- Deep Water Emergent Zone
- Floating-leaved Bed Zone
- Forested Zone
- Riparian Buffer Zone
- 100 year Floodplain
- 2005 Soil Classification
- Access Road/Trail

Streams

- QHEI
- HHEI
- Severe Bank Erosion

Ohio Rivers and Streams

- Streams
- Intermittent Stream

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-8
Restoration/Enhancement Plan for SC-6
Monclova Township, Lucas County, Ohio

County Map of Ohio

0 250 500 1,000 Feet
1:6,000

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: DAO002
File Name: DAO002_Concept2_Fig4-8_SiteSC-6.mxd
Date: March, 2009

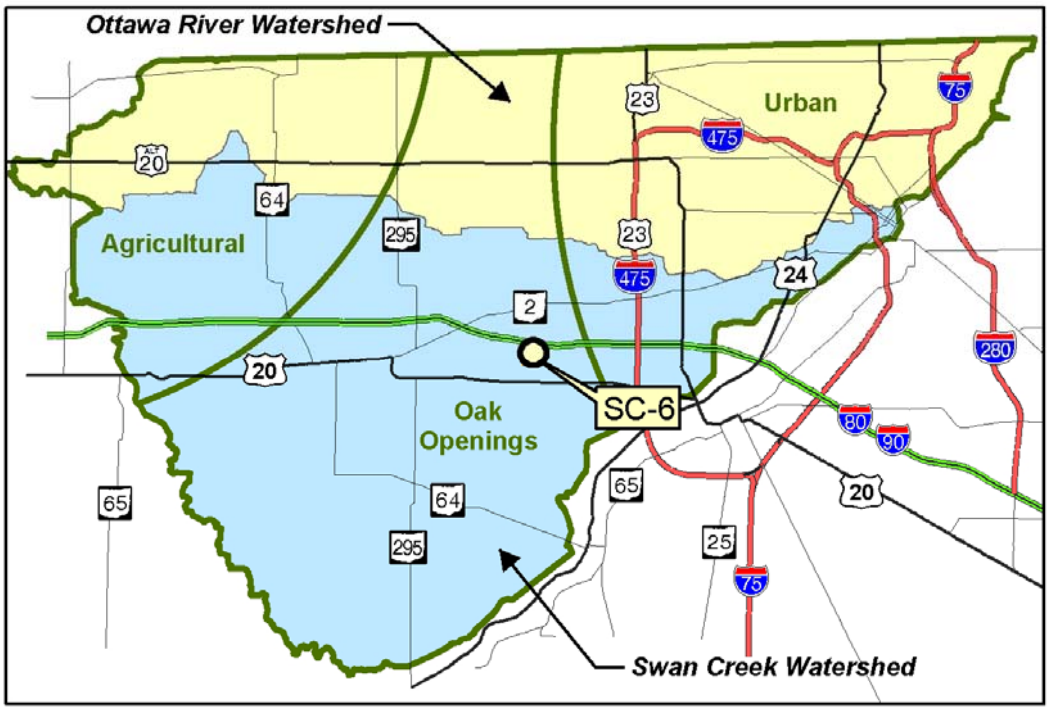
SITE SC-6
NON-ISOLATED WETLAND RESTORATION

Project Description:
Create 16-96 acres of palustrine wetland on hydric soil
Plant 6800 feet of riparian corridor
Enhance 101 acres of upland habitat for wildlife
Enhance 15.6 acres of buffer along Cairl Ditch

General Restoration/Enhancement Concept:
Restoration/Enhancement of Historically Channelized Waterways in Sandy Soils
Wetland Restoration/Enhancement on Sandy Soils
Restoration/Enhancement of Riparian Buffers

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 1.09 sq. mi.
County: Lucas **Municipality**: Monclova Township **Location:** 83°23.71"W 41°35' 10.76"N
Streams: Cairl Ditch, UNT to Cairl Ditch
Watershed: Swan Creek HUC 0410000908 (Lower Swan Creek)
Wetland: none
Stream buffers: narrow, low quality
Surrounding land use: row crop
Field-estimated gradient: 0.5% to 0.1% (0.05 to 0.1 feet per hundred feet), low
Ohio Gazetteer published average gradient: 0.15% (8 feet per mile), moderate



SITE SC-6
NON-ISOLATED WETLAND RESTORATION

Site Description

The site consists of six agricultural parcels comprising 169.16 acres, located east of Crissey Road and North of Salisbury Road in Monclova Township, Lucas County, Ohio (Figure 4-8). This site overlaps a Priority Conservation Agricultural and Development Areas, as identified by the Swan Creek Technical Advisory Committee.

Cairl Ditch facing downstream

Existing Site Conditions

At this location, two low-gradient agricultural drainage ditches with small drainage ways (<2,000 acres or 3.1 square miles) were documented. These streams were not formerly natural stream channels but were created to facilitate drainage in the area. They have been extensively hydrologically modified, and are maintained on a regular basis to remove accumulated sediments and maintain sub-surface tile drainage from adjacent row-crop agriculture. The QHEI score for Cairl Ditch was 37. Instream cover and buffer width/quality were low, but higher than is typical for this type of stream. The HHEI score for the unnamed tributary to Cairl Ditch was 56, resulting in an existing beneficial use of perennial Modified Class II PHWH.

Row crops are planted up to the edge of low-quality, narrow (averaging 10- to 15-foot) riparian buffers on each bank. Gradient and stream power are insufficient to move silt and sand substrates resulting in the formation of instream mid-channel and transverse sediment bars. Streambank stability (e.g., erosion, slumping) is moderate to good due to well-vegetated, shallow-sloping banks.

There are no existing wetlands at Site SC-6. The majority of the soils are mapped as hydric Lamson fine sandy loam (La) and non-hydric Tedrow (TdA) fine sand, 0 to 3 percent slopes, which may contain unmapped inclusions of hydric Granby loamy fine sand (Gr) or Gilford fine sand loam (Gf) soils. Colwood loam (Co), a hydric soil unit, occurs along an unnamed drainageway at the site.

SITE SC-6
NON-ISOLATED WETLAND RESTORATION

Recommended Stream Enhancement and Wetland Restoration Strategy

Existing riparian plant community, Cairl Ditch

The following measures can be implemented to enhance the quality of the two streams in this area:

- Where streambank gradient is excessive, re-grade streambanks to reduce slope and stabilize with herbaceous vegetation. (see *Restoration/ Enhancement of Historically Channelized Waterways in Sandy Soils* concept)
- Widen the wooded riparian buffer to 50 to 100 feet from the top of each bank, and incorporate 20-foot wide maintenance access road. The wooded riparian buffer enhancement should leave the existing narrow buffer intact. (see *Restoration/Enhancement of Riparian Buffers* concept).
- Implement limited sediment bar and selective snag removal per Ohio Drainage Manual guidelines.

Up to 96 acres of palustrine emergent/scrub/shrub wetland can be restored on the site. Restoration efforts could be accomplished in a series of smaller projects initially focused on the areas closest to Cairl Ditch. The wetland restoration areas have been designated as Area A (15.95 acres), Area B (19.28 acres), Area C (26.91 acres), and Area D (33.37 acres) totaling 95651 acres. Depending on the amount of agricultural weeds present at the time restoration is initiated, a glyphosphate herbicide may be needed. After this application, some simple grading may be necessary prior to planting. This grading would create shallow hills and swales that would increase both floral and faunal diversity (see *Wetland Restoration/Enhancement on Sandy Soils* concept). Grading would then be followed by seeding of sedges and grasses that are adapted to this type of emergent community. A diverse emergent seed mix can be placed in this marsh.

SITE SC-6
NON-ISOLATED WETLAND RESTORATION

Potential Stream Enhancement and Wetland Restoration Goals

Implementation of the measures described above will improve the quality of Cairl Ditch and adjacent riparian habitat by:

- The restoration of up to 96 acres of palustrine emergent/scrub/shrub wetlands on the property;
- Regarding the stream bank along Cairl Ditch and replanting the banks with native vegetation;
- Removal or accumulated sediments from Cairl Ditch; and
- Establishment of a wider wooded riparian habitat along Cairl Ditch.

These measures will be reflected in:

- An increase in the QHEI of Cairl Ditch of 5 to 7 points;
- An increase in the HHEI of the unnamed tributary by 6 to 9 points;
- An increase in the flood retention capacity of the area;
- A reduction in wind-caused soil erosion;
- A reduction in siltation into Cairl Ditch;
- A reduction in the frequency of needed ditch cleanout to 10 years or more, although selective snag removal may have to occur as frequently as every other year; and
- An improvement in the quality of fish and macroinvertebrate communities in Cairl Ditch.

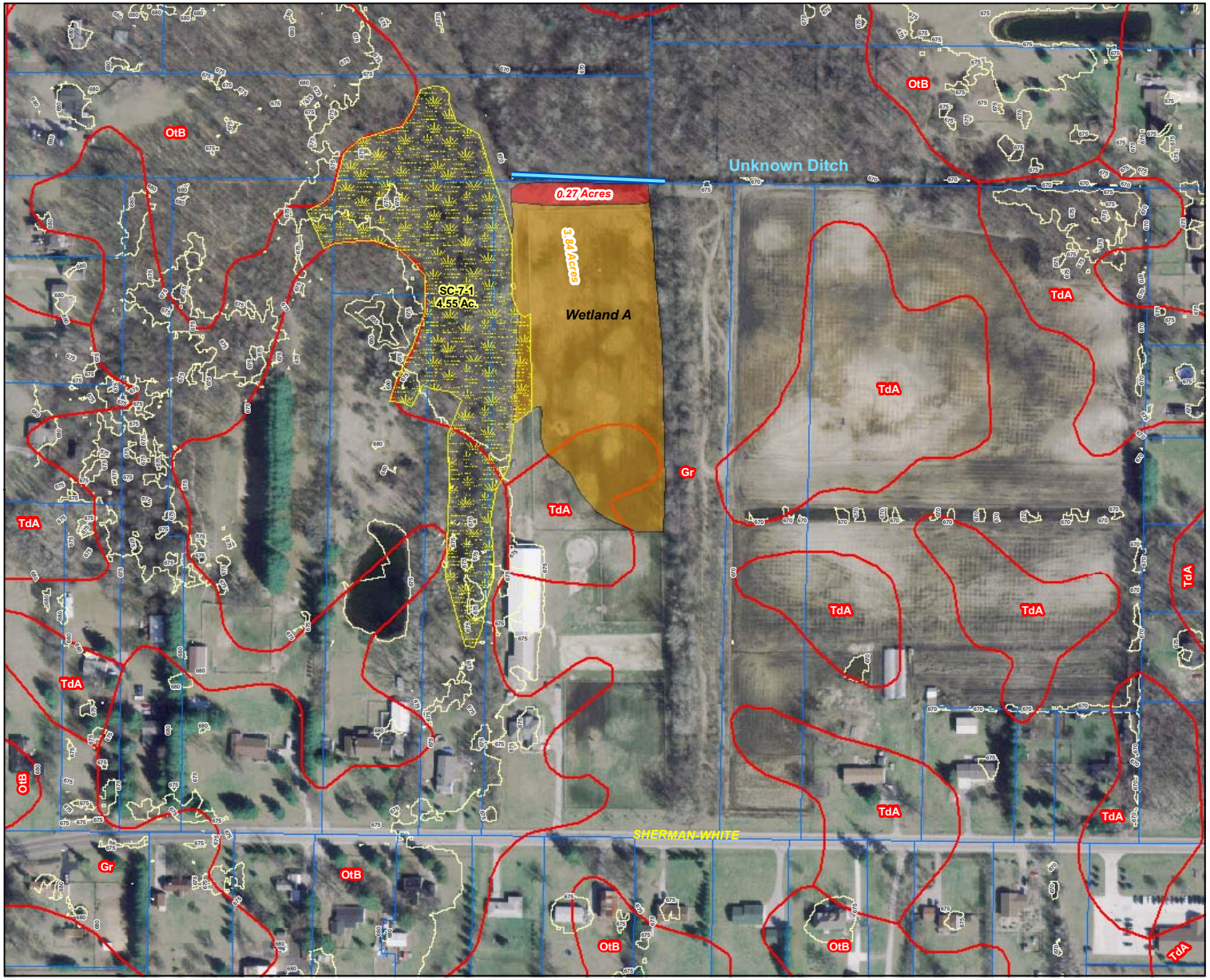
Preliminary Cost Estimate

The estimated cost to construct the proposed projects is summarized in the table below. This project can be constructed in phases as funding opportunities become available.

Table 4-14
Estimated Cost Summary for Site SC-6

Project	Quantity	Unit	Unit Cost	Total Cost
Streambank Slope Reduction/Stabilization	6800	linear foot	$25	$170,000
Riparian Buffers Enhancement	23.00	acre	$11,000	$253,000
Wildlife Enhancement (upland)	101.14	acre	$3,000	$303,420
Wetland Restoration A	15.95	acre	$14,000	$223,300
Wetland Restoration B	19.28	acre	$14,000	$269,920
Wetland Restoration C	26.91	acre	$14,000	$376,740
Wetland Restoration D	33.37	acre	$14,000	$467,180
Stream Maintenance	3400	linear foot	$5	$17,000
Total Estimated Construction Cost				**$2,080,560**

SITE SC-7



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

Prepared for:

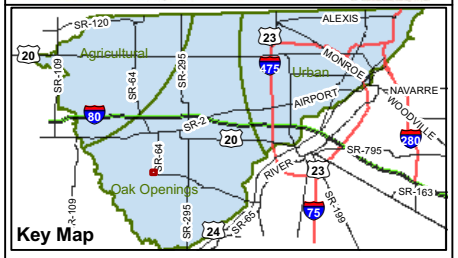
Partners for Clean Streams

Partners for Clean Streams, Inc.
P.O. Box 822
Bowling Green, Ohio 43402
www.PartnersForCleanStreams.org

Prepared by:

Mannik & Smith Group, Inc.

Hull & Associates, Inc.



Legend

- Sample Plot
- 2005 Soils Classification
- Parcel Line
- Existing Wetland
- QHEI
- HHEI
- 5' Contour

Proposed Wetland Enhancement

- Wildlife Enhancement
- Ditch Restoration
- Emergent
- Deep Water Emergent
- Floating-leaved Emergent
- Forested
- Riparian Buffer
- Trail/Access Road

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-9
Restoration/Enhancement Plan for SC-7
Swanton Township, Lucas County, Ohio

County Map of Ohio

0 100 200 400 Feet

1:2,400

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: P163A1A
File Name: P163A1A_LucasSites.mxd
Date: January 19, 2009

SITE SC-7
NON-ISOLATED WETLAND RESTORATION

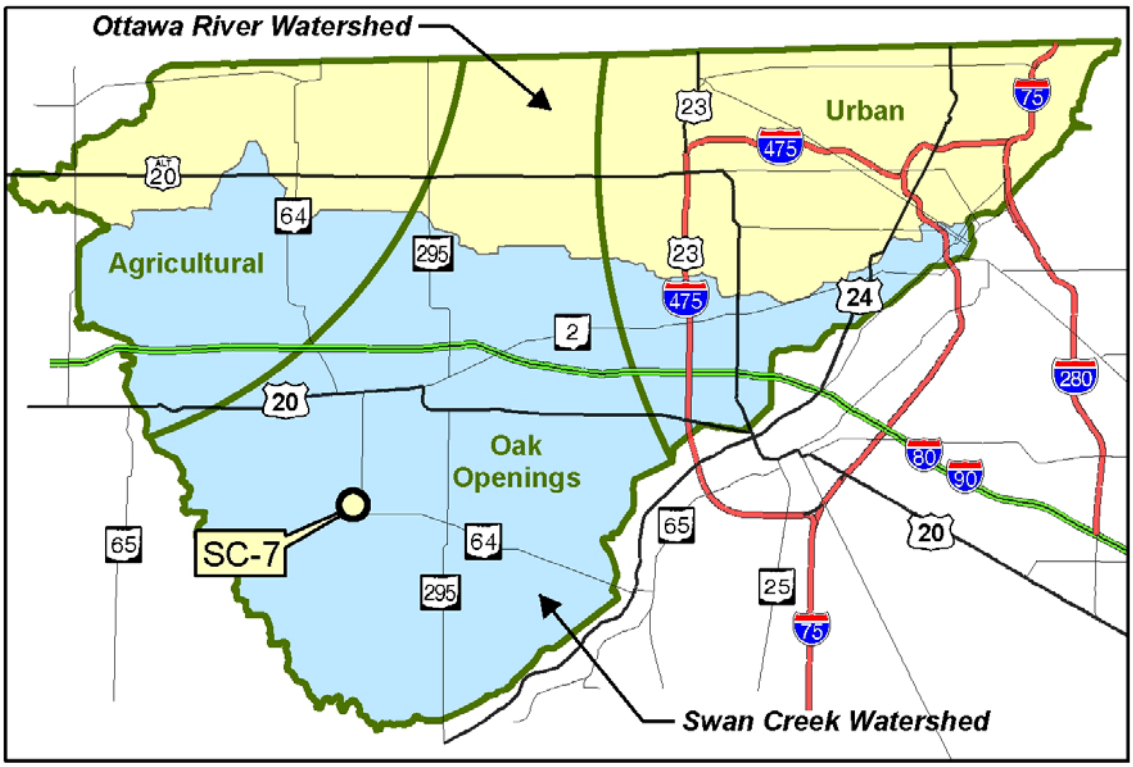
Oak Openings Subregion

Project Description:
Create 3.84 acres of palustrine wetland on hydric soil
Plant 250 feet of riparian corridor
Enhance 0.26 acres of existing wetland
Enhance 0.27 acres of buffer along unnamed ditch

General Restoration/Enhancement Concept:
Wetland Restoration/Enhancement on Sandy Soils
Restoration/Enhancement of Riparian Buffers

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Watershed Area: 0.19 sq. mi.
County: Lucas **Municipality**: Swanton Township **Location:** 83°52' 42.17"W 41°0.76"N
Stream: Unnamed Ditch (QHEI = 25, HHEI = 31)
Watershed: Swan Creek HUC 0410000908 (Lower Swan Creek)
Wetland: SC-7-1 (palustrine forest/palustrine emergent); ORAM 47
Stream buffers: Narrow, low to moderate (wooded) quality
Surrounding land use: Forested, horse farms, residential
Field-estimated gradient: 0.1% (0.1 foot per hundred feet), low



SITE SC-7
NON-ISOLATED WETLAND RESTORATION

Site Description

Site SC-7 is a 15-acre parcel located at 14124 Sherman-White Road in Swanton Township, Lucas County, Ohio (Figure 4-9). The site contains a private residence and horse farm divided into one large pasture, several smaller pastures and a large barn/stable. The site located on the north side of Sherman-White Road, approximately 0.2 mile east of the Fulton/Lucas County line. The Swan Creek Technical Committee identified that Site SC-7 overlapped and was adjacent to Priority Conservation Areas.

Facing south with mowed emergent wetland in foreground

Existing Site Conditions

One existing wetland (SC-7-1) was identified along the west side of the property. It is a palustrine forested/emergent wetland that occupies at least 4.6 acres (see description below). One small, 6-foot wide intermittent channel exists along the northern edge of the parcel. This channel has a small (0.19 square mile) watershed. Indications exist throughout the parcel that seasonally high water saturates the soils in the spring.

The majority of the existing soil is mapped as hydric Granby fine sandy loam (Gr). Other soils types reported for the site include Ottokee fine sand, 0 to 6 percent slopes (OtB) and Tedrow (TdA) fine sand, 0 to 3 percent slopes. These latter two soils are non-hydric but may contain hydric inclusions according to Lucas County (LSWCD, 1998). This site is on the western edge of the Oak Openings Region.

The unnamed ditch achieved a QHEI score of 25, which is low but typical of the small, unnamed tributaries in the watershed. This score was due to the presence of narrow to non-existent buffers through the pasture and agricultural fields, very little instream cover and moderate erosion along the ditch banks.

The one wetland on the property is a palustrine forested wetland that is dominated by silver and red maples (*Acer saccharinum* and *A. rubrum*), characteristic species of a young secondary-growth forest. The rest of the delineated portion of the wetland is a mowed emergent and shrubby edge area around the fenced pastures. Dominant plants were lakebank sedge (*Carex lacustris*), fox sedge (*Carex vulpinoidea*), boneset (*Eupatorium perfoliatum*), silky dogwood (*Cornus amomum*) and several silver maple trees. Positive indicators of wetland hydrology

included water-stained leaves, local soil survey data, a positive FAC-neutral test and one-inch high water marks above the saturated soil. The hydric soils and hydrology of this wetland continues into the horse pasture. This pastured area of the site is sparsely vegetated with wetland and upland plants. The ORAM score for this wetland was 47, which correlates to a Category 1 wetland. The low score was based on the small size of the wetland and the low-quality vegetation community.

Start of the HHEI on unnamed tributary facing east

A small headwater ditch is located along the north side of the property (Figure 4-9). This tributary is bordered to the north by a small upland forest while the southern buffer is a narrow shrubby corridor between the mentioned pasture. This ditch was evaluated through QHEI (=25) and the HHEI (=31). The ditch received a low QHEI score due to the lack of in-stream cover, little in-stream development and intermittent flow.

Recommended Restoration/Enhancement Strategy

Site SC-7 provides both wetland and riparian restoration and enhancement opportunities. The enhancement opportunity exists in the eastern-most area of Wetland SC-7-1. Here the large pasture can be enhanced by treating the existing vegetation with a non-species specific herbicide to eradicate the non-desirable plant species. No large patches of invasive species were observed, although if found, these patches would also need to be removed. Due to the previous land use, the existing seed bank may be

Forested wetland of SC 7-1

seriously depleted. Therefore, after herbicide treatment, the area should be seeded with a mixture of native sedges and grasses that are adapted to this type of emergent community (see *Wetland Restoration/Enhancement on Sandy Soils* concept). Horses would also have to be excluded from this area for the wetland to be successful.

The restoration opportunity at the site involves the creation of approximately 4 acres of additional wetland. This area is depicted in Figure 4-9. Minor grading would be necessary to create shallow mounds and swales that would increase both floral and faunal diversity (see *Wetland Restoration/ Enhancement on Sandy Soils* concept).

The riparian enhancement site is an approximately 250-foot long by 100-foot wide linear corridor along the southern side of the unnamed ditch. Presently, the northern buffer of the stream is already forested. The southern buffer is overgrown with a narrow, but dense, shrub layer dominated by dogwood (*Cornus* sp.) and multiflora rose (*Rosa multiflora*). This riparian buffer can be enhanced by creating a wide forested/shrub boundary to shade the stream, slow surface runoff and inhibit blowing soils from the neighboring horse pasture. Planting this area with woody species would slow the erosion problems observed in the field (see *Restoration/ Enhancement of Riparian Buffers* concept). It is expected that species such as American elm (*Ulmus americana*), eastern cottonwood (*Populus deltoides*), and several species of dogwoods (*Cornus* spp.) and willows (*Salix* spp.) would come in naturally.

Potential Restoration Goals

Implementation of the measures described above will improve the quality of the unnamed tributary and adjacent riparian habitat by:

- Enhancing Wetland SC-7-1;
- Creating up to four acres of additional wetland on the site; and
- Enhancing the south bank of the creek by planting a wider, forested buffer to shade the stream.

These measures should be reflected in:

- An increase in the QHEI of the unnamed tributary of 2 to 4 points;
- An increase in the ORAM score for Wetlands SC-7-1; and
- An improvement in the quality of fish and macroinvertebrate communities in the unnamed tributary and Swan Creek.

Preliminary Cost Estimate

The estimated cost to construct the proposed projects (250-foot buffer enhancement, wetland enhancement, and wetland restorations) would be approximately $63,680 depending primarily on the number of phases of the project that would be undertaken. These projects could easily be constructed independently of one another as funding opportunities become available. A summary of the estimated costs for this site are provided in Table 4-15.

SITE SC-7
NON-ISOLATED WETLAND RESTORATION

Table 4-15 Estimated Cost Summary for Site SC-7				
Project	Quantity	Unit	Unit Cost	Total Cost
Wetland Restoration: Area A	3.84	acre	$14,000	$53,760
Unnamed Tributary Enhancement	250	linear foot	$25	$6,250
Wetland Enhancement	0.27	acre	$3,000	$810
Riparian Buffers Enhancement	0.26	acre	$11,000	$2,860
			Total Estimated Construction Cost	$63,680

SITE SC-7
NON-ISOLATED WETLAND RESTORATION

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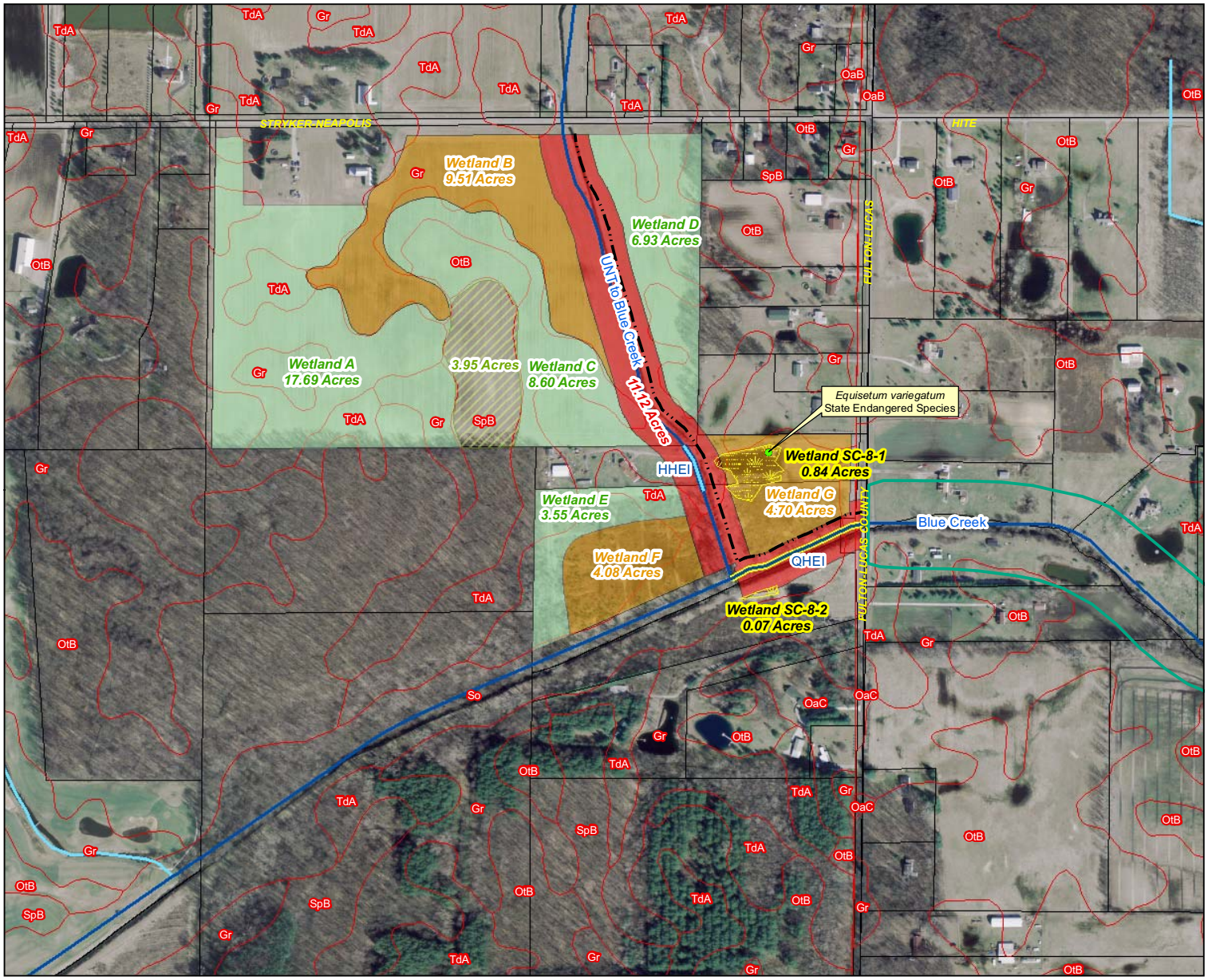
SITE SC-8



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

Prepared for:

Partners for Clean Streams

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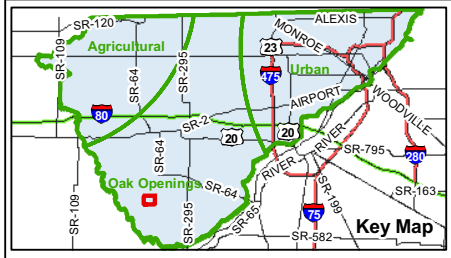
Prepared by:

Mannik & Smith Group, Inc. — Hull & Associates, Inc.



Legend

- Project Boundary
- Parcels
- Existing Wetlands

Wetland Restoration Areas

- Wildlife Enhancement
- Ditch/Linear Wetland Restoration
- Emergent Zone
- Deep Water Emergent Zone
- Floating-leaved Bed Zone
- Forested Zone
- Riparian Buffer Zone

- 100 year Floodplain
- 2005 Soil Classification
- Access Road/Trail

Streams

- QHEI
- HHEI
- Severe Bank Erosion

Ohio Rivers and Streams

- Streams
- Intermittent Stream

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-10
Restoration/Enhancement Plan for SC-8
Swan Creek Township, Fulton County, Ohio

County Map of Ohio

0 200 400 800 Feet
1:4,800

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: DAO002
File Name: DAO002_Concept2_Fig4-10_SiteSC-8.mxd
Date: March, 2009

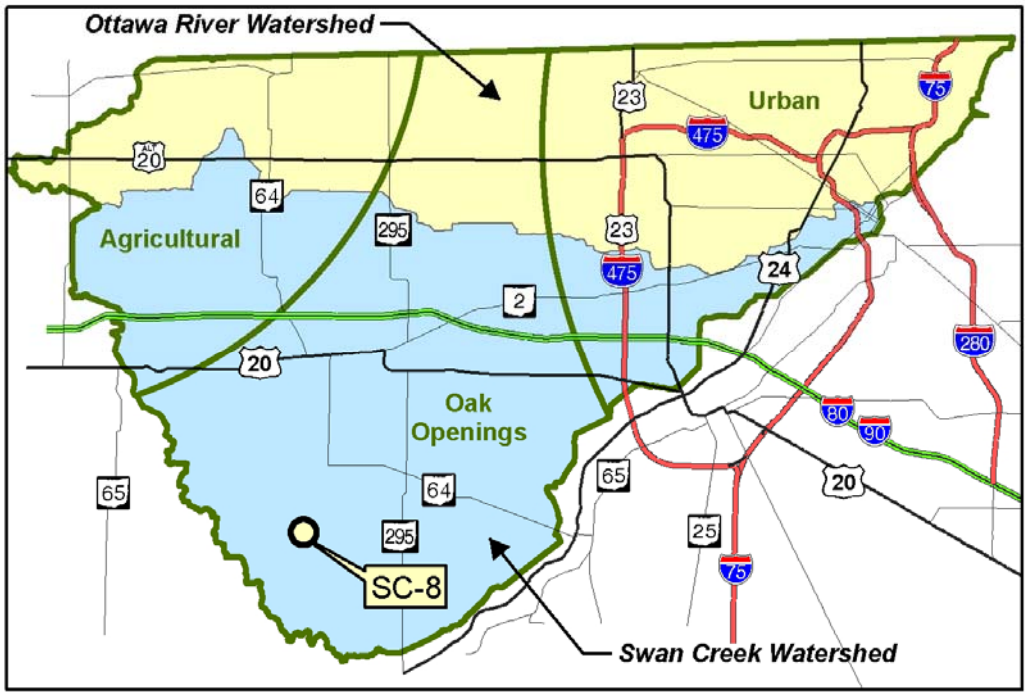
SITE SC-8
NON-ISOLATED WETLAND RESTORATION

Project Description:
Restore 55 acres of emergent Oak Openings wetland
Enhance 0.84 acre of existing wetland
Stabilize 2400 linear feet of streambank
Plant 11.2 acres of wooded riparian buffer
Enhance 3.95 acres of existing upland

General Restoration/Enhancement Concept:
Restoration/Enhancement of Historically Channelized Waterways in Sandy Soils
Restoration/Enhancement of Riparian Buffers
Wetland Restoration/Enhancement on Sandy Soils

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 10.3 sq. mi. (Blue Creek); 1.92 sq. mi. (Unnamed Tributary)
County: Fulton **Municipality**: Swan Creek Township **Location:** 83°531 17.02"W 41°29' 58.10"N
Streams: Blue Creek; Unnamed Tributary to Blue Creek
Watershed: Swan Creek HUC 0410000908 (Lower Swan Creek)
Wetland: None
Stream buffers: None
Surrounding land use: Row crop agriculture, residential
Field-estimated gradient: 0.05%
Ohio Gazetteer published average gradient (Blue Creek): 0.07% (3.5 feet per mile)



SITE SC-8
NON-ISOLATED WETLAND RESTORATION

Site Description

The site consists of three agricultural and scrub-shrub parcels comprising 79.57 acres, located west of Fulton-Lucas County Road in Swan Creek Township, Lucas County, Ohio (Figure 4-10). The site overlaps a Priority Conservation Area as identified by the Swan Creek Advisory Committee.

Blue Creek, upstream sample reach

Existing Site Conditions

The stream is low-gradient. This stream was not formerly a natural stream channel and was constructed to facilitate agricultural drainage in the area. It is maintained as needed to remove accumulated sediments and restore sub-surface tile drainage from adjacent row-crop agriculture. The QHEI score for Blue Creek was 45. Substrate quality and channel morphology quality were low, but this is typical for this type of stream.

Blue Creek, downstream sample reach

An unnamed tributary flows into Blue Creek from the north and has sparse or no riparian buffers. Land use on either side of this stream is row-crop agriculture and field tiles empty into the stream. The HHEI score for this stream was 56. This stream scored low on the substrate metric and pool depths and bankfull widths are typical for this type of stream.

A lawn and old field are present up to the edge of low-quality, narrow (averaging 10- to 15-foot) wooded riparian buffers on each bank of Blue Creek. Gradient and stream power are insufficient to move the dominant silt substrates, which tend to accumulate on the stream

bottom, requiring maintenance in order to maintain flow. In addition, improperly placed riprap from the construction of the bridge at Fulton-Lucas County Road exists at the downstream end of the sample reach. The riprap has restricted flow within the stream, thereby allowing large amounts of sediment to deposit and accumulate in the reach.

There is one existing wetland at Site SC-8. Wetland SC-8-1 is a non-isolated emergent wetland. It is dominated by purple panic grass (*Panicum rigidulum*), sedge (*Carex scoparia),* and veiny-lined aster (*Aster praealtus*). This wetland is located in an area that is mapped as Sloan loam, occasionally flooded (So), a hydric soil. This soil type was confirmed in the field as soils were found to be hydric. Hydrology indicators at the time of evaluation included sediment deposits, water-stained leaves, and a positive FAC neutral test. Wetland SC-8-1 is a Category 3 wetland. The ORAM score was 63, and was strongly influenced by a diversity of communities, moderate buffers and a lack of hydrological modification. The presence of the state endangered *Equisetum variegata* (variegated horsetail) within the wetland would have automatically raised the category of this wetland to Category 3 status.

The majority of the soils at SC-8 are mapped as Granby loamy fine sand (Gr), a hydric soil; Ottokee fine sand, 0-6% slopes (OtB) a non-hydric soil that may contain unmapped inclusions of the hydric Granby loamy fine sand; and Tedrow fine sand, 0-3% slopes (TdA), a non-hydric soil that may contain unmapped inclusions of the hydric Granby loamy fine sand and Gilford fine sandy loam (Gf).

Fish species observed at this location are listed in Table 4-16.

Table 4-16 Fish Samples at Site SC-8 (Blue Creek)					
Common Name[1]	Species[1]	Feed Guild[2]	Tol.[3]	# of Fish	Avg. Wt. (grams)
Rock Bass	*Ambloplites rupestris*	C	N/A	3	-
Yellow Bullhead	*Ameiurus natalis*	I	T	8	-
Stoneroller	*Campostoma anomalum*	H	N/A	163	-
White Sucker	*Catostomus commersonii*	O	T	2	-
Common Carp*	*Cyprinus carpio*	O	T	12	-
Grass Pickerel	*Esox americanus*	P	P	6	-
Northern Pike	*Esox lucius*	P	N/A	12	-
Green Sunfish	*Lepomis cyanellus*	I	T	7	-
Green x Bluegill	*Lepomis cyanellus* x *gibbosus*	N/A	N/A	3	-
Bluegill Sunfish	*Lepomis macrochirus*	I	P	119	-
Largemouth Bass	*Micropterus salmoides salmoides*	C	M	3	-
Golden Shiner	*Notemigonus crysoleucas*	I	T	13	-
Spotfin Shiner	*Notropis spilopterus*	I	N/A	38	-
Sand Shiner	*Notropis stramineus*	I	M	10	-
Tadpole Madtom	*Noturus gyrinus*	I	N/A	4	-
Bluntnose Minnow	*Pimephales notatus*	O	T	129	-
Central mudminnow	*Umbra limi*	I	T	23	-

** Non-native*
[1] according to ODNR, Division of Wildlife guide http://www.dnr.state.oh.us/tabid/17913/Default.aspx
[2] Feeding Guild: P - Piscivore, F - Filter Feeder, V - Invertivore, I - Specialist Insectivore, O - Omnivore, G - Generalist, H - Herbivore, C - Carnivore, N/A = Not assigned.
[3] Tolerance Guild: R - Rare Intolerant, S - Special Intolerant, I - Common Intolerant, M - Moderately Intolerant (Headwaters), T - Highly Tolerant, P - Moderately Tolerant, N/A = Not assigned.

Macroinvertebrates observed at this location is listed in Table 4-17.

Table 4-17 Macroinvertebrate Samples at Site SC-8 (Blue Creek)				
Elevated Taxa	Lowest Taxa	Common Name	Tolerance	Number Collected
Coleoptera	*Psephenus* sp.	aquatic beetle	4	1
Ephemeroptera	*Caenis* sp.	mayfly	7	3
Gastropoda	*Physa* sp.	snail	8	1
Gastropoda	*Helisoma*sp.	snail	6	3
Gastropoda	*Lymnaea* sp.	snail	6	2
Megaloptera	*Sialis* sp.	alderfly	4	1
Pelecypoda	Pelecypoda	clam	6 to 8	4
Odonata	*Enallagna* sp.	damselfly	8	3

SITE SC-8
NON-ISOLATED WETLAND RESTORATION

Stream Restoration/Enhancement Strategy

The following measures can be implemented to enhance the quality of the streams in this area:

- Carefully remove the accumulated sediment within the sampling reach on Blue Creek.
- Grade streambanks along the unnamed tributary stream to reduce slope and stabilize with herbaceous vegetation (see *Restoration/Enhancement of Historically Channelized Waterways in Sandy Soils* concept).
- Widen and enhance the wooded riparian buffer to 50 feet from the top of each bank for both Blue Creek and the unnamed tributary stream. Incorporate a 20-foot wide maintenance access track along one bank on Blue Creek and one bank on the tributary stream (see *Restoration/Enhancement of Riparian Buffers concept*).
- Remove the riprap from Blue Creek at the Fulton-Lucas Co. Road bridge and reinstall properly to keep the material from falling back into the stream.

Unnamed Tributary to Blue Creek, Upstream Sample Reach

The very low gradient of Blue Creek and its tributary, and the lack of sinuosity indicate little opportunity for full stream restoration through natural channel design to increase efficiency in moving sediments. Improvements in water quality are best effected by decreasing sediment and nutrient inputs from surrounding agricultural land uses (accomplished through wetland restoration); improving the width and quality of riparian buffers, and adopting best management practices (BMPs) for agricultural ditches to be implemented during periodic ditch maintenance. In addition, by repairing the rip rap at the downstream end of the reach, flow and sediment transport will be improved.

Up to 53.8 acres of non-isolated wetlands can be restored on this site. Restoration efforts can be accomplished in a series of smaller projects initially focused on the agricultural areas adjacent to the tributary stream. Depending on the amount of agricultural weeds presenting at the time restoration is initiated, a glyphosphate herbicide may be needed. After this application, some simple grading would be necessary prior to planting. This grading would create shallow hills and swales that would increase both floral and faunal diversity. Grading would then be followed by seeding of sedges and grasses that are adapted to this type of emergent community. A diverse

emergent seed mix can be placed in this marsh (see *Wetland Restoration/Enhancement on Sandy Soils* concept).

The existing wetland can be enhanced by improving the quality of the vegetation. Depending on the amount of agricultural weeds and/or invasive species present, a glyphosphate herbicide may be needed. Herbicide application would then be followed by seeding of sedges and grasses that are adapted to this type of emergent community. A diverse emergent seed mix can be placed in this marsh.

View of Blue Creek buffer community on right bank

Potential Stream Restoration Goals

Implementation of the measures described above will improve the quality of Blue Creek and the adjacent riparian habitat by:

- Removing accumulated sediments from Blue Creek;
- Re-grading and re-vegetating portions of the stream bank along Blue Creek;
- Widening the existing riparian buffer along the creek;
- Restoring up to 53.8 acres of non-isolated wetlands on the site; and
- Enhancing the existing wetland on the property.

These improvements should be reflected in:

- An increase in the QHEI of the Blue Creek by 3 to 5 points;
- An increase in the HHEI of the unnamed tributary by 3 to 5 points;
- An increase in the ORAM for the existing wetland on the site;
- An increase in flood retention in the area;
- A reduction in wind-caused soil erosion on the site;
- An increase in sediment transport in Blue Creek; and
- An improvement in the quality of fish and macroinvertebrate communities in Blue Creek.

SITE SC-8
NON-ISOLATED WETLAND RESTORATION

Preliminary Cost Estimate

The estimated cost to construct the proposed projects is summarized in Table 4-18. This project can be constructed in phases as funding opportunities become available.

Table 4-18
Estimated Cost Summary for Site SC-8

Project	Quantity	Unit	Unit Cost	Total Cost
Sediment Removal	1100	cubic yard	$10	$11,000
Streambank Slope Reduction/Stabilization	2400	linear foot	$25	$60,000
Riparian Buffers Enhancement	11.12	acre	$11,000	$122,320
Rip Rap Removal	50	cubic yard	$20	$1,000
Stream Maintenance	2400	linear foot	$5	$12,000
Wetland Enhancement	0.84	Acre	$3,000	$2,520
Wetland Restoration A - forested	17.69	acre	$16,000	$283,040
Wetland Restoration B - emergent	9.51	acre	$14,000	$133,140
Wetland Restoration C - forested	8.60	acre	$16,000	$137,600
Wetland Restoration D - forested	6.93	acre	$16,000	$110,880
Wetland Restoration E - forested	3.55	acre	$16,000	$56,800
Wetland Restoration F - emergent	4.08	acre	$14,000	$57,120
Wetland Restoration G - emergent	4.70	acre	$14,000	$65,800
Wildlife Enhancement	3.95	acre	$3,000	$11,850
Total Estimated Construction Cost				**$1,065,070**

SITE SC-8
NON-ISOLATED WETLAND RESTORATION

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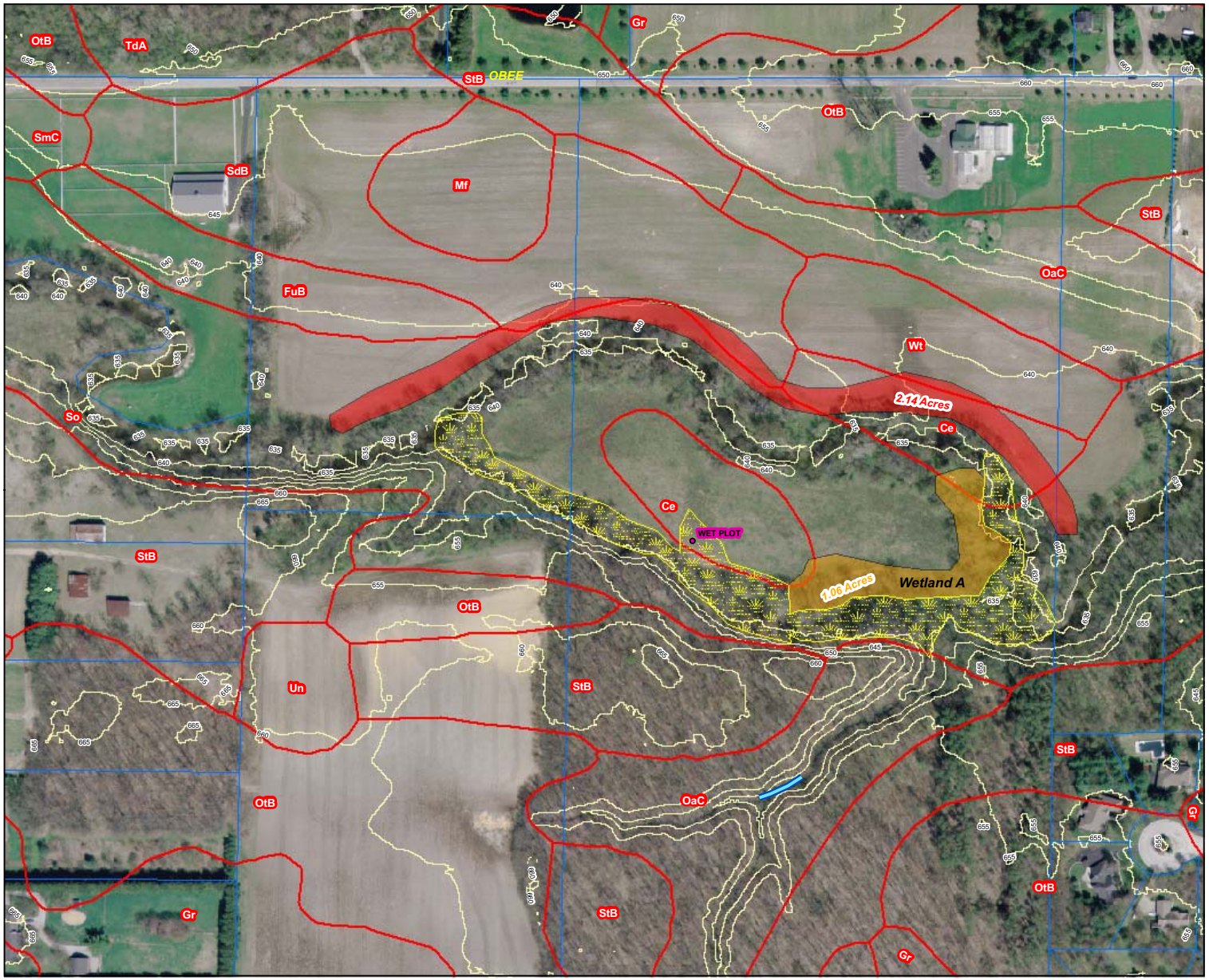
SITE SC-17



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

Prepared for:

Partners for Clean Streams, Inc.
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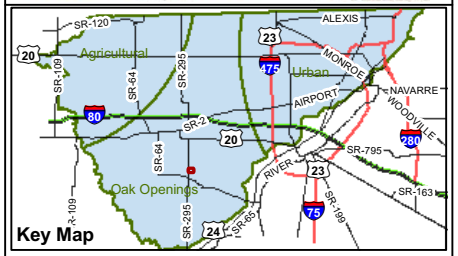
Bowling Green, Ohio 43402
www.PartnersForCleanStreams.org

Prepared by:

Mannik & Smith Group, Inc.

Hull & Associates, Inc.



Legend

- Sample Plot
- 2005 Soils Classification
- Parcel Line
- Existing Wetland
- QHEI
- HHEI
- 5' Contour

Proposed Wetland Enhancement

- Wildlife Enhancement
- Ditch Restoration
- Emergent
- Deep Water Emergent
- Floating-leaved Emergent
- Forested
- Riparian Buffer
- Trail/Access Road

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-11
Restoration/Enhancement Plan for SC-17
Waterville Township, Lucas County, Ohio

County Map of Ohio

0 100 200 400 Feet
1:2,400

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: P163A1A
File Name: P163A1A_LucasSites.mxd
Date: January 19, 2009

SITE SC-17
STREAM RESTORATION

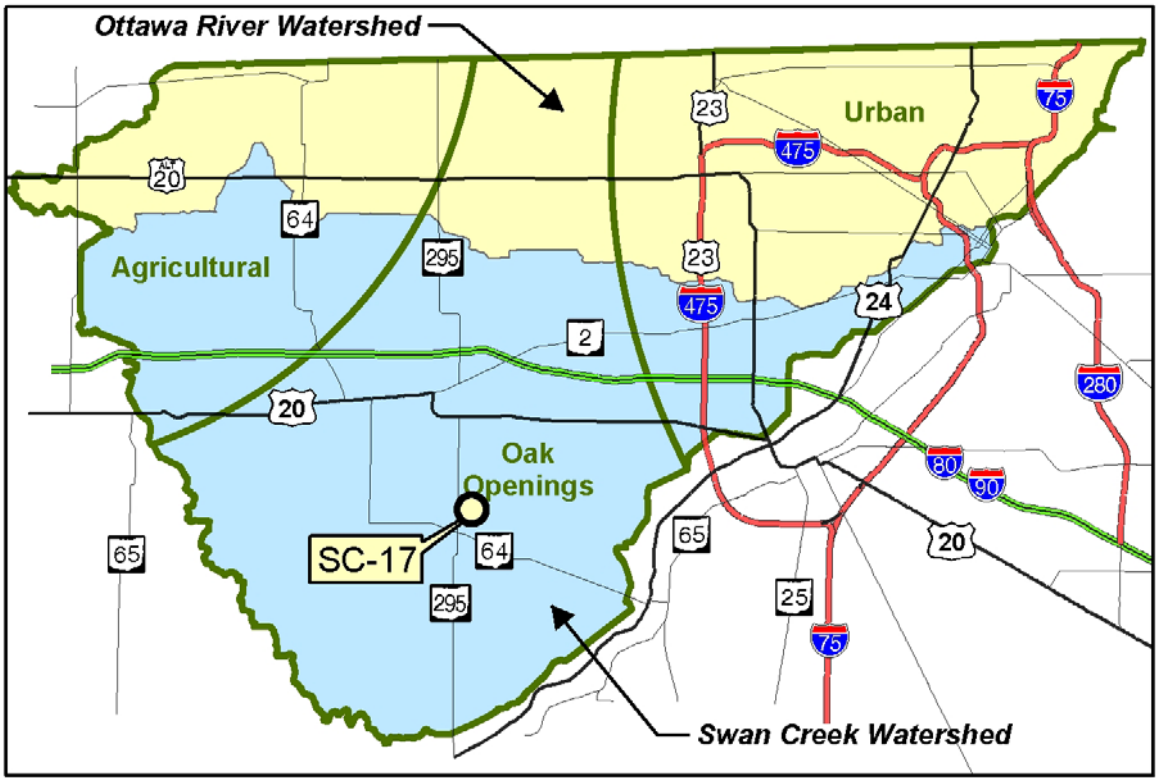
Oak Openings Subregion

Project Description:
Create 1.06 acres of palustrine wetland on hydric soil
Enhance 2.14 acres of open pastured wetland
Plan 1500 feet of riparian corridor

General Restoration/Enhancement Concept:
Wetland Restoration/Enhancement on Sandy Soils
Restoration/Enhancement of Riparian Buffers

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 68.7 sq. mi.
County: Lucas **Municipality**: Waterville Township **Location:** 83°49' 01.79"W 41°32' 10.46"N
Streams: Swan Creek; unnamed tributary to Swan Creek (HHEI = 48)
Watershed: Swan Creek HUC 0410000907 (Upper Swan Creek)
Wetland: SC-17-1 (palustrine forest/emergent/shrub) ORAM = 71
Stream buffers: Narrow, low to moderate (wooded) quality
Surrounding land use: Residential, row crops
Field-estimated gradient: 0.1% (0.1 feet per hundred feet), low



SITE SC-17 STREAM RESTORATION

Site Description

Site SC-17 is located approximately 0.2 mile east of S.R. 295 at 11455 Obee Road in Waterville Township, Lucas County (Figure 4-11). The 60-acre site occupies portions of three parcels that can be divided into several areas that include an active agricultural field, the riparian floodplain of Swan Creek, and an oak-dominated woodland that contains a small headwater stream. Swan Creek flows though the property from west to east. The site overlaps Priority Development and Priority Conservation Areas, as identified by the Swan Creek Technical Advisory Committee.

Small headwater stream that flows into Wetland 17-1

Existing Site Conditions

One existing wetland (SC-17-and two riparian waterways exist on this site. Soils in this wetland are comprised of hydric Sloan silt loam (So). Several other soil types also exist on the site. These include Ceresco sandy loam, occasional flooded (Ce), Ottokee fine sand, 0 to 6 percent slopes (OtB), Spinks fine sand, 2 to 6 percent slopes (StB), Wauseon fine sandy loam (Wt) and Oakville fine sand, 6 to 18 percent slopes (OaC) (Stone *et al.*, 1980).

The woodland headwater, which flows into wetland SC-17-1 and then into Swan Creek, attained an HHEI score of 48. This moderately high score was influenced by the width of the channel and moderate pool depth.

Wetland SC-17-1 is a 2.7-acre forested-emergent-shrub system that resides within the floodplain of Swan Creek. This wetland is open with very little shrub cover. Dominant plants include lakebank sedge (*Carex lacustris*), rice cut grass (*Leersia oryzoides*), sedge (*Carex stipata*) and giant ragweed (*Ambrosia trifida*) in the emergent wetland portion. This wetland also contained a buttonbush (*Cephalanthus occidentalis*) shrub swamp with whorled dock (*Rumex verticllata*), sensitive fern (*Onoclea sensilbilis*) and blue iris (*Iris virginica*) and a backwater pin oak (*Quercus palustris*) forested floodplain. Soils in the wetland consist of approximately twelve inches of black (10 YR 2/1) sandy clay loam underlain by at least fourteen inches of dark gray (10YR 4/1) clay loam with yellowish brown (10YR 5/6) and dark brown (10YR 3/3) mottles. Positive indicators of wetland hydrology included water-stained leaves, sediment deposits and a positive FAC-neutral test. The ORAM score for this wetland was 71, which correlates to a

Category 3 wetland. This high score can be attributed to the presence of several vegetation communities, wide buffers, low intensity of land use and lack of modifications to the hydrology of the wetland.

Fish species observed at this location are listed in Table 4-19.

Table 4-19
Fish Samples at Site SC-17 (Swan Creek)

Common Name[1]	Species[1]	Feed Guild[2]	Tol.[3]	# of Fish	Avg. Wt. (grams)
Rock Bass	*Ambloplites rupestris*	C	N/A	5	37.50
White Sucker	*Campostoma anomalum*	O	T	36	56.40
Goldfish*	*Carassius auratus*	O	T	1	1999.20
Grass Pickerel	*Esox americanus*	P	P	5	1775.00
Rainbow Darter	*Etheostoma caeruleum*	I	M	4	6.25
Johnny Darter	*Etheostoma nigrum*	I	N/A	13	1.0
Green Sunfish	*Lepomis cyanellus*	I	T	8	36.70
Green x Bluegill Sunfish	*Lepomis cyanellus* x *gibbosus*	N/A	N/A	3	7.5
Bluegill Sunfish	*Lepomis macrochirus*	I	P	5	10.00
Largemouth Bass	*Micropterus salmoides salmoides*	C	M	2	64.10
Spotted Sucker	*Minytrema melanops*	I	N/A	7	75.90
Common Shiner	*Notropis cornutus*	I	N/A	37	6.70
Spotfin Shiner	*Notropis spilopterus*	I	N/A	2	10.00
Blackside Darter	*Percina maculata*	I	M	10	3.10
Bluntnose Minnow	*Pimephales notatus*	O	T	17	1650.0
Creek Chub	*Semotilus atromaculatus*	G	T	40	29.5

** Non-native*
[1] according to ODNR, Division of Wildlife guide http://www.dnr.state.oh.us/tabid/17913/Default.aspx
[2] Feeding Guild: P - Piscivore, F - Filter Feeder, V - Invertivore, I - Specialist Insectivore, O - Omnivore, G - Generalist, H - Herbivore, C - Carnivore, N/A = Not assigned.
[3] Tolerance Guild: R - Rare Intolerant, S - Special Intolerant, I - Common Intolerant, M - Moderately Intolerant (Headwaters), T - Highly Tolerant, P - Moderately Tolerant, N/A = Not Assigned.

Macroinvertebrates observed at this location are listed in Table 4-20.

Table 4-20
Macroinvertebrate Samples at Site SC-17 (Swan Creek)

Elevated Taxa	Lowest Taxa	Common Name	Tolerance	Number Collected
Crustacea	*Asellus* sp.	isopod	8	10
Diptera	Unknown	fly larvae	-	1
Ephemeroptera	Hydropysche	mayfly	-	1
Ephemeroptera	*Caenis* sp.	mayfly	7	2
Gastropoda	*Lymnaea* sp.	snail	6	6
Odonata	*Enallagna* sp.	damselfly	8	1

SITE SC-17
STREAM RESTORATION

Recommended Restoration/ Enhancement Strategy

Wetland SC-17-1 can be expanded to enlarge the existing Category 3 wetland that already exists on site. As shown on the attached figure, the proposed plan is to convert approximately 1.1 acre of currently existing upland to palustrine emergent wetland habitat, in accordance with the general guidelines that have been presented for the *Wetland Restoration/Enhancement on Sandy Soils* concept.

Upland forest

The existing stream channel of Swan Creek can also be improved by restoring the riparian buffer along approximately 1,500 feet of the north bank (see *Restoration/ Enhancement of Riparian Buffers* concept). A 50-foot wide linear corridor of deciduous trees and shrubs can be planted, resulting in the addition of 2.14 acres of woody riparian corridor to the watershed. Planting this area with woody species will expand the buffer along the creek, decrease runoff and siltation and promote shading of the stream. Planting a variety of native plants along the stream corridor will also increase the diversity of the site and improve wildlife habitat. It is expected that species such as American elm (*Ulmus americana*), eastern cottonwood (*Populus deltoides*), hackberry (Celtis *occidentalis*) and several species of dogwoods (*Cornus* spp.) and willows (*Salix* spp.) will become established naturally as well.

Small headwater stream that flows into Wetland 17-1

In-stream work is also recommended to remove large logs/log jams that divert the water flow into eroding banks. Also, installation of a variety of structures that change the water flow and direction to create a larger variety of habitats for different fish and macroinvertebrate populations is also recommended. Such structures may include locked logs, locked limbs, rootways, bendway wiers, hydraulic cover stones, and thalwag control stones.

Potential Restoration Goals

Implementation of the measures described above will improve the quality of Swan Creek and adjacent riparian habitat by:

- Expanding Wetland SC-17-1;
- Restoring the riparian buffer along 1,500 feet of the north bank of Swan Creek; and
- Removing large log jams from the creek and installing in-stream structures at key locations to improve in-stream cover for fish.

These improvements should be reflected in:

- An increase in the QHEI of the Swan Creek by 3 to 5 points; and
- An improvement in the quality of fish and macroinvertebrate communities in Swan Creek.

Preliminary Cost Estimate

The estimated cost to construct all three of the proposed projects (1500-foot buffer enhancement, 1500-foot in-stream restoration and wetland restoration) would be approximately $76,000. This project can easily be constructed in phases as funding opportunities become available. A summary of the estimated costs for this site are provided in Table 4-21.

Table 4-21
Estimated Cost Summary for Site SC-17

Project	Quantity	Unit	Unit Cost	Total Cost
Swan Creek Instream Restoration	1500	linear foot	$25	$37,500
Swan Creek Buffer Restoration	2.14	acre	$11,000	$23,540
Wetland Restoration Wetland A	1.06	acre	$14,000	$14,840
Total Estimated Construction Cost				**$75,880**

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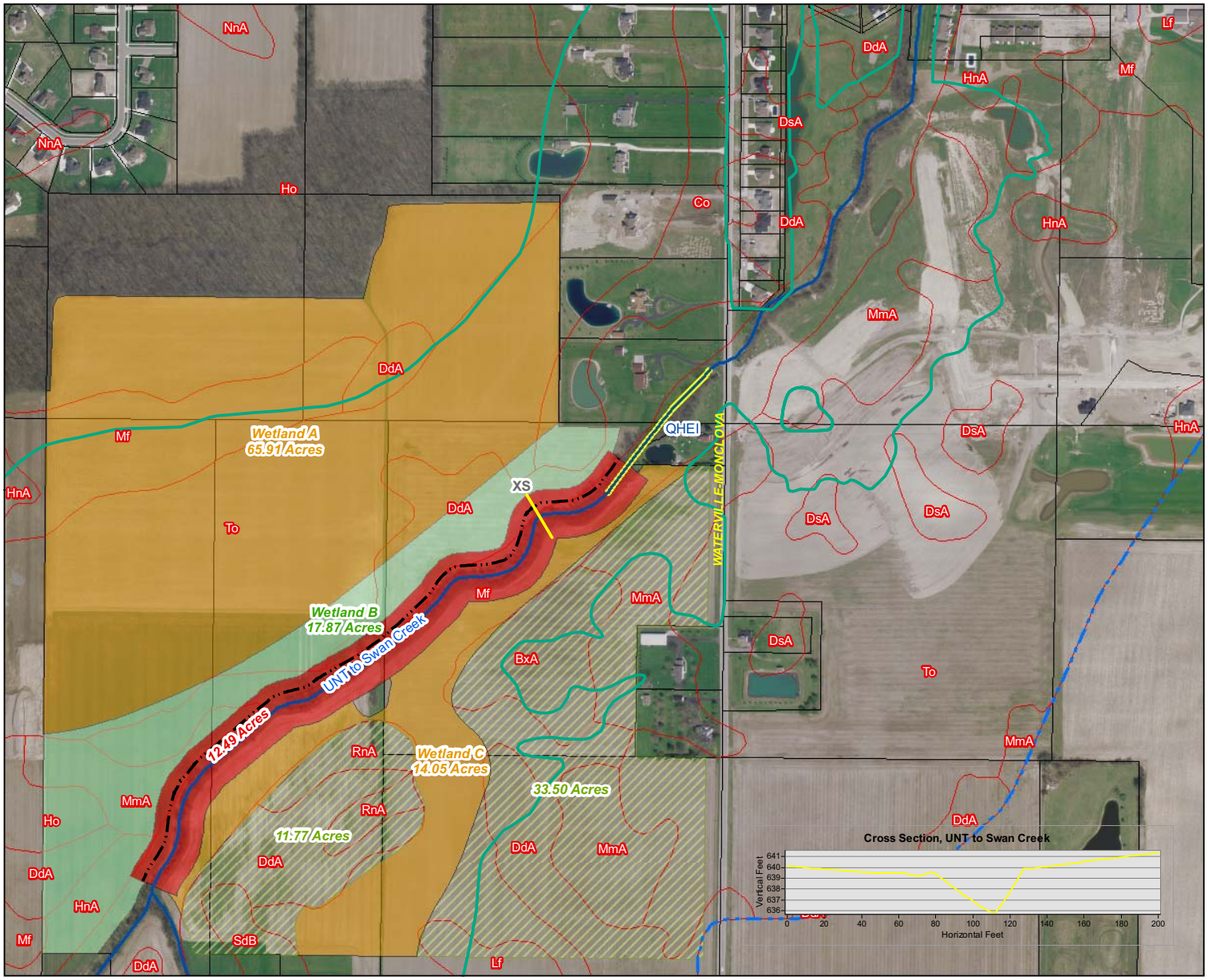
SITE SC-20



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

Prepared for:

Partners for Clean Streams

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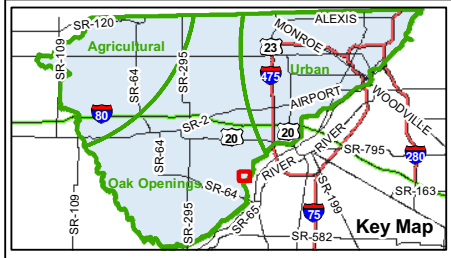


Legend

- Project Boundary
- Parcels
- Existing Wetlands
- Wetland Restoration Areas
  - Wildlife Enhancement
  - Ditch/Linear Wetland Restoration
  - Emergent Zone
  - Deep Water Emergent Zone
  - Floating-leaved Bed Zone
  - Forested Zone
  - Riparian Buffer Zone
- 100 year Floodplain
- 2005 Soil Classification
- Cross Section Line
- Access Road/Trail
- Streams
  - QHEI
  - HHEI
  - Severe Bank Erosion
- Ohio Rivers and Streams
  - Streams
  - Intermittent Stream

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-12
Restoration/Enhancement Plan for SC-20
Waterville Township, Lucas County, Ohio

County Map of Ohio

0 200 400 800 Feet

1:4,800

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: DAO002
File Name: DAO002_Concept2_Fig4-12_SiteSC-20.mxd
Date: March, 2009

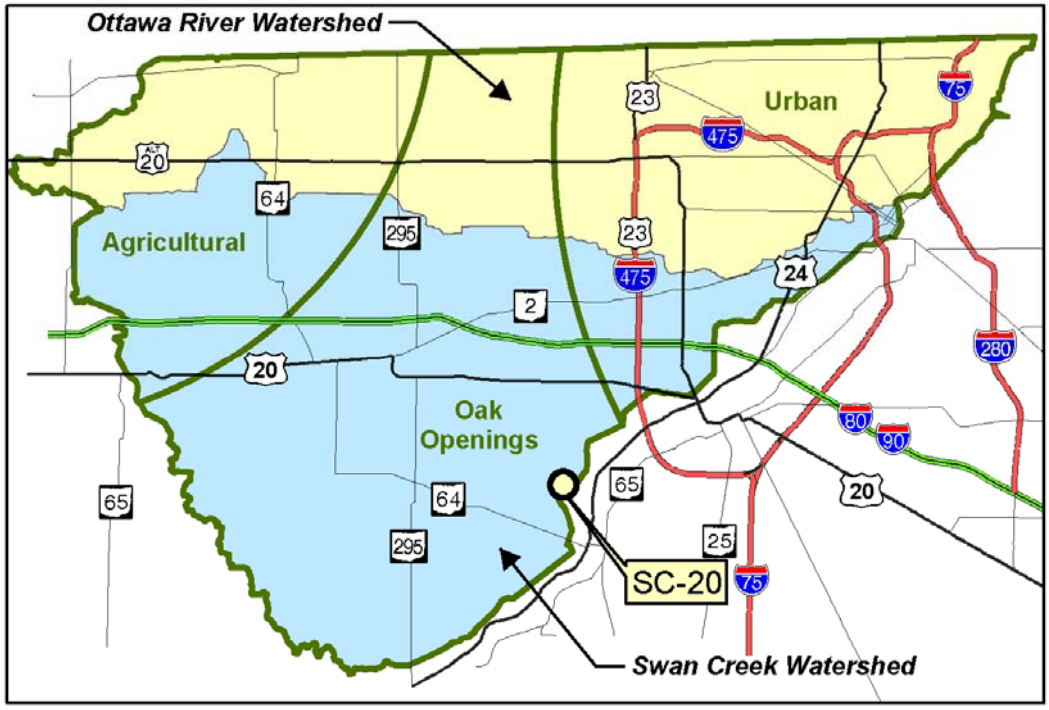
SITE SC-20
STREAM RESTORATION

Project Description:
Restore 2500 linear feet of easting stream channel
Restore up to 80 acres of emergent wetland
Restore up to 18 acres of forested wetland
Plant 12.49 acres of wooded riparian corridor
Enhance 45.27 acres of upland buffer

General Restoration/Enhancement Concept:
Restoration/Enhancement of Large Streams
Restoration/Enhancement of Riparian Buffers
Wetland Restoration/Enhancement on Sandy Soils

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 5.62 sq. mi.
County: Lucas **Municipality**: Monclova Township **Location:** 83°44' 17.78"N 41°31' 37.74"N
Streams: Unnamed Tributary to Swan Creek
Watershed: Swan Creek HUC 0410000908 (Lower Swan Creek)
Wetland: None
Stream buffers: None
Surrounding land use: Row crop agriculture
Field-estimated gradient: 0.1%



SITE SC-20 STREAM RESTORATION

Site Description

The site consists of portions of six agricultural parcels comprising 200.12 acres, located west of Waterville-Monclova Road in Monclova Township, Lucas County, Ohio (Figure 4-12). The site overlaps with Priority Development and Priority Agricultural Areas as identified by the Swan Creek Technical Advisory Committee. This site is also adjacent to Priority Agricultural, Priority Conservation and Priority Development Areas.

Unnamed Tributary to Swan Creek, facing upstream

Existing Site Conditions

The unnamed tributary to Swan Creek is a low-gradient stream with significant agricultural tile influence; however, this stream has a large watershed and its hydrology and channel formation processes are driven by bankfull (not benchfull) flows. Row crops abut the edge of low-quality, very narrow (averaging <5m) riparian areas on each bank. Gradient/stream power is insufficient to move silt and sand substrates, and small sediment deposits were observed. Resulting substrates in riffles are unstable and dominated by fine gravel and sand with moderate embeddedness. Habitat features within the stream are of poor to fair quality. At the time of evaluation, isolated pools dominated the stream pattern, but the depth of the pools is not sufficient to support predatory fish species. These pools are often

Unnamed Tributary to Swan Creek, facing downstream; rock dam visible

shaded, providing fish refuge. The most noticeable influence on habitat quality on the evaluated reach was a low rock dam, presumably built by a nearby homeowner in order to fill a pond. The QHEI score for the unnamed tributary to Swan Creek was 39.5. Instream cover and buffer width/quality were low, but higher than is typical for this type of stream.

A generalized channel cross-section (XS) for the unnamed tributary to Swan Creek is depicted as an inset on Figure 4-12. The cross-section was developed using the Digital Elevation Model (DEM) for Lucas County, Ohio. The generalized cross section shows the channel with its adjoining terraces (abandoned floodplains) on each bank, but the DEM is not sensitive enough to map active floodplain or provide detailed features of the channel such as bankfull features. The overall channel width (terrace to terrace) is about 45 feet, and the channel depth below the terraces is about 4 feet.

There are no existing wetlands at Site 20. The majority of the soils are mapped as Toledo silty clay (To), Mermill loam (Mf), and Hoytville clay loam (Ho), all hydric soils. There are also several "pockets" of non-hydric sandy soils including Metamora sand loam, 0-3% slopes (MmA) which may contain unmapped inclusions of hydric Mermill loam and Rimer loamy fine sand, 0-3% slopes (RnA) which may contain unmapped inclusions of hydric Wauseon fine sandy loam (Wt).

Existing buffer community

Stream and Wetland Restoration Strategy

The following measures can be implemented to restore the stream at this site:

- Perform fluvial hydrogeomorphic survey and restore stable stream channel, dimension and profile using the techniques described in the *Restoration/Enhancement of Large Streams* concept.
- Widen the wooded riparian buffer to 50 feet from the top of each bank, and incorporate 20-foot wide maintenance access track along left bank (see *Restoration/Enhancement of Riparian Buffers* concept).

Improvements in water quality can also be achieved by decreasing stormwater peak flow inputs and taking steps to decrease sediment and nutrient inputs from surrounding agricultural land uses.

SITE SC-20
STREAM RESTORATION

Up to 143.1 acres of non-isolated wetland can be restored on this site. Restoration efforts could be accomplished via a series of smaller projects initially focused on the areas closest to the UNT to Swan Creek. Depending on the amount of agricultural weeds present at the time restoration is initiated, application of a glyphosphate herbicide may be warranted. After this application, simple grading would be necessary prior to planting. This grading would create shallow hills and swales that would increase both floral and faunal diversity. Grading would then be followed by seeding of sedges and grasses that are adapted to this type of emergent community. A diverse emergent seed mix can be placed on the site (see *Wetland Restoration/Enhancement on Sandy Soils* concept).

Potential Stream Enhancement and Wetland Restoration Goals

Implementation of the measures described above will improve the quality of the unnamed tributary to Swan Creek and the adjacent riparian habitat by:

- Widening the wood riparian buffer along each side of the stream; and
- Restoring up to 143.5 acres of high quality wetlands on the site.

These improvements should be reflected in:

- An increase in the QHEI of the unnamed tributary by 10 to 14 points;
- An increase in the Index of Biotic Integrity (IBI - fish community index) by 3 to 6 points;
- A reduction in wind-caused soil erosion and runoff into the creek; and
- An improvement in the quality of the macroinvertebrate communities in the unnamed tributary.

The wetland restoration sites would restore the wetlands from assumed Category 1 farmed and drained wetlands to Category 2 or 3 wetlands. Restoration would benefit surface water quality in the receiving stream by slowing surface flow and containing sediments from surrounding areas before it discharges to the stream. In addition, restored upland areas would provide habitat for ground nesting bird species and increase use of the wetlands by waterfowl, songbird and other wildlife species. The presence of perennially vegetated wetlands and upland areas would also reduce wind-caused soil erosion and runoff to the creek.

Preliminary Cost Estimate

The estimated cost to construct the proposed projects is summarized in Table 4-22. This project can be constructed in phases as funding opportunities become available.

SITE SC-20
STREAM RESTORATION

Table 4-22 Estimated Cost Summary for Site SC-20				
Project	Quantity	Unit	Unit Cost	Total Cost
Natural Channel Restoration	2500	linear foot	$275	$687,500
Riparian Buffer Enhancement	12.49	acre	$11,000	$137,390
Wildlife Enhancement (upland)	45.27	acre	$3,000	$135,810
Annual Maintenance (natural channel)	2500	linear foot	$2	$5,000
Wetland Restoration Wetland A - emergent	65.91	acre	$14,000	$922,740
Wetland Restoration Wetland B - forested	17.87	Acre	$16,000	$285,920
Wetland Restoration Wetland C - emergent	14.05	Acre	$14,000	$196,700
Total Estimated Construction Cost				**$2,371,060**

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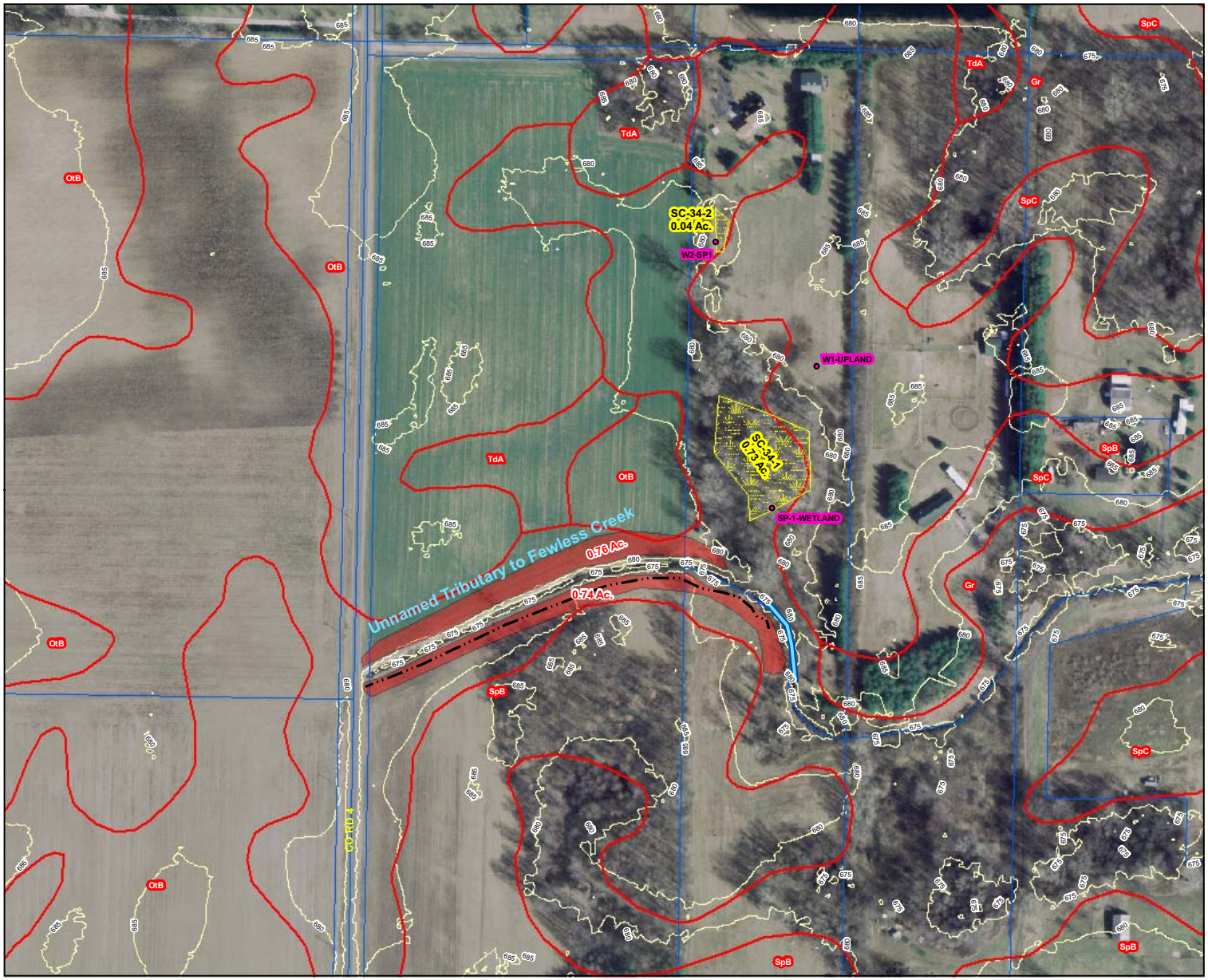
SITE SC-34



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

Prepared for:

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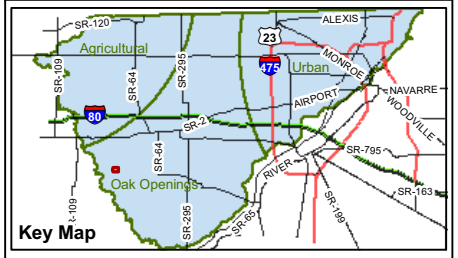


Legend

- Sample Plot
- 2005 Soils Classification
- Existing Wetland
- Parcel Line
- QHEI
- HHEI
- 5' Contour

Proposed Wetland Enhancement

- Wildlife Restoration
- Ditch Restoration
- Emergent
- Deep Water Emergent
- Floating-leaved Bed
- Forested
- Riparian Buffer
- OutFlow Structure
- Trail/Access Road

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-13
Restoration/Enhancement Plan for SC-34
Swan Creek Township, Fulton County, Ohio

County Map of Ohio

0 100 200 400 Feet

1:2,400

NOTES:
The Fulton County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: P163A1A
File Name: P163A1A_FultonSites.mxd
Date: February 19, 2009

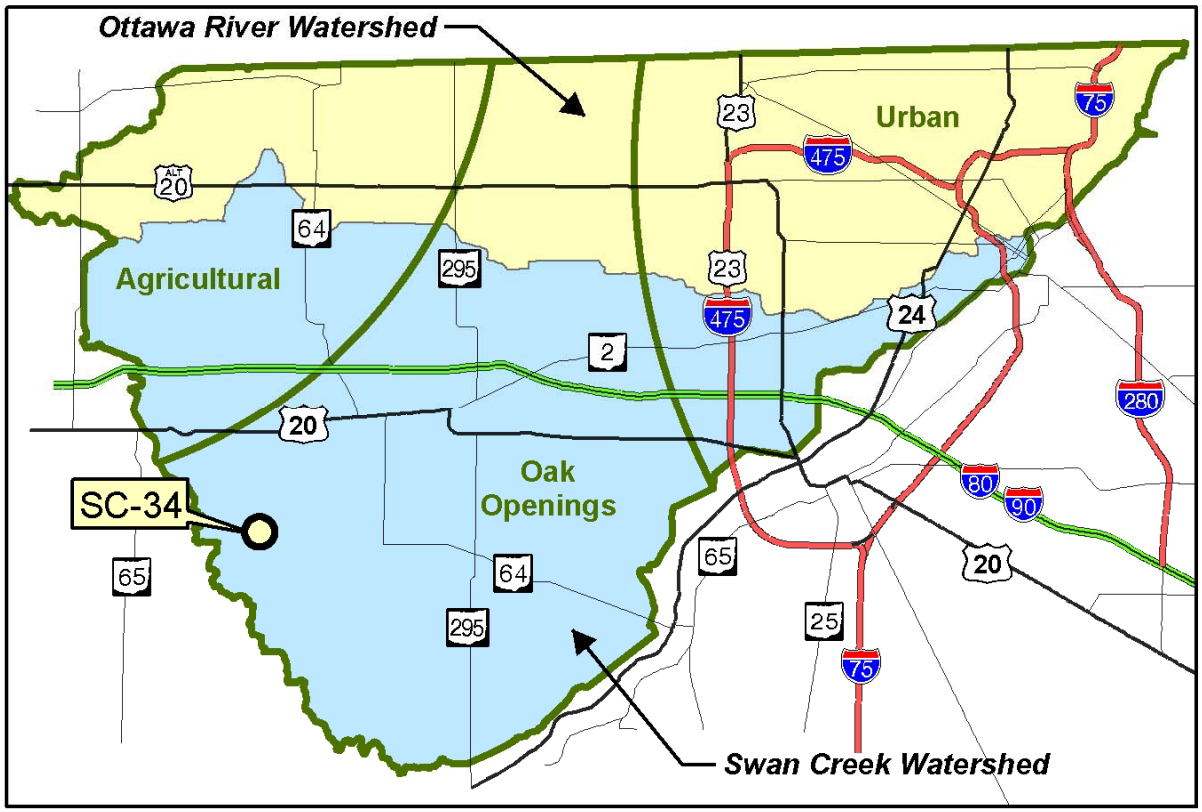
SITE SC-34
NON-ISOLATED WETLAND RESTORATION

Project Description:
Restore 900 feet of riparian corridor

General Restoration/Enhancement Concept:
Restoration/Enhancement of Riparian Buffers

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 0.13 sq. mi.
County: Fulton **Municipality**: Swan Creek Township **Location:** 83°56' 21.66"W 41°32' 04.27"N
Stream: Unnamed Tributary (HHEI = 46)
Watershed: Swan Creek HUC 0410000907 (Upper Swan Creek)
Wetlands: SC-34-1 (palustrine forest) ORAM = 49.5; SC-34-2 (palustrine emergent) ORAM = 33
Stream buffers: Narrow, low to moderate (wooded) quality
Surrounding land use: Residential, row crops
Field-estimated gradient: 0.1% (0.1 feet per hundred feet), low



SITE SC-34
NON-ISOLATED WETLAND RESTORATION

Site Description

The site, which is located east of County Road 4 in Swan Creek Township, Fulton County (Figure 4-13). This site overlaps a Priority Conservation Area, as identified by the Swan Creek Technical Advisory Committee.

Existing Site Conditions

Two existing wetlands exist on the site. Wetland SC-34-1 is a small (0.73 acre) forested wetland just north of an unnamed tributary. Wetland SC-34-2 is a smaller (0.04 acre) palustrine emergent wetland that is located along a maintained tree lawn of the residence. Both wetlands are located on hydric Granby loamy find sand. Other soils types present include Ottokee fine sand, 0 to 6 percent slopes (OtB) and Tedrow (TdA) fine sand, 0 to 3 percent slopes (USDA, 1984). These two soils are non-hydric, but may contain inclusions of hydric soils in drainage ways and low spots. This site is on the western edge of the Oak Openings Region.

The unnamed tributary attained an HHEI score of 46, due to the presence of a relatively wide channel, sandy substrate and moderate pool depth. The tributary also has steep sandy side slopes and narrow to non-existent buffers. This has caused moderate erosion along the banks.

Wetland SC-34-2

Unnamed tributary to Fewless Creek; start of HHEI

SITE SC-34
NON-ISOLATED WETLAND RESTORATION

Two small wetlands were identified on the site. Wetland SC-34-1 is a small (0.73 acre) palustrine forested depressional wetland within a larger forest just north of an unnamed tributary. This wetland has an open understory with very little shrub cover. Dominant plants include false nettle (*Boehmeria cylindrica*), jewelweed (*Impatiens capensis*), and poison-ivy (*Toxicodendron radicans*) in the understory and box-elder (*Acer negundo*), eastern cottonwood (*Populus deltoides*) and red maple (*Acer rubrum*) in the overstory. Soils consist of twelve inches of black (10 YR 2/1) sandy loam underlain by at least two inches of dark gray (10YR 4/1) loamy sand with yellowish brown (10YR 5/8) mottles. Positive indicators of wetland hydrology include the presence of water-stained leaves, watermarks up to ten inches high and buttressed tree trunks.

Wetland SC-34-2 is a very small (0.04 acre) palustrine emergent wetland located along a maintained tree lawn of the residence. Dominant plants include umbrella-sedge (*Cyperus strigosus*), lady's-thumb (*Polygonum persicaria*), common rush (*Juncus effusus*), Indian hemp (*Apocynum cannabinum*) and crab grass (*Digitaria ischaemum*). Positive indicators of wetland hydrology included the presence of water-stained leaves and visible sediment deposits. The ORAM score for this wetland was 33, which correlates to the gray zone between a Category 1 and 2 wetland. This would be a low quality wetland based on its size and vegetation community.

Recommended Restoration/Enhancement Strategy

Although the GIS predictive model characterized Site SC-34 as a Non-Isolated Wetland Restoration site, the result of field studies indicate that no wetland restoration opportunities exist at the this location. Instead, the site is limited to riparian buffer restoration/enhancement, in accordance with the *Restoration/Enhancement of Riparian Buffers* concept that is included within this report.

Riparian buffer restoration is recommended along approximately 900 feet of both sides of the unnamed tributary. PCS recommends that prior to planting, both banks be regraded to create more gradual sideslopes along the stream channel. After grading, the banks should be planted with native herbaceous and woody species. Once established, the vegetation will inhibit erosion and siltation of the stream. In addition to the vegetation that will be planted on the site, it is reasonable to expect that some species, such as American elm (*Ulmus americana*), eastern cottonwood (*Populus deltoides*), dogwoods (*Cornus* spp.) and willows (*Salix* spp.) will come in naturally.

Potential Restoration Goals

Implementation of the measures described above will improve the quality of the unnamed tributary to Swan Creek and the adjacent riparian habitat by widening the woody riparian buffer along 900 feet of the stream.

These improvements should be reflected in an increase in the HHEI of the unnamed tributary by 3 to 5 points.

SITE SC-34
NON-ISOLATED WETLAND RESTORATION

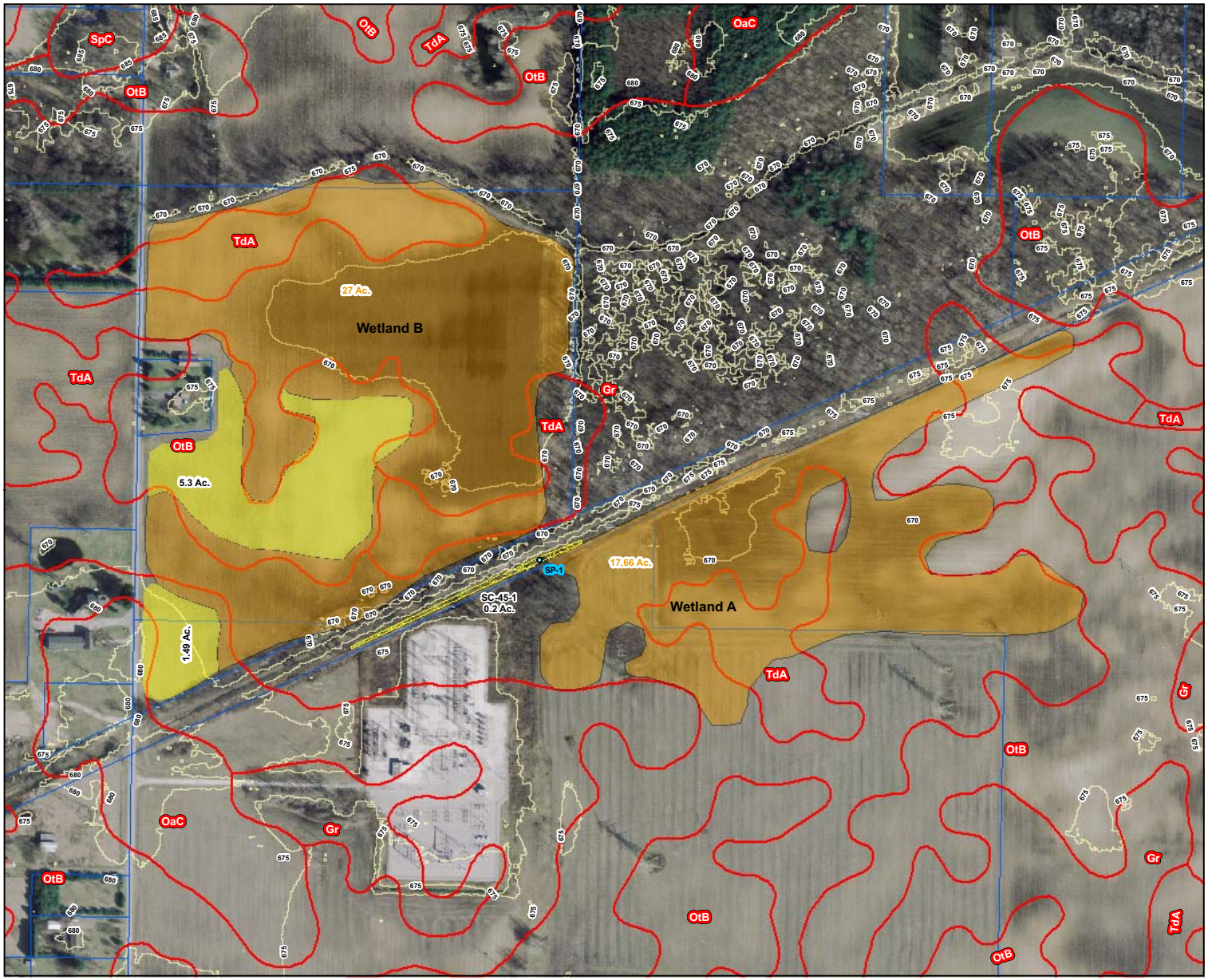
Preliminary Cost Estimate

The cost to restore the riparian corridor along the unnamed tributary is estimated to be approximately $22,500. A summary of the estimated costs for this site is provided in Table 4-23.

Table 4-23
Estimated Cost Summary for Site SC-34

Project	Quantity	Unit	Unit Cost	Total Cost
Unnamed Tributary to Fewless Creek Enhancement	900	linear foot	$25	$22,500
			Total Estimated Construction Cost	$22,500

SITE SC-45



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

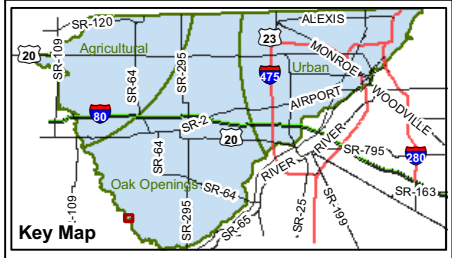
Prepared for:

Partners for Clean Streams, Inc.
P.O. Box 822
Bowling Green, Ohio 43402
www.PartnersForCleanStreams.org

Prepared by:

Mannik & Smith Group, Inc.

Hull & Associates, Inc.



Legend

- Sample Plot
- Existing Wetlands
- 2005 Soils Classification
- Parcel Line
- QHEI
- HHEI
- 5' Contour

Proposed Wetland Enhancement

- Wildlife Restoration
- Ditch Restoration
- Emergent
- Deep Water Emergent
- Floating-leaved Bed
- Forested
- Riparian Buffer
- Trail/Access Road

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-14
Restoration/Enhancement Plan for SC-45 Washington Township, Henry County, Ohio

County Map of Ohio

0 150 300 600 Feet

1:3,600

NOTES:
The Henry County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: P163A1A
File Name: P163A1A_HenrySites.mxd
Date: January 19, 2009

SITE SC-45
ISOLATED WETLAND RESTORATION

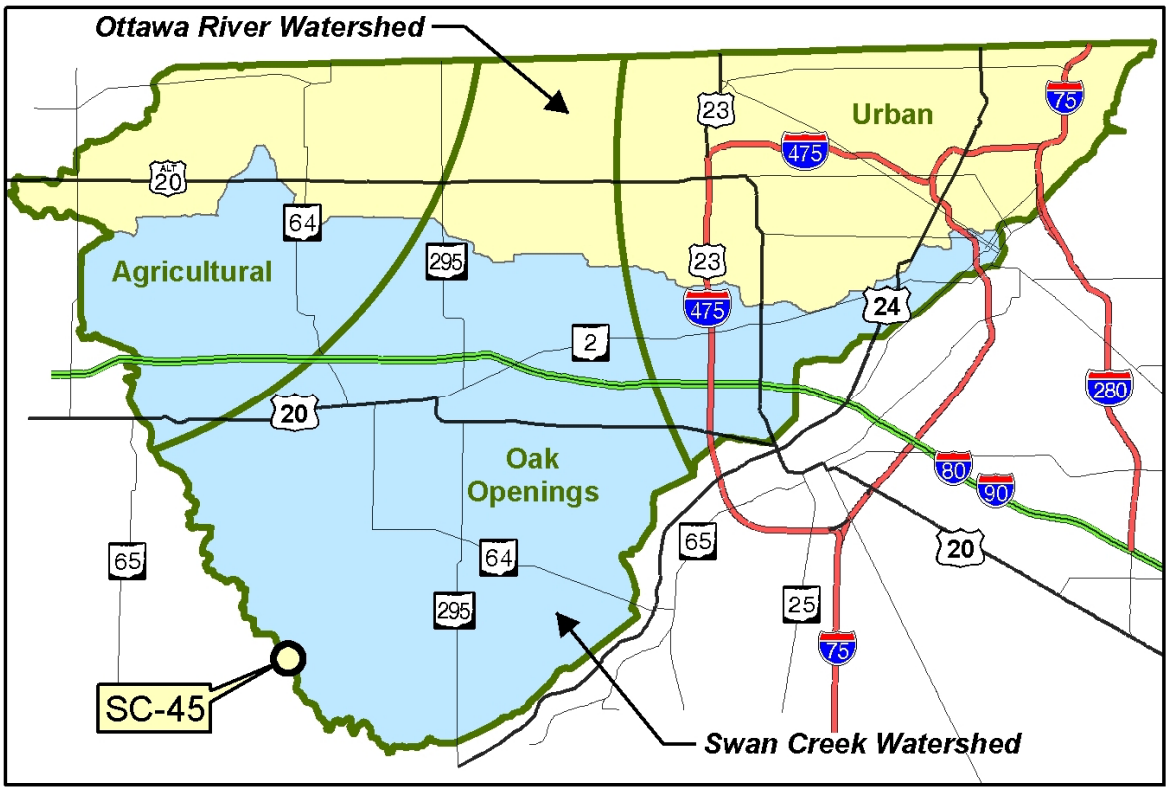
Oak Openings Subregion

Project Description:
Restore 44.66 acres of palustrine wetland on hydric soil
Enhance 6.79 acres of upland buffer

General Restoration/Enhancement Concept:
Wetland Restoration/Enhancement on Sandy Soils Concept

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: NA
County: Henry **Municipality**: Washington Township **Location:** 83°55' 01.29"W 41°28' 39.19"N
Stream: None
Watershed: Swan Creek HUC 041000908 (Lower Swan Creek)
Wetland: SC-45-1 (palustrine emergent); ORAM 53.5
Stream buffers: NA
Surrounding land use: Row crop, and Maumee State Forest to the north and east
Field-estimated gradient: 0.1% (0.1 feet per hundred feet), low



SITE SC-45
ISOLATED WETLAND RESTORATION

Site Description

This site is located along an abandoned railroad track that is presently part of the rails to trails path, just east of Henry County Road 3, in Washington Township (Figure 4-14). The northern portion of the site is bordered along the east side by the Maumee State Forest. The southern edge of the abandoned railroad is bordered by a small vegetated ditch. South of this vegetated swale are several large agricultural fields. Site SC-45 overlaps a Priority Conservation Areas as identified by the Swan Creek Technical Advisory Committee.

Wetland swale in foreground with substation in background

Existing Site Conditions

The majority of existing soils on the site are mapped as hydric Granby loamy fine sandy (Gr). Other soils types present include Ottokee fine sand, 0 to 6 percent slopes (OtB) and Tedrow (TdA) fine sand, 0 to 3 percent slopes. These latter two soils are listed as non-hydric but are known to contain hydric inclusions along drainage ways and in depressions. This site lies within the Oak Openings Region.

One small wetland swale (Wetland SC-45-1) exists on the property. This is a fully vegetated drainage ditch that runs along the south side of the existing railroad track that crosses the site. This wetland is dominated by Sartwell's sedge (*Carex sartwellii*), fox sedge (*Carex vulpinoidea*), sandbar willow (*Salix exigua*) and bulrush (*Scirpus atrovirens*). Positive indicators of wetland hydrology included wetland drainage patterns, inundation with up to 1 inch of water, the presence of water-stained leaves, a positive FAC-neutral test, local soil survey data and sediment deposits. Wetland 45-1 had black (10YR 2/1) sandy loam soils. The ORAM score for this wetland was a 53.5, which correlates to a Category 2 Wetland.

Recommended Restoration/Enhancement Strategy

As proposed, as much as 39 acres of palustrine, Oak Openings wetland can be restored on the three properties that abut the abandoned railroad tracks (Figure 4-14). Both potential wetland restoration areas are currently actively farmed agricultural lands that are on hydric soils. Restoring wetlands on these sites would extend the already protected wetlands found in the Maumee State Forest, as well as those found along the abandoned railroad bed. Due to the

presence of agricultural weeds on the site, a non-species specific herbicide, such as a glyphosate, should be applied to the site prior to minor grading activities. Some grading of the site is recommended to create small depressions and ridges, which will to increase microtopography. Due the species present in nearby wetlands, a supplemental seed mix may not be needed to vegetate the site. The presence of purple loosestrife and some reed canary grass is a concern. These species should be treated with the non-specific glyphosate (see *Wetland Restoration/ Enhancement on Sandy Soils* concept).

Agricultural field of Area 45-B facing south toward Rails to trails

Potential Restoration Goals

Implementation of the measures described above will result in the restoration of up to 45 acres of high quality, Category 2 or 3 wetlands on the site. This would increase and extend the high quality wetland found adjacent to the Maumee State Forest. The presence of perennially vegetated wetlands would also reduce wind-caused soil erosion.

Preliminary Cost Estimate

The estimated cost to construct the wetland restoration projects would be approximately $646,000 depending primarily on the number of phases of the project that would be undertaken. The project can easily be constructed in phases as funding opportunities become available. A summary of the estimated costs for this site are provided in Table 4-24.

Table 4-24
Estimated Cost Summary for Site SC-45

Project	Quantity	Unit	Unit Cost	Total Cost
Wetland Restoration: Site SC-45-A	17.66	acre	$14,000	$247,240
Wetland Restoration: Site SC-45-B	27.00	acre	$14,000	$378,000
Wildlife Enhancement (upland)	6.79	acre	$3,000	$20,370
Total Estimated Construction Cost				**$645,610**

SITE SC-45
ISOLATED WETLAND RESTORATION

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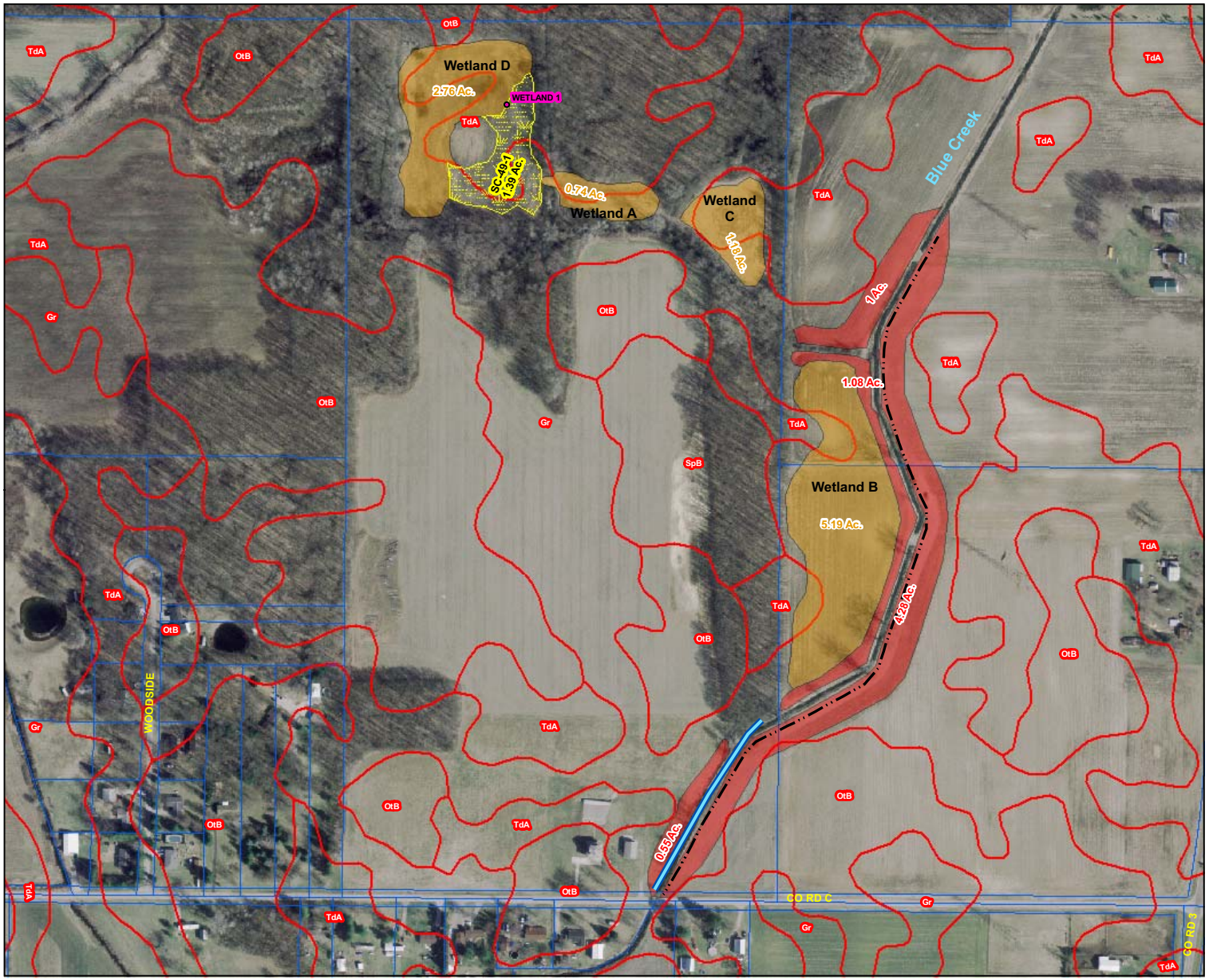
SITE SC-49



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

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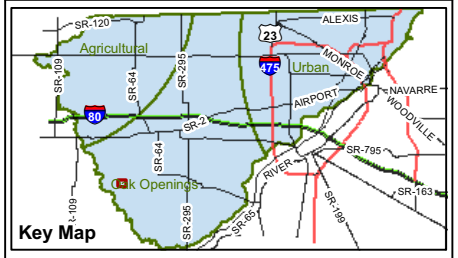


Legend

- Sample Plot
- 2005 Soils Classification
- Existing Wetland
- Parcel Line
- QHEI
- HHEI
- 5' Contour

Proposed Wetland Enhancement

- Wildlife Restoration
- Ditch Restoration
- Emergent
- Deep Water Emergent
- Floating-leaved Bed
- Forested
- Riparian Buffer
- OutFlow Structure
- Trail/Access Road

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-15
Restoration/Enhancement Plan for SC-49 Swan Creek Township, Fulton County, Ohio

County Map of Ohio

0 100 200 400 Feet

1:3,600

NOTES:
The Fulton County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: P163A1A
File Name: P163A1A_FultonSites.mxd
Date: February 19, 2009

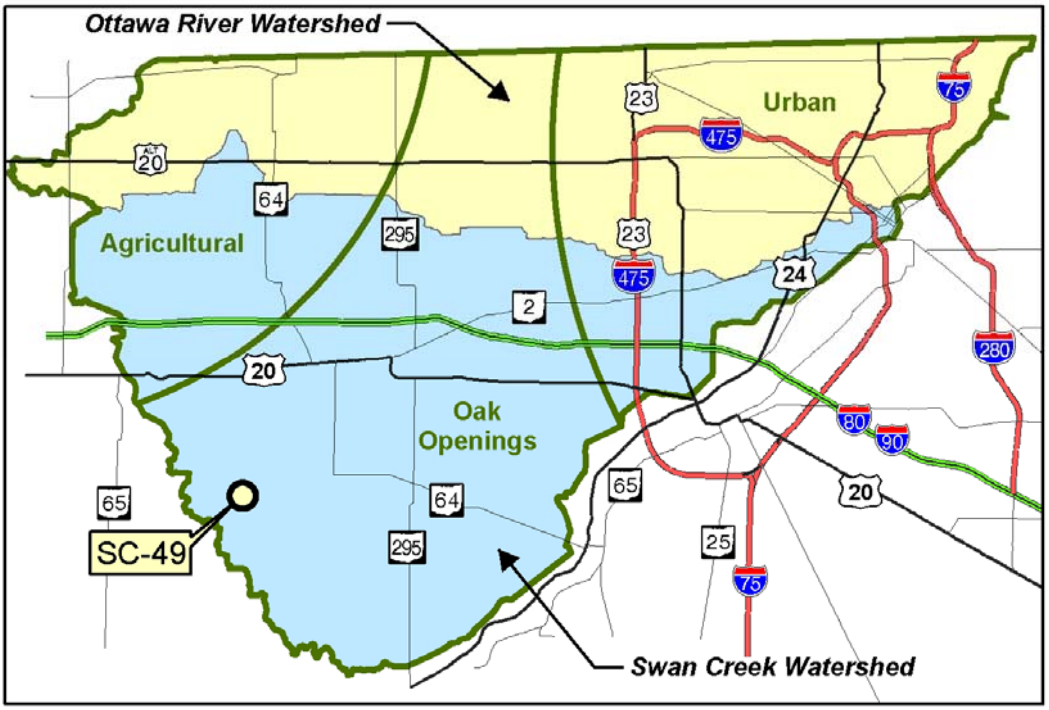
SITE SC-49
ISOLATED WETLAND RESTORATION

Project Description:
Restore 9.81 acres of palustrine wetland on hydric soil
Enhance 1.39 acres of emergent wetland
Restore 2400 feet (6.91 ac) of riparian corridor

General Restoration/Enhancement Concept:
Restoration/Enhancement of Historically Channelized Waterways in Sandy Soils
Wetland Restoration/Enhancement on Sandy Soils
Restoration/Enhancement of Riparian Buffers

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 0.42 sq. mi.
County: Fulton **Municipality**: Swan Creek Township **Location:** 83°55' 35.97"N 41°31' 11.01W
Streams: Branch of Blue Creek (QHEI = 26); unnamed tributary to Blue Creek (HHEI =32)
Wetland: SC-49-1 (palustrine emergent); ORAM 34.5
Watershed: Swan Creek HUC 0410000908 (Lower Swan Creek)
Stream buffers: Narrow, low to moderate (wooded) quality
Surrounding land use: Row crop, and forest to the north
Field-estimated gradient: 0.1% (0.1 feet per hundred feet), low



SITE SC-49
ISOLATED WETLAND RESTORATION

Site Description

The site, which is located on three parcels, north of Fulton County Road C, in Swan Creek Township, Fulton County, Ohio (Figure 4-15), is adjacent to a Priority Conservation Area as identified by the Swan Creek Technical Advisory Committee.

Wetland SC-49-1

Existing Site Conditions

The majority of soils on the site are mapped as Granby loamy fine sandy (Gr), which is hydric. Other soil types that are reported to exist on the site include Ottokee fine sand, 0 to 6 percent slopes (OtB), Spinks fine sand (StB) and Tedrow (TdA) fine sand, 0 to 3 percent slopes. These soils are non-hydric; however they may contain hydric inclusions along drainage ways and in depressions (LSWCD, 1998). This site is within the Oak Openings Subregion of the study area.

The tributary to Blue Creek consists of a wide (7 feet), shallow (up to 8 inches deep) waterway that runs along the eastern side of the site. This segment of stream exhibited a QHEI of 28, which is very low, but typical of many of the low gradient drainage ditches in the Swan Creek watershed. This low score was due to the presence of narrow buffers through the pasture and agricultural fields, very little in-stream cover and moderate erosion. A smaller headwater stream flows into this tributary from the west. The HHEI for this stream was 32. This is an intermittent, leaf bottom swale with a 6 to 9-foot bank full width.

One small wetland was identified on the site. This palustrine wetland, which is identified as Wetland SC-49-1, lies within an occasionally farmed section of a larger soybean field. Other areas of the field also had wetland characteristics but would properly be designated as a farmed wetland that in most years can be successfully farmed. Wetland SC-49-1 is dominated by lady's thumb (*Polygonum persicaria*), rush (*Juncus nodosus*), reed canary grass (*Phalaris arundinacea*) and seed-box (*Ludwigia alternifolia*). Observed indicators of wetland hydrology included water-stained leaves, a positive FAC-neutral test, local soil survey data and sediment deposits up to 5 feet above the saturated soil. Wetland SC-49-1 had black (10YR 2/1) sandy loam soils. The ORAM score for this wetland was a 34.5, which correlates to the gray zone between a Category 1 and Category 2 wetland. This would be a low quality wetland based on its size, disturbance history, few sources of hydrology and low quality vegetation community.

SITE SC-49
ISOLATED WETLAND RESTORATION

Recommended Restoration/Enhancement Strategy

Site SC-49 provides opportunities for wetland restoration, wetland enhancement, ditch restoration and riparian buffer restoration. Wetland SC-49-1 can be improved in conjunction with the restoration of 2.8 additional acres of high quality wetlands in Area D (See Figure 4-15). Restoration methods should follow those that are described in the general recommendations for *Restoration/Enhancement of Wetlands on Sandy Soils* concept. Specific measures that should be considered for implementation include treatment of the area with a non-specific herbicide, such as glyphosate, minor grading to create variations in micro topography and then allowing the seed bank to germinate in lieu of supplemental plantings. This procedure can be implemented for restoration of palustrine wetlands in areas A, B and C.

Approximately 2,400 feet of the tributary to Blue Creek can also be enhanced by recontouring the streambanks to create more gradual, fully vegetated slopes that will minimize erosion into the stream. Specific restoration methods should follow those that are included in the general recommendations for the *Restoration/Enhancement of Historically Channelized Waterways in Sandy Soils* concept.

Forested area east of Wetland SC-49-1

Sand barren along eastern edge of agricultural field

SITE SC-49
ISOLATED WETLAND RESTORATION

Blue Creek at start of QHEI

After the streambanks have been modified, a 50- to 100-foot wide woody riparian buffer can also be planted along both banks of the creek. As shown on Figure 4-15, the total restoration of the riparian buffer would cover 3.3 acres. Planting this area with woody species would slow the sedimentation and erosion problems observed in the field (see *Restoration/Enhancement of Riparian Buffers* concept). It is expected that species such as American elm (*Ulmus americana*), eastern cottonwood (*Populus deltoides*), and several species of dogwoods (*Cornus* spp.) and willows (*Salix* spp.) would come in naturally.

Potential Restoration Goals

Blue Creek at end of QHEI

Implementation of the measures described above will improve the quality of the unnamed tributary to Blue Creek and the adjacent riparian habitat by:

- Re-contouring up to 2,400 feet of stream bank along unnamed tributary;
- Restoring and/or enhancing up to 10 acres of high quality, Category 2 or 3 wetlands on the site; and
- Restoring up to 3.3 acres of riparian buffer along the stream.

These improvements should be reflected in:

- An increase in the QHEI of the unnamed tributary to Blue Creek by 5 to 7 points; a reduction of erosion and siltation in the stream; and
- An improvement in the quality of the fish and macroinvertebrate communities in the unnamed tributary.

SITE SC-49
ISOLATED WETLAND RESTORATION

Preliminary Cost Estimate

The estimated cost to construct all three of the proposed projects (2400-foot buffer enhancement, 2400-foot stream enhancement, wetland enhancement, and wetland restorations) would be approximately $300,000 depending primarily on the number of phases of the project that would be undertaken. These projects could easily be constructed in phases as the funding opportunities become available. A summary of the estimated costs for this site are provided in Table 4-25.

Table 4-25
Estimated Cost Summary for Site SC-49

Project	Quantity	Unit	Unit Cost	Total Cost
Wetland Enhancement W49-1	1.39	acre	$14,000	$19,460
Wetland Restoration: Site SC-49-A	0.74	acre	$14,000	$10,360
Wetland Restoration: Site SC-49-B	5.19	acre	$14,000	$71,820
Wetland Restoration: Site SC-49-C	1.18	acre	$14,000	$16,520
Wetland Restoration: Site SC-49-D	2.76	acre	$14,000	$38,640
Riparian Buffer Enhancement:	6.91	acre	$11,000	$76,010
Blue Creek Enhancement	2600	linear foot	$25	$65,000
Total Estimated Construction Cost				**$297,810**

SITE SC-49
ISOLATED WETLAND RESTORATION

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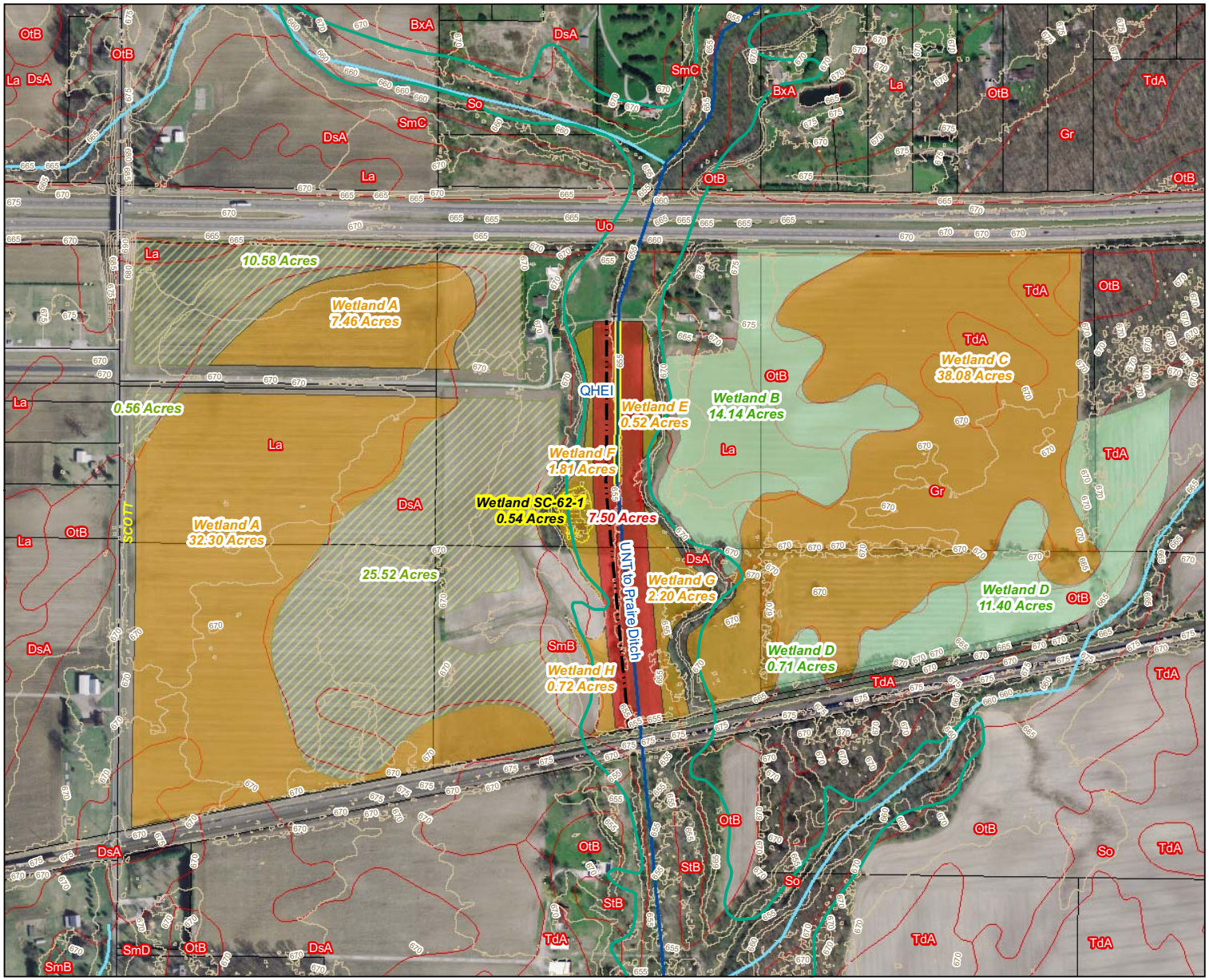
SITE SC-62



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

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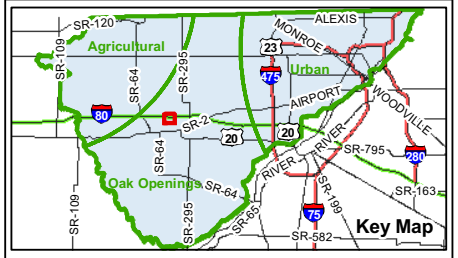


Legend

- Project Boundary
- Parcels
- Existing Wetlands

Wetland Restoration Areas

- Wildlife Enhancement
- Ditch/Linear Wetland Restoration
- Emergent Zone
- Deep Water Emergent Zone
- Floating-leaved Bed Zone
- Forested Zone
- Riparian Buffer Zone
- 100 year Floodplain
- 2005 Soil Classification
- Access Road/Trail
- 5' Contour

Streams

- QHEI
- HHEI
- Severe Bank Erosion

Ohio Rivers and Streams

- Streams
- Intermittent Stream

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-16
Restoration/Enhancement Plan for SC-62
Swanton Township, Lucas County, Ohio

County Map of Ohio

0 200 400 800 Feet

1:4,800

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: DAO002
File Name: DAO002_Concept2_Fig4-16_SiteSC-62.mxd
Date: March, 2009

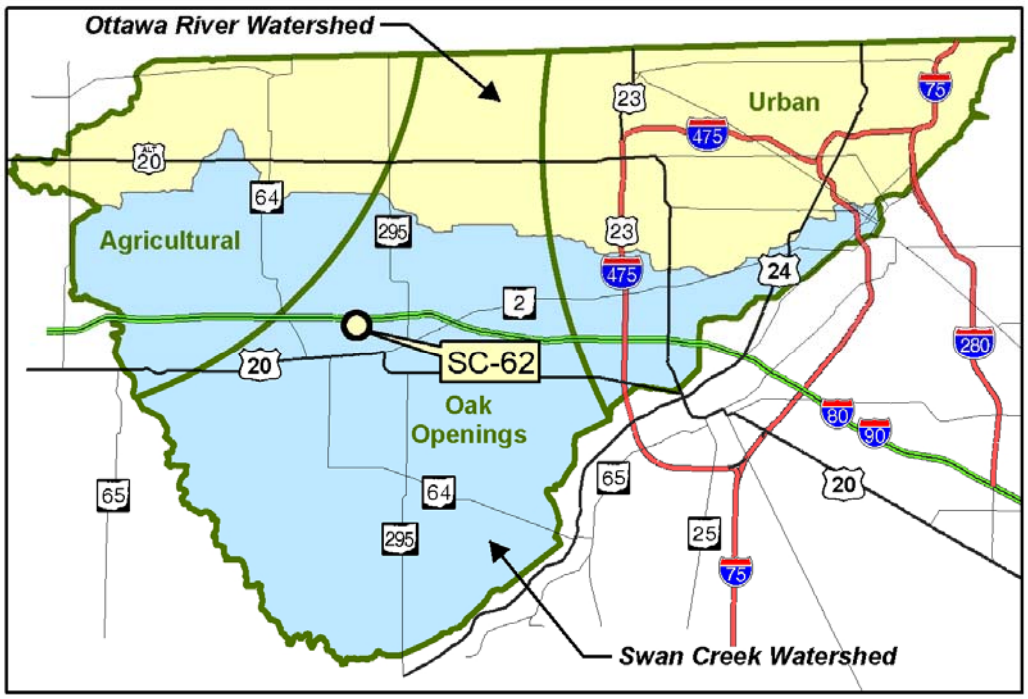
SITE SC-62
STREAM RESTORATION

Project Description:
Enhance 1600 linear feet of streambank
Restore up to 109 acres of emergent wetlands
Enhance 0.54 acres of existing floodplain wetland
Plant 7.5 acres of wooded riparian corridor
Enhance 36.66 acres of upland buffer

General Restoration/Enhancement Concept:
Restoration/Enhancement of Historically Channelized Waterways in Sandy Soils
Wetland Restoration/Enhancement on Sandy Soils
Restoration/Enhancement of Riparian Buffers

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 0.13 sq. mi.
County: Lucas **Municipality:** Swanton Township **Location:** 83°51' 24.12"W 41°35' 48.77"N
Stream: Unnamed Tributary to Prairie Ditch
Watershed: Swan Creek HUC 0410000907 (Upper Swan Creek)
Wetland: Wetland SC-62-1 (palustrine/emergent)
Stream buffers: None
Surrounding land use: Row crop and pasture
Field-estimated gradient: <0.1%



SITE SC-62 STREAM RESTORATION

Site Description

The site consists of 11 agricultural parcels comprising 205.14 acres, located south of Interstate 80, east of Scott Road, and north of the railroad tracks in Swanton Township, Lucas County, Ohio (Figure 4-16). According to information provided by the Swan Creek Technical Advisory Committee, SC-62 overlaps and is adjacent to both Priority Agricultural and Priority Conservation Areas.

Unnamed Tributary to Prairie Ditch, facing upstream

Existing Site Conditions

The waterway is a low-gradient agricultural drainage ditch with a small watershed (<2,000 acres or 3.1 square miles). This ditch was not formerly a natural stream channel, but was constructed to facilitate drainage in the area. It has been maintained on a regular basis to remove accumulated sediments and restore sub-surface tile drainage from adjacent row-crop agriculture. The QHEI score for the unnamed tributary to Prairie Ditch was 32.5. All measured qualities of this stream were extremely low, but this is typical for this type of stream.

Unnamed Tributary to Prairie Ditch, facing downstream

Row crops are planted up to the edge of low-quality, narrow (averaging 5- to 7-foot) riparian buffers on the right bank. Horse and/or livestock pasture is present up to the edge of low-quality, (averaging 5- to 7-foot) riparian buffers on the left bank. Gradient

and stream power are insufficient to move the dominant silt substrates which tend to accumulate in the stream, requiring frequent maintenance in order to maintain flow.

Wetland SC-62-1, facing southwest

There is one existing wetland at Site SC-62. Wetland SC-62-1 is a non-isolated emergent wetland dominated by yellow nut sedge (*Cyperus strigosus*) and lady's thumb (*Polygonum persicaria*). Sloan loam, a hydric soil unit, reportedly comprises the dominant soil in this wetland. This soil type was confirmed in the field, as soils were found to be hydric. Sediment deposits were observed in the wetland at the time of evaluation. Wetland SC-62-1 is a Category 1 wetland. The ORAM score was 28 and was strongly influenced by lack of buffers and poor habitat development.

The majority of soils at Site SC-62 are mapped as non-hydric Dixboro fine sand loam, 0-2% slopes (DsA) which may contain unmapped inclusions of hydric Colwood loam (Co) and hydric Lamson find sand loam (La); Ottokee fine sand, 0-6% slopes (OtB) which may contain unmapped inclusions of hydric Granby loamy fine sand (Gr); Lamson find sand loam (La) a hydric soil unit, and Granby loamy fine sand, both hydric soil units.

Stream Enhancement and Wetland Restoration Strategy

The following measures can be implemented to enhance the quality of the stream at this site:

- Grade streambanks to reduce slope and stabilize with herbaceous vegetation (see *Restoration/Enhancement of Historically Channelized Waterways in Sandy Soils* concept).
- Widen the riparian buffer to 50 feet from the top of each bank, and incorporate 20-foot wide maintenance access along one bank (see *Restoration/Enhancement of Riparian Buffers* concept).
- Implement limited sediment bar and selective snag removal per Ohio Drainage Manual guidelines.

The very low gradient of the unnamed tributary to Prairie Ditch and its lack of sinuosity indicate little opportunity for full stream restoration through natural channel design to increase efficiency in moving sediments. Improvements in water quality are best achieved by decreasing sediment

and nutrient inputs from surrounding agricultural land uses, improving the width and quality of riparian buffers, and adopting best management practices (BMPs) for agricultural ditches to be implemented during periodic ditch maintenance.

The existing wetland can be enhanced by excluding livestock/horses and enhancing the vegetation. Depending on the amount of agricultural weeds that are present at the time revegetation is initiated, treatment with a glyphosphate herbicide may be needed. Herbicide application would then be followed by seeding of sedges and grasses that are adapted to this type of emergent community. A diverse emergent seed mix can be placed in this marsh (see *Wetland Restoration/Enhancement on Sandy Soils* concept).

Up to 140.74 acres of isolated wetlands and 3.44 acres of nonisolated wetlands can be created on the site. Restoration efforts could be accomplished through a series of smaller projects initially focused on the nonisolated wetland areas. Depending on the amount of agricultural weeds that are present at the time restoration is initiated, a glyphosphate herbicide may be needed. After this application, some simple grading would be necessary prior to planting. This grading would create shallow hills and swales that would increase both floral and faunal diversity. Grading would then be followed by seeding of sedges and grasses that are adapted to this type of emergent community. A diverse emergent seed mix can be placed in this marsh.

In addition to wetland restoration, this site also provides the opportunity to restore upland wildlife habitat on the two small slopes present to the west and east of the stream. Wooded areas of these slopes should be maintained, while invasive species may need to be managed with an herbicide application as necessary.

Potential Stream Enhancement and Wetland Restoration Goals

Implementation of the measures described above will improve the quality of the unnamed tributary to Prairie Ditch and the adjacent riparian habitat by:

- Re-grading and re-vegetating the stream bank along the unnamed tributary;
- Restoring up to 140.74 acres of high quality, Category 2 or 3 wetlands on the site; and
- Restoring upland wildlife habitat on the site.

These improvements should be reflected in:

- An increase in the QHEI of the unnamed tributary by 3 to 5 points;
- A reduction in the frequency of needed ditch cleanout;
- An increase in flood retention on the site; and
- An improvement in the quality of fish and macroinvertebrate communities in the unnamed tributary.

Preliminary Cost Estimate

The estimated cost to construct the proposed projects is summarized in Table 4-26. This project can be constructed in phases as funding opportunities become available.

Table 4-26
Estimated Cost Summary for Site SC-62

Project	Quantity	Unit	Unit Cost	Total Cost
Streambank Slope Reduction/Stabilization	1600	linear foot	$25	$40,000
Riparian Buffer Enhancement	7.5	acre	$11,000	$82,500
Stream Maintenance	1600	linear foot	$5	$8,000
Wetland Restoration A - emergent	39.76	acre	$14,000	$556,640
Wetland Restoration B - forested	14.14	acre	$16,000	$226,240
Wetland Restoration C - emergent	38.08	acre	$14,000	$533,120
Wetland Restoration D - forested	12.11	acre	$16,000	$193,760
Wetland Restoration E - emergent	0.52	acre	$14,000	$7,280
Wetland Restoration F - emergent (including wetland SC-62-1)	1.81	acre	$14,000	$25,340
Wetland Restoration G - emergent	2.20	acre	$14,000	$30,800
Wetland Restoration H - emergent	0.72	acre	$14,000	$10,080
Wildlife Enhancement	36.66	acre	$3,000	$109,980
Total Estimated Construction Cost				**$1,823,740**

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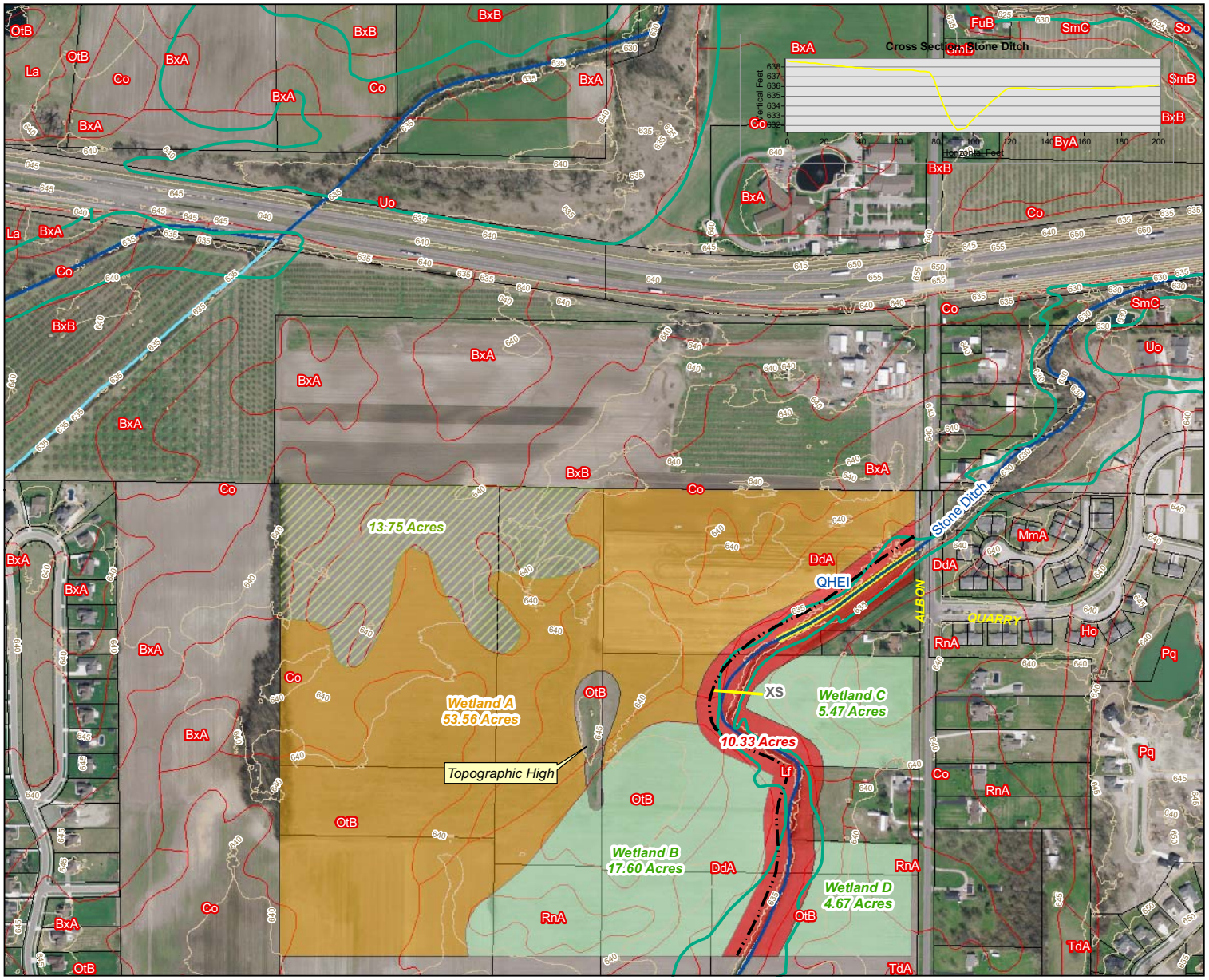
SITE SC-64



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

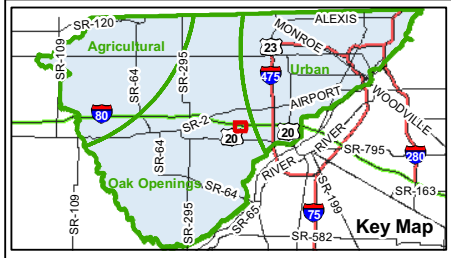
Prepared for:

Partners for Clean Streams, Inc.
P.O. Box 822
Bowling Green, Ohio 43402
www.PartnersForCleanStreams.org

Prepared by:

Mannik & Smith Group, Inc.

Hull & Associates, Inc.



Legend

- Project Boundary
- Parcels
- Existing Wetlands
- Wetland Restoration Areas
  - Wildlife Enhancement
  - Ditch/Linear Wetland Restoration
  - Emergent Zone
  - Deep Water Emergent Zone
  - Floating-leaved Bed Zone
  - Forested Zone
  - Riparian Buffer Zone
- 100 year Floodplain
- 2005 Soil Classification
- Cross Section Line
- Access Road/Trail
- 5' Contour
- Streams
  - QHEI
  - HHEI
  - Severe Bank Erosion
- Ohio Rivers and Streams
  - Streams
  - Intermittent Stream

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-17
Restoration/Enhancement Plan for SC-64
Monclova Township, Lucas County, Ohio

County Map of Ohio

0 200 400 800 Feet
1:4,800

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: DAO002
File Name: DAO002_Concept2_Fig4-17_SiteSC-64.mxd
Date: March, 2009

SITE SC-64
STREAM RESTORATION

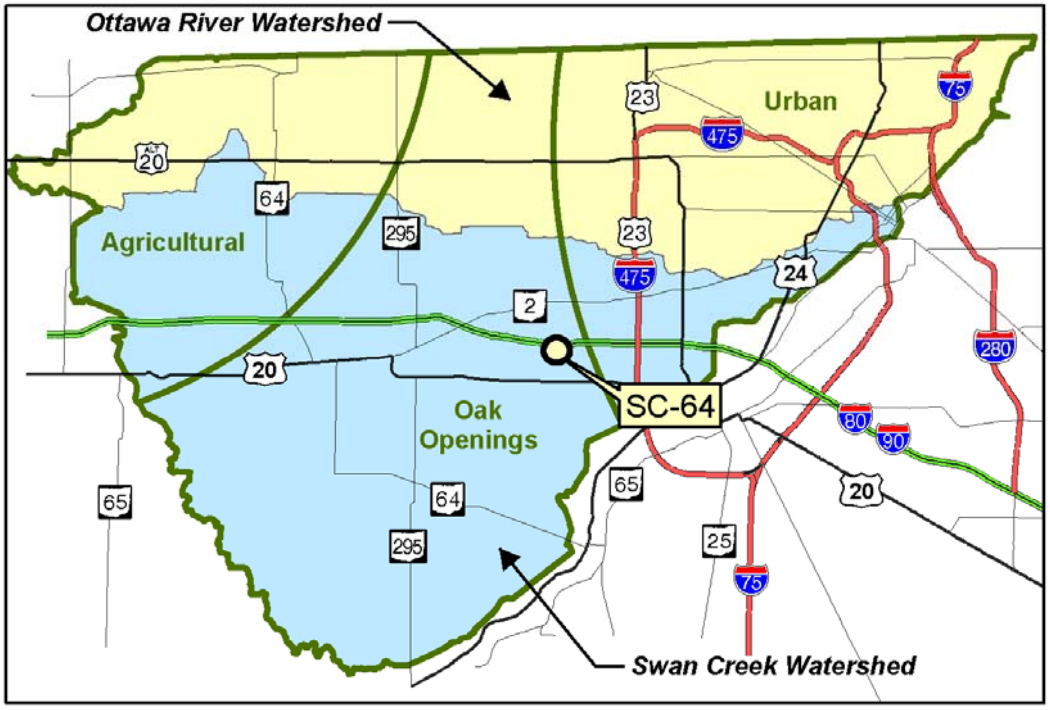
Oak Openings Subregion

Project Description:
Restore 2200 linear feet of stream channel
Restore up to 82 acres of emergent wetlands
Plant 10.33 acres of wooded riparian buffer
Plant 13.75 acres of upland buffer enhancement

General Restoration/Enhancement Concept:
Restoration/Enhancement of Large Stream
Wetland Restoration/Enhancement on Sandy Soils
Restoration/Enhancement of Riparian Buffers

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 7.91 sq. mi.
County: Lucas **Municipality**: Monclova Township **Location:** 83°44' 33.04"W 41°35' 08.72"N
Stream: Stone Ditch
Watershed: Swan Creek HUC 0410000908 (Lower Swan Creek)
Wetland: None
Stream buffers: None
Surrounding land use: Row crop
Field-estimated gradient: 0.1%



SITE SC-64 STREAM RESTORATION

Site Description

The site consists of up to 11 agricultural parcels comprising 132.91 acres, located south of Interstate 80 and west of Albon Road in Monclova Township, Lucas County, Ohio (Figure 4-17). According to information provided by the Swan Creek Technical Advisory Committee SC-64 overlaps Priority Conservation and Priority Agricultural Areas and is adjacent to a Priority Development Area.

Stone Ditch, facing upstream

Existing Site Conditions

Stone Ditch is a low-gradient stream with significant agricultural tile influence; however, this stream has a large watershed and its hydrology and channel formation processes are driven by bankfull (not benchfull) flows. Row crops and residential parcels about the edge of low-quality, very narrow (averaging 8- to 10-foot) riparian areas on each bank. This stream was formerly a natural stream channel, but was modified to facilitate drainage in the area. It has been extensively hydrologically modified, and is maintained on a regular basis to remove accumulated sediments and restore sub-surface tile drainage from adjacent row-crop agriculture. The QHEI for Stone Ditch was 30.5. All measured qualities of this stream were extremely low, but this is typical for this type of stream.

Existing buffer community on Stone Ditch

SITE SC-64
STREAM RESTORATION

A generalized cross-section (XS) for Stone Ditch is depicted as an inset in Figure 4-17. The cross-section was developed using the Digital Elevation Model (DEM) for Lucas County, OH. The generalized cross section shows the channel with its adjoining terraces (abandoned floodplains) on each bank, but the DEM is not sensitive enough to map active floodplain or provide detailed features of the channel such as bankfull features. The overall channel width (terrace to terrace) is about 40 feet. Channel depth below the left-bank terrace is about 4.5 feet, and the channel depth below the higher right-bank terrace is about 6 feet.

There are no existing wetlands at Site SC-64. The majority of the soils are mapped as Ottokee fine sand, 0-6% slopes (OtB), and Colwood loam (Co) both of which are hydric soil units; and Del Ray loam, 0-3% slopes (DdA) which is non-hydric but may contain unmapped inclusions of the hydric Lenawee (Lf) unit.

Stream and Wetland Restoration Strategy

The following measures can be implemented to enhance the quality of the stream at this site:

- Perform fluvial hydrogeomorphic survey and restore stable stream planform, dimension and profile using techniques described in the *Restoration/Enhancement of Large Streams* concept.
- Widen the wooded riparian buffer to 50 feet from the top of each bank, and incorporate 20-foot wide maintenance access track along one bank (see *Restoration/Enhancement of Riparian Buffers* concept).

Improvements in water quality can also be approached by decreasing stormwater peak flow inputs, and taking steps to decrease sediment and nutrient inputs from surrounding agricultural land uses.

Wetland restoration on this site could create up to 81 acres of non-isolated wetland. Restoration efforts could be accomplished in a series of smaller projects initially focused on the areas closest to Stone Ditch. Depending on the amount of agricultural weeds presenting at the time restoration is initiated, treatment with a glyphosphate herbicide may be needed. After this application, simple grading would be necessary prior to planting, to create shallow hills and swales that would increase both floral and faunal diversity (see *Wetland Restoration/ Enhancement on Sandy Soils* concept). Grading would then be followed by seeding with sedges and grasses that are adapted to this type of emergent community. A diverse emergent seed mix can be placed in the wetland restoration area (see *Wetland Restoration/Enhancement on Sandy Soils* concept).

Potential Stream and Wetland Restoration Goals

Implementation of the measures described above will improve the quality of Stone Ditch and the adjacent riparian habitat by:

- Widening the riparian buffer on the site;
- Restoring up to 81 acres of high quality, Category 2 or 3 wetlands on the property; and
- Enhancing the existing stream channel.

These improvements should be reflected in:

- An increase in the QHEI of the Stone Ditch by 10 to 14 points;
- An increase in the Index of Biotic Integrity by 3 to 6 points;
- An increase in sediment and nutrient retention on the site;
- An increase in vegetation diversity on the site; and
- An improvement in the quality of the macroinvertebrate communities in Stone Ditch.

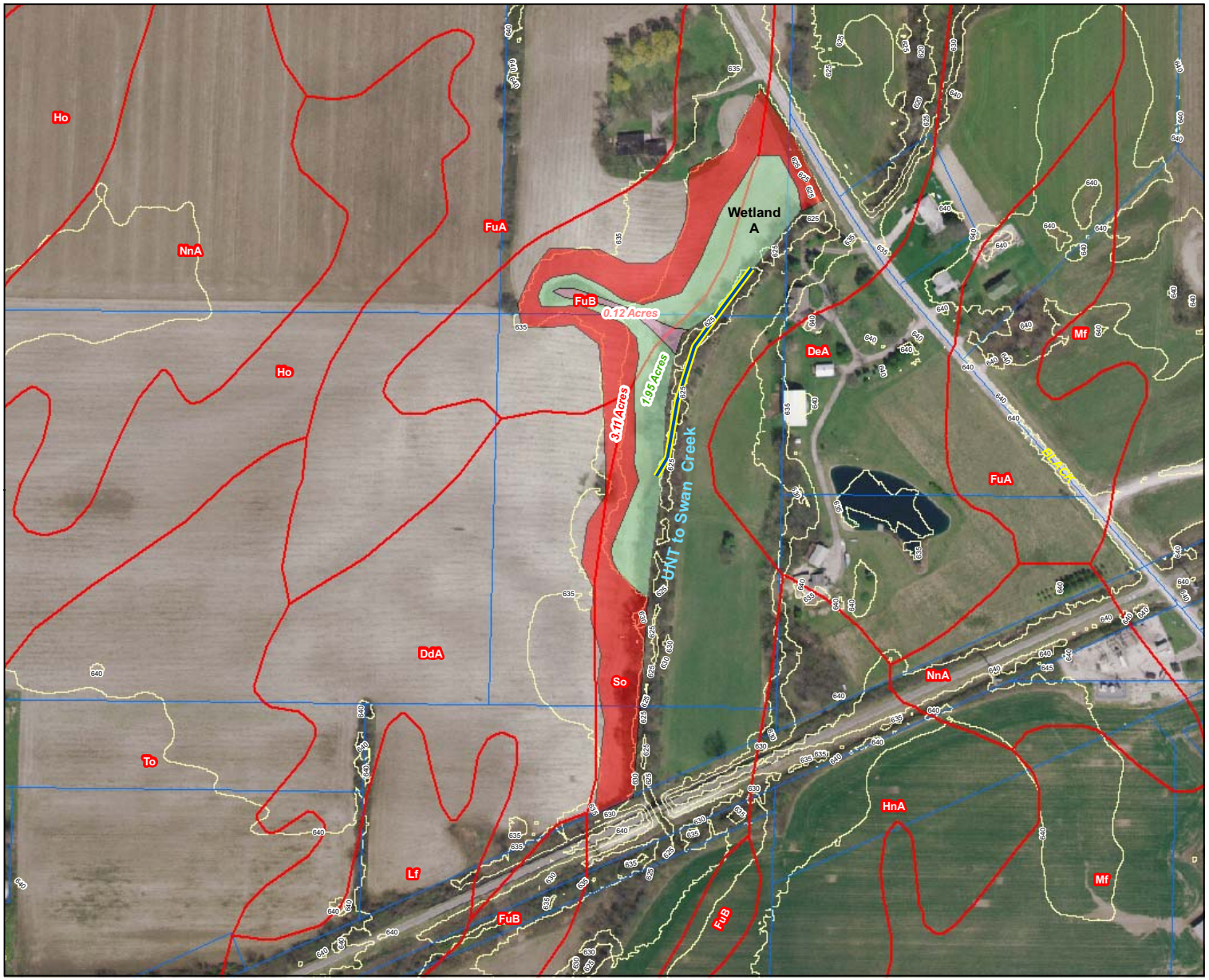
Preliminary Cost Estimate

The estimated cost to construct the proposed projects is summarized in Table 4-27. Various components of this project could be constructed independently of one another as funding opportunities become available.

Table 4-27
Estimated Cost Summary for Site SC-64

Project	Quantity	Unit	Unit Cost	Total Cost
Natural Channel Restoration	2200	linear foot	$275	$605,000
Riparian Buffer Enhancement	10.33	acre	$11,000	$113,630
Annual Maintenance (natural channel)	2200	linear foot	$2	$4,400
Annual Maintenance (riparian buffer)	5	acre	$25	$125
Wetland Restoration A - emergent	53.56	acre	$14,000	$749,840
Wetland Restoration B - forested	17.60	acre	$16,000	$281,600
Wetland Restoration C - forested	5.47	acre	$16,000	$87,520
Wetland Restoration D - forested	4.67	acre	$16,000	$74,720
Wildlife Enhancement	13.75	acre	$3,000	$41,250
Total Estimated Construction Cost				**$1,958,085**

SITE SC-70



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

Prepared for:

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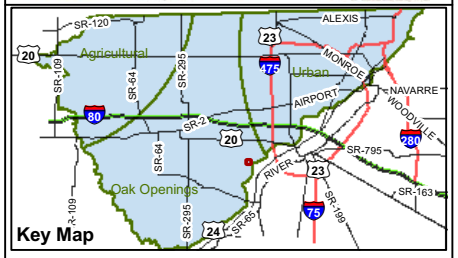


Legend

- Sample Plot
- 2005 Soils Classification
- Parcel Line
- Existing Wetland
- QHEI
- HHEI
- 5' Contour

Proposed Wetland Enhancement

- Wildlife Enhancement
- Ditch Restoration
- Emergent
- Deep Water Emergent
- Floating-leaved Emergent
- Forested
- Riparian Buffer
- Trail/Access Road

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-18
Restoration/Enhancement Plan for SC-70
Monclova Township, Lucas County, Ohio

County Map of Ohio

0 100 200 400 Feet

1:2,400

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: P163A1A
File Name: P163A1A_LucasSites.mxd
Date: January 19, 2009

SITE SC-70
STREAM RESTORATION

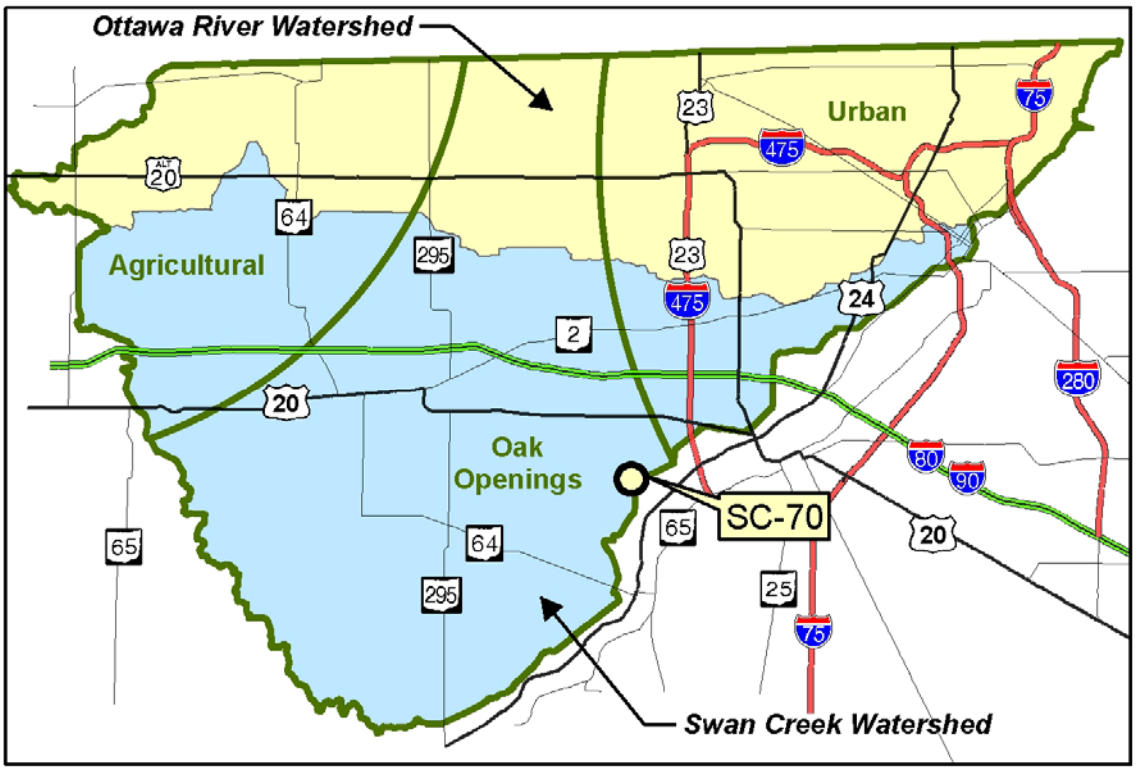
Oak Openings Subregion

Project Description:
Restore 1.95 acres of palustrine wetland on hydric soil
Enhance 3.11 acres of riparian corridor
Plant 250 feet of vegetative swale

General Restoration/Enhancement Concept:
Wetland Restoration/Enhancement on Clay Soils
Restoration/Enhancement of Riparian Buffers

Beneficial Use Impairments (BUI) Addressed:
BUI #3 Degradation of fish and wildlife populations
BUI #6 Degradation of benthos
BUI #14 Loss of fish and wildlife habitat

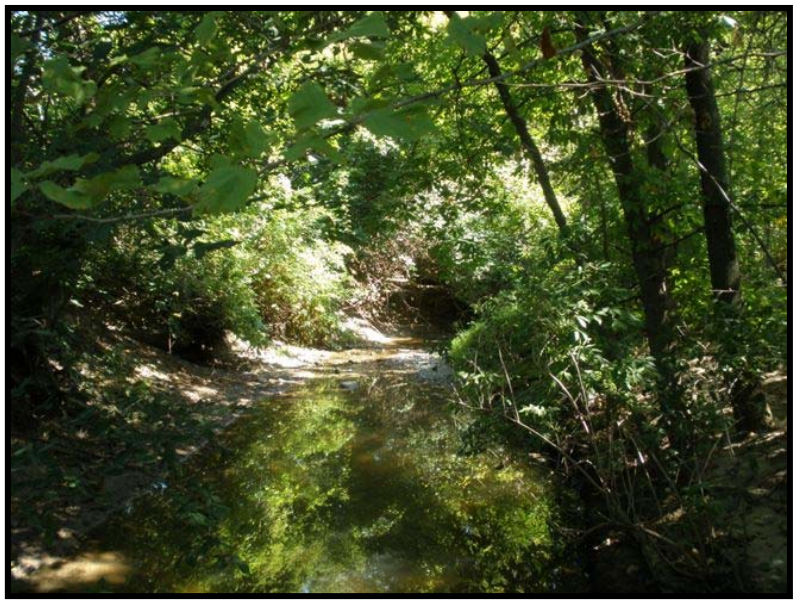
Drainage Area: 7.62 sq. mi.
County: Lucas **Municipality**: Monclova Township **Location:** 83°43' 36.37"W 41°32' 50.70"N
Stream: Blystone Ditch (QHEI = 37)
Watershed: Swan Creek HUC 0410000908 (Lower Swan Creek)
Wetland: None
Stream buffers: Very narrow wooded quality
Surrounding land use: Row crop
Field-estimated gradient: 0.1% (0.1 feet per hundred feet), low



SITE SC-70 STREAM RESTORATION

Site Description

The site exists on portions of four parcels that are located along the west side of Blystone Ditch, southwest west of Black Road, in Monclova Township, Lucas County, Ohio (Figure 4-18). In 2008, the entire proposed restoration site was planted in soybeans, except for the area along Black Road, which is residential. Very little buffer exists along Blystone Ditch, as the agricultural field is tilled and planted to within 10-15 from the edge of the stream. Based on information provided by the Swan Creek Technical Advisory Committee, Site SC-70 overlaps Priority Agricultural and Priority Development Areas.



End of QHEI facing upstream

Existing Site Conditions

No existing wetlands were found on this site. Several areas along the edge of the agricultural field did exhibit hydrological indicators that indicated that a wetland might readily develop if the area was not actively farmed. Blystone Ditch is a low quality, channelized ditch with a narrow, wooded corridor.

Three soil types are mapped within the site. These are hydric Sloan loam, occasionally flooded (So) along with the non-hydric Fulton silty clay loam (FuB) and Del Rey loam (DdA). The latter two soils may contain hydric inclusions along drainage ways and in depressional (LSWCD, 1998).

Blystone Ditch exhibited a QHEI of 37, which is low but typical for low gradient drainage ditches in the area. This low score was due to the narrow buffer that exists along the ditch, a lack of instream cover and the presence of moderate erosion.

Restoration/Enhancement Strategy

Site SC-70 provides both wetland and stream restoration opportunities.

Approximately 2 acres of riparian forested wetland can be restored along the west bank of the ditch, as shown in Figure 4-18. Restoration methods should follow the general

recommendation presented in the *Restoration/Enhancement of Wetlands on Clay Soils* concept. Noxious weeds should be treated with a glyphosate herbicide prior to grading. The amount of grading necessary will be dependent on the degree to which the topography in the area must be altered to intercept flood waters from Blystone Ditch.

Start of QHEI facing downstream

Approximately 1,300 feet of Blystone Ditch may be enhanced by adding a wooded riparian buffer to the west side of the streambank, above the restored wetland area. Approximately 3.11-acre of riparian buffer can be created by planting a forested/scrub/shrub boundary to shade the stream surface, slow surface run-off and prevent blowing soils from the neighboring agricultural field. Planting this area with woody species would slow the sedimentation and erosion problems observed in the field (see *Restoration/Enhancement of Riparian Buffers* concept). In addition to the species planted at the site, it is expected that American elm (*Ulmus americana*), eastern cottonwood (*Populus deltoides*), and several species of dogwoods (*Cornus* spp.) and willows (*Salix* spp.) would come in naturally.

Area of ponded water within agricultural field facing south

Potential Restoration Goals

Implementation of the measures described above will improve the quality of Blystone Ditch and the adjacent riparian habitat by:

- Restoring up to 2 acres of high quality Category 2 or 3

wetlands on the property; and
- Adding up to 1,300 feet of wooded riparian buffer along the Blystone Ditch.

These improvements should be reflected in:

- An increase in the QHEI of the Stone Ditch by 5 to 7 points;
- An increase in vegetation diversity on the site; and
- An improvement in the quality of fish and macroinvertebrate communities in Blystone Ditch.

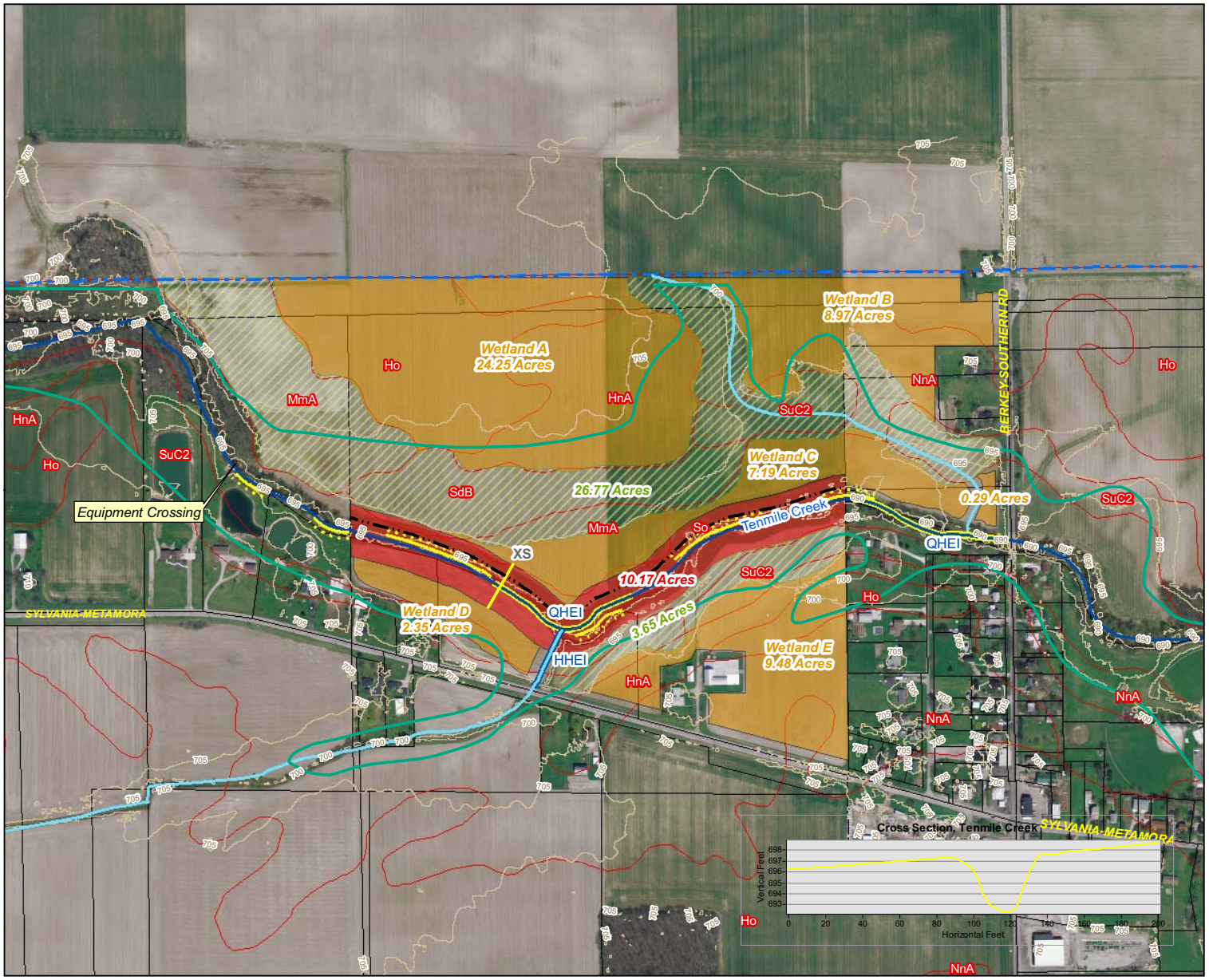
Preliminary Cost Estimate

The estimated cost to construct all three of the proposed projects (Buffer Enhancement, Ditch and Wetland Restorations) would be approximately $63,190 depending primarily on the number of projects that would be undertaken. This project can easily be constructed in phases as funding opportunities become available. A summary of the estimated costs for this site are provided in Table 4-28.

Table 4-28
Estimated Cost Summary for Site SC-70

Project	Quantity	Unit	Unit Cost	Total Cost
Ditch Restoration - Emergent Wetland	0.12	acre	$14,000	$1,680
Wetland Restoration: Site SC-70-A	1.95	acre	$14,000	$27,300
Riparian Buffer Enhancement: Site SC-16-C	3.11	acre	$11,000	$34,210
Total Estimated Construction Cost				**$63,190**

SITE OR-58



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

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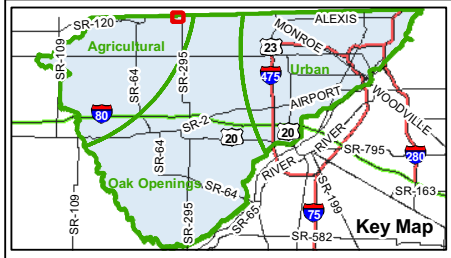


Legend

- Project Boundary
- Parcels
- Existing Wetlands
- Wetland Restoration Areas
  - Wildlife Enhancement
  - Ditch/Linear Wetland Restoration
  - Emergent Zone
  - Deep Water Emergent Zone
  - Floating-leaved Bed Zone
  - Forested Zone
  - Riparian Buffer Zone
- 100 year Floodplain
- 2005 Soil Classification
- Cross Section Line
- Access Road/Trail
- 5' Contour
- Streams
  - QHEI
  - HHEI
  - Severe Bank Erosion
- Ohio Rivers and Streams
  - Streams
  - Intermittent Stream

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-19
Restoration/Enhancement Plan for OR-58
Richfield Township, Lucas County, Ohio

County Map of Ohio

0 200 400 800 Feet

1:4,800

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: DAO002
File Name: DAO002_Concept2_Fig4-19_SiteOR-58.mxd
Date: March, 2009

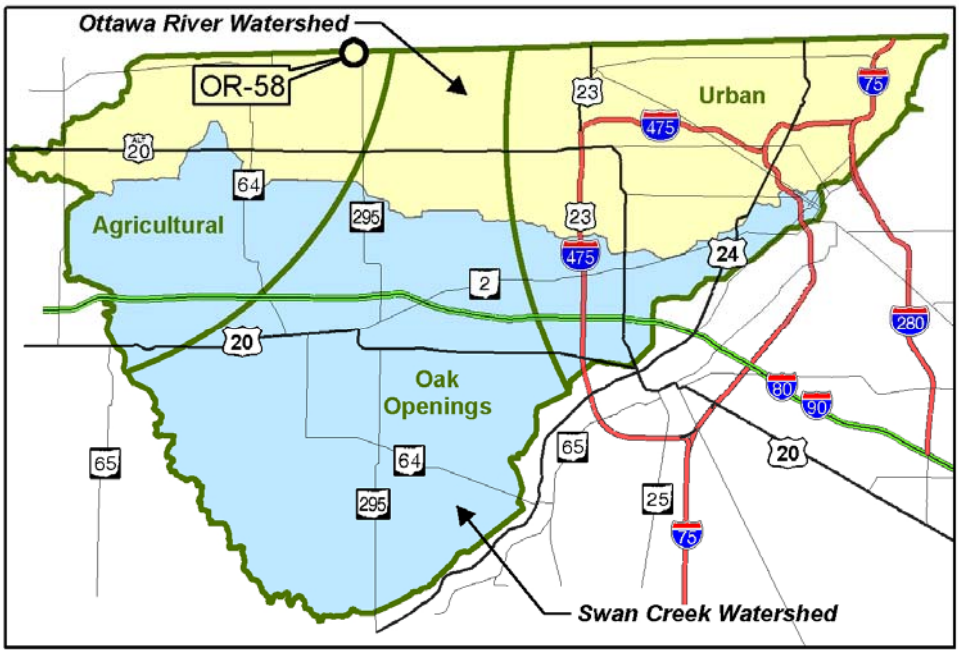
SITE OR-58
STREAM AND NON-ISOLATED WETLAND RESTORATION

Project Description:
Restore 2100 liner feet of stream channel
Create up to 53 acres of emergent wetland
Plant 10.17 acres of wooded riparian corridor
Plant 26.7 acres of upland buffer enhancement

General Restoration/Enhancement Concept:
Restoration/Enhancement Large Streams
Restoration/Enhancement of Riparian Buffers
Wetland Restoration/Enhancement on Clay Soils

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 29.2 (Tenmile Creek) and 0.27 (unnamed tributary) sq. mi.
County: Lucas **Municipality**: Richfield Township **Location:** 83°50' 44.71"W 41°43' 09.87"N
Streams: Tenmile Creek; Unnamed Tributary to Tenmile Creek
Watershed: Ottawa River HUC 0410000103
Wetland: None
Stream buffers: None
Surrounding land use: Row crop
Field-estimated gradient: 0.1%
Ohio Gazetteer published average gradient (Tenmile Creek): 0.09% (4.7 feet per mile)



SITE OR-58 STREAM AND NON-ISOLATED WETLAND RESTORATION

Site Description

The site consists of up to eight agricultural parcels comprising 99.56 acres, located north of Sylvania-Metamora Road and west of Berkey-Southern Road in Richfield Township, Lucas County, Ohio (Figure 4-19).

Existing Site Conditions, Tenmile Creek

Tenmile Creek is a low-gradient stream with significant agricultural tile influence; however, this stream has a large watershed and its hydrology and channel formation processes are driven by bankfull (not benchfull) flows. Row crops abut the edge of the streambank, and there is no riparian buffer. Gradient/stream power is evidently sufficient to move silt, sand and gravel substrates. Resulting substrates in riffles are moderately stable and dominated by sand and gravel with low embeddedness. There is extensive evidence of lateral erosion and subsequent bank repair, and the stream is probably on occasion mechanically deepened. The time period between cleanouts is sufficient for recovery of many good habitat features, including moderate quality in-stream cover and fair to good channel morphological development. Extensive pools dominate the stream patterning, although the depth of the pools is not sufficient to support predatory

Tenmile Creek facing upstream; west of Berkey-Southern Road

Tenmile Creek facing downstream; north of Sylvania Road

fish species. These pools are not shaded. The most noticeable instability and degrading influence on habitat quality is evidence of periodic torrential/flashy flows (not observed directly) that are confined to an incised and moderately entrenched channel (<2.0) leading to high shear stresses and lateral scouring on the outside of meander bends and adjacent to transverse gravel bars. The stream has a considerable amount of artificial substrate that has accumulated in-stream from attempted or failed streambank repair projects, and also a moderate amount of trash, metal, car tires, etc. that should be removed.

A generalized channel cross-section (XS) for Tenmile Creek is depicted in Figure 4-19. The cross-section was developed using the Digital Elevation Model (DEM) for Lucas County, Ohio. The generalized cross section shows the channel with its adjoining terraces (abandoned floodplains) on each bank, but the DEM is not sensitive enough to map active floodplain or provide detailed features of the channel such as bankfull features. The overall channel width (terrace to terrace) is about 40 feet, and the channel depth below the terraces is about 5.5 feet.

The QHEI score for the sample reach of Tenmile Creek north of Sylvania-Metamora Road was 49. The QHEI score for the sample reach of Tenmile Creek upstream of Berkey-Southern Road was 57.5. The buffers in the Berkey-Southern sample reach were wider, and there was more instream cover, possibly due to only one bank being planted to row crops.

Existing Site Conditions, Unnamed Tributary to Tenmile Creek

The stream is a low-gradient agricultural drainage ditch with a small watershed (<2,000 acres or 3.1 square miles). This stream was formerly a natural stream channel. It has been extensively hydrologically modified, and is maintained on a regular basis to remove accumulated sediments and restore sub-surface tile drainage from adjacent row-crop agriculture. The HHEI score for the unnamed tributary to Tenmile Creek was 52, resulting in an existing beneficial use of intermittent Modified Class II PHWH.

View of Unnamed Tributary to Tenmile Creek (right side of photo)

SITE OR-58 STREAM AND NON-ISOLATED WETLAND RESTORATION

Row crops are planted up to the edge of low-quality, very narrow (averaging 1- to 3-foot) riparian buffers on each bank. Gradient and stream power are insufficient to move the dominant silt substrates which tend to accumulate on the stream bottom, requiring frequent maintenance in order to maintain flow. In addition, overflow from a broken leach field or septic tank apron line is currently discharging directly into the stream from the east bank.

There are no existing wetlands at Site OR-58. The majority of soils are mapped as Sloan loam, occasionally flooded (So), Hoytville clay loam (Ho) both of which are hydric, and non-hydric Haskins loam, 0-3% slopes (HnA) which may contain unmapped inclusions of hydric Mermill loam (Mf) soils. Several "pockets" of sandy soil are mapped on the site: Metamora sandy loam, 0-3% slopes (MmA), a non-hydric soils with hydric inclusions and non-hydric St. Clair silty clay loam, 4-12% slopes, eroded (SuC2).

Fish species observed at this location are listed in Table 4-29.

Table 4-29
Fish Samples at Site OR-59 (Tenmile Creek)

Common Name[1]	Species[1]	Feed Guild[2]	Tol.[3]	# of Fish	Avg. Wt. (grams)
Yellow Bullhead	*Ameiurus natalis*	I	T	2	54.2
Stoneroller	*Campostoma anomalum*	H	N/A	76	58.0
White Sucker	*Catostomus commersonii*	O	T	69	53.2
Rainbow Darter	*Etheostoma caeruleum*	I	M	13	3.5
Johnny Darter	*Etheostoma nigrum*	I	N/A	50	1.0
Green Sunfish	*Lepomis cyanellus*	I	T	7	36.70
Largemouth Bass	*Micropterus salmoides salmoides*	C	M	2	27.8
Common Shiner	*Notropis cornutus*	I	N/A	192	28.8
Spotfin Shiner	*Notropis spilopterus*	I	N/A	23	4.7
Sand Shiner	*Notropis stramineus*	I	M	36	4.7
Blackside Darter	*Percina maculata*	I	M	3	3.1
Bluntnose Minnow	*Pimephales notatus*	O	T	226	1650.0
Fathead Minnow	*Pimephales promelas*	O	T	38	33.6
Creek Chub	*Semotilus atromaculatus*	G	T	192	29.5

** Non-native*
[1] according to ODNR, Division of Wildlife guide http://www.dnr.state.oh.us/tabid/17913/Default.aspx
[2] Feeding Guild: P - Piscivore, F - Filter Feeder, V - Invertivore, I - Specialist Insectivore, O - Omnivore, G - Generalist, H - Herbivore, C - Carnivore, N/A = Not assigned.
[3] Tolerance Guild: R - Rare Intolerant, S - Special Intolerant, I - Common Intolerant, M - Moderately Intolerant (Headwaters), T - Highly Tolerant, P - Moderately Tolerant, N/A = Not assigned.

SITE OR-58 STREAM AND NON-ISOLATED WETLAND RESTORATION

Macroinvertebrates observed at this location is listed in Table 4-30.

Table 4-30
Macroinvertebrate Samples at Site OR-58 (Tenmile Creek)

Elevated Taxa	Lowest Taxa	Common Name	Tolerance	Number Collected
Annelida	Oligochaeta	segmented worm	8	1
Coleoptera	Undetermined Elmidae	riffle beetle	5	3
Crustacea	*Asellus* sp.	isopod	8	2
Diptera	Chironomidae	chronomid	6	1
Ephemeroptera	*Stenonema* sp.	mayfly	3	5
Gastropoda	*Ferrissia* sp.	limpet	6	1
Pelecypoda	Pelecypoda	clam	6 to 8	6
Trichoptera	Hydroptilidae	caddisfly	6	1
Trichoptera	*Hydropsyche* sp.	caddisfly	4	3

Stream and Wetland Restoration Strategy

The following measures can be implemented to restore of the stream at this site:

- Restore stable stream planform, dimension and profile using techniques that are described in the *Restoration/Enhancement of Large Streams* concept.
- Widen the wooded riparian buffer to 50 feet from the top of each bank, and incorporate 20-foot wide maintenance access track along one bank (see *Restoration/Enhancement of Riparian Buffers* concept).
- Repair damage from equipment crossing.

Up to 42.65 acres of isolated wetland and 9.83 acres of non-isolated wetland can also be created on this site. Restoration efforts could be accomplished in a series of smaller projects initially focused on the areas closest to Tenmile Creek. Depending on the amount of agricultural weeds present at the time restoration is initiated, treatment with a glyphosphate herbicide may be warranted. After this application, simple grading may be necessary prior to planting. This grading would create shallow rises and swales that would increase both floral and faunal diversity (see *Wetland Restoration/Enhancement on Clay Soils* concept). Grading would then be followed by seeding of herbaceous species that are adapted to this type of emergent community. A diverse emergent seed mix can be placed at the site.

This site also provides the opportunity to restore 26.76 acres of upland wildlife habitat. Depending on the amount of agricultural weeds presenting at the time restoration is initiated, a glyphosphate herbicide may be needed. After herbicide application, the area could be planted with fruit bearing shrub species (*Cornus* spp., *Viburnum* spp., *Vaccinium* spp., etc.) and upland prairie grasses.

SITE OR-58 STREAM AND NON-ISOLATED WETLAND RESTORATION

Stream enhancement on the unnamed tributary is best approached by attempting to reduce the amount of sediment inputs from surrounding land uses, and efforts to repair and maintain septic systems that discharge to the stream.

Potential Stream Enhancement and Wetland Restoration Goals

Implementation of the measures described above will improve the quality of Tenmile Creek and the adjacent riparian habitat by:

- Restoring up to 53 acres of high quality Category 2 or 3 wetlands on the site;
- Restoring up to 26.76 acres of high quality upland wildlife habitat on the site;
- Restoring up to 2,100 feet of existing stream channel; and
- Enhancing up to 10.17 acres of riparian buffers.

These improvements should be reflected in:

- An increase in the QHEI of Tenmile Creek by 10 to 14 points;
- A reduction into siltation and embeddedness in the stream;
- An increase in the diversity of vegetation within riparian zone;
- An increase in the Index of Biotic Integrity (IBI) by 3 to 6 points; and
- An improvement in the quality of the macroinvertebrate communities in the creek.

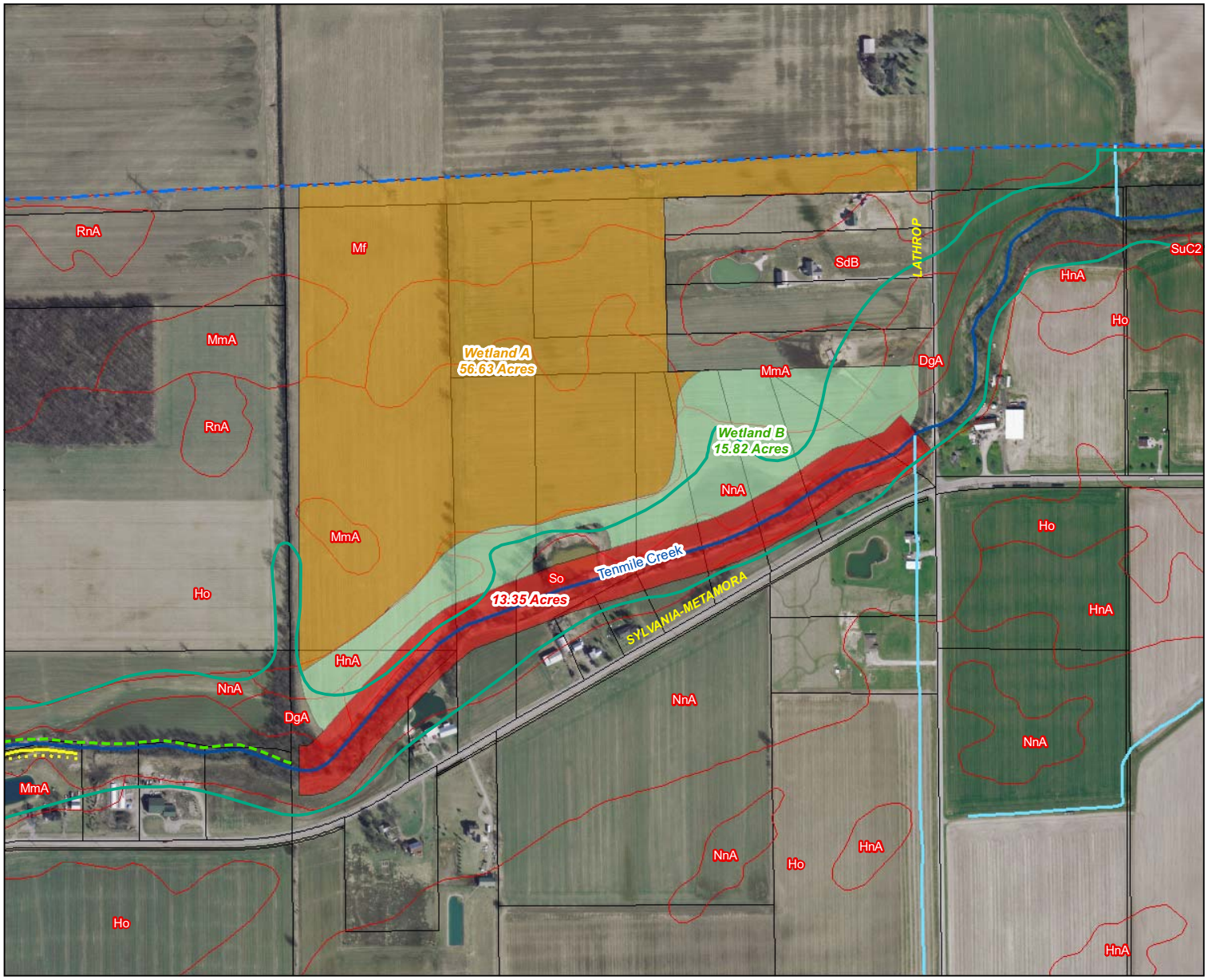
Preliminary Cost Estimate

The estimated cost to construct the proposed projects is summarized in Table 4-31. This project can be constructed in phases as funding becomes available.

Table 4-31
Estimated Cost Summary for Site OR-58

Project	Quantity	Unit	Unit Cost	Total Cost
Natural Channel Restoration	2100	linear foot	$275	$577,500
Riparian Buffer Enhancement	10.17	acre	$11,000	$111,870
Wildlife Enhancement	26.77	acre	$3,000	$80,310
Repair Damage from Equipment Crossing	50	linear foot	$1,500	$75,000
Annual Maintenance (natural channel)	2100	linear foot	$2	$4,200
Wetland Restoration A - emergent	24.25	acre	$14,000	$339,500
Wetland Restoration B - emergent	8.97	acre	$14,000	$125,580
Wetland Restoration C - emergent	7.48	acre	$14,000	$104,720
Wetland Restoration D - emergent	2.35	acre	$14,000	$32,900
Wetland Restoration E - emergent	9.48	acre	$14,000	$132,720
			Estimated Total Construction Cost	**$1,584,300**

SITE OR-59



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

Prepared for:

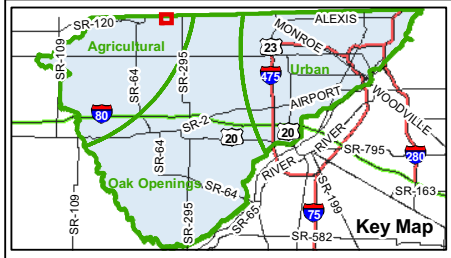
Partners for Clean Streams

Partners for Clean Streams, Inc.
P.O. Box 822
Bowling Green, Ohio 43402
www.PartnersForCleanStreams.org

Prepared by:

Mannik & Smith Group, Inc.

Hull & Associates, Inc.



Legend

- Project Boundary
- Parcels
- Existing Wetlands
- Wetland Restoration Areas
- Ditch/Linear Wetland Restoration
- Emergent Zone
- Deep Water Emergent Zone
- Floating-leaved Bed Zone
- Forested Zone
- Riparian Buffer Zone
- 100 year Floodplain
- 2005 Soil Classification
- Access Road/Trail
- Streams
- QHEI
- HHEI
- Severe Bank Erosion
- Ohio Rivers and Streams
- Streams
- Intermittent Stream

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-20
Restoration/Enhancement Plan for OR-59
Richfield Township, Lucas County, Ohio

County Map of Ohio

0 200 400 800 Feet

1:4,800

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: DAO002
File Name: DAO002_Concept2_Fig4-20_SiteOR-59.mxd
Date: March, 2009

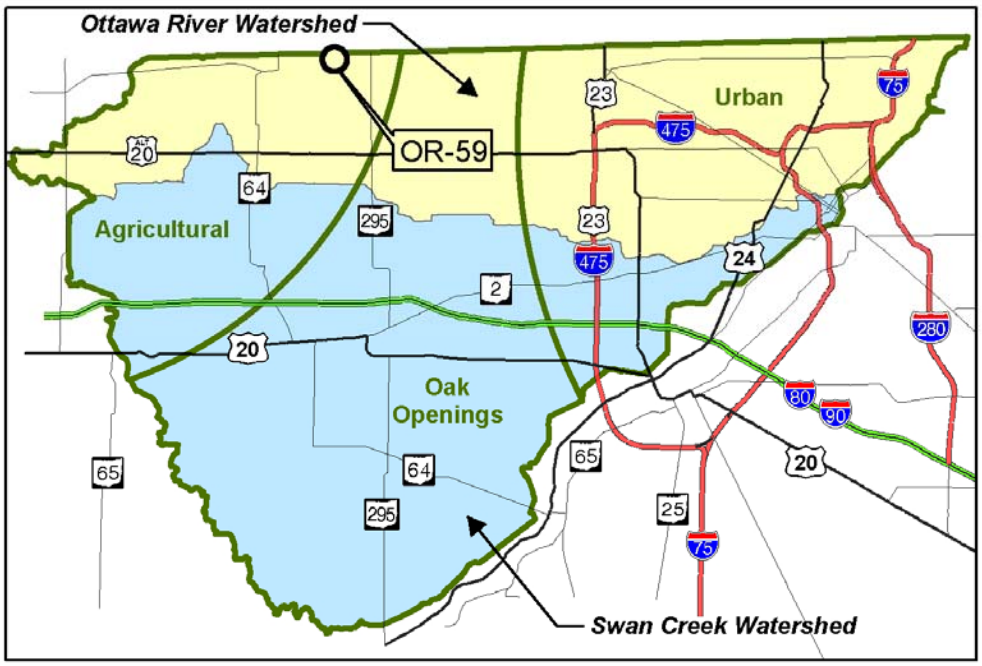
SITE OR-59
STREAM AND NON-ISOLATED WETLAND RESTORATION

Project Description:
Stabilize 1000 linear feet of streambank
Restore up to 73 acres of palustrine wetlands
Plant 13.35 acres of wooded riparian corridor

General Restoration/Enhancement Concept:
Restoration/Enhancement Large Stream
Wetland Restoration/Enhancement on Clay Soils
Restoration/Enhancement of Riparian Buffers

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 28.1 sq. mi.
County: Lucas **Municipality**: Richfield Township **Location:** 83°51' 54.12"W 41°43' 05.07"N
Stream: Tenmile Creek
Watershed: Ottawa River HUC 0410000103 (Frontal Lake Erie)
Wetland: None
Stream buffers: None
Surrounding land use: Row crop
Field-estimated gradient: 0.05 to 0.1%
Ohio Gazetteer published average gradient: 0.09% (4.7 feet per mile)



SITE OR-59
STREAM AND NON-ISOLATED WETLAND RESTORATION

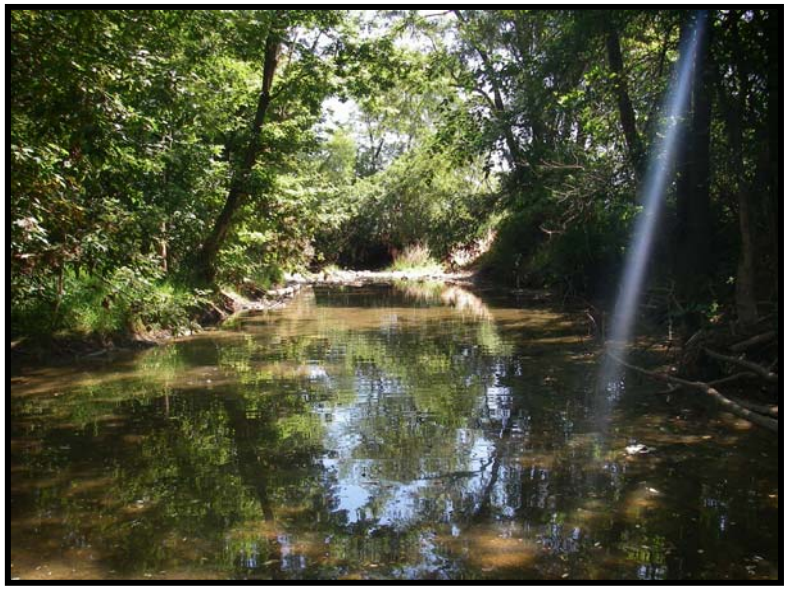
Agricultural Subregion

Site Description

The site consists of up to 14 agricultural parcels comprising 102.25 acres, located north of Sylvania-Metamora Road and west of Lathrop Road in Richfield Township, Lucas County, Ohio (Figure 4-20).

Existing Site Conditions

Tenmile Creek is a low-gradient stream with significant agricultural tile influence; however, this stream has a large watershed and its hydrology and channel formation processes are driven by bankfull (not benchfull) flows. Row crops are planted up to the edge of low-quality, narrow (averaging 10- to 15-foot) riparian buffers on the left bank. Residential areas and row crop agriculture abut the right bank (south) and some properties have septic or leach field overflow tiles which drain directly into the stream. Gradient/stream power is evidently sufficient to move silt, sand and gravel substrates. Resulting substrates in riffles are moderately stable and dominated by sand and gravel with low embeddedness. Some cobble and boulder-sized substrate was noted. There is evidence of lateral erosion and subsequent bank repair indicates that channel flow capacity is maintained by natural processes. It is unknown whether this portion of the stream is mechanically deepened



Tenmile Creek facing upstream

Junction of UNT with Ten Mile Creek

occasionally. If cleanouts have occurred, the time period between such activities is sufficient for recovery of many good habitat features, including moderate quality instream cover and fair to good channel morphological development. Pools dominate the stream patterning. These pools are often shaded, providing fish refuge. The most noticeable instability and degrading influence on habitat quality is evidence of periodic torrential/flashy flows (not observed directly) that are confined to a moderately entrenched channel (<2.0) leading to high shear stresses and lateral scouring on the outside of meander bends and adjacent to transverse gravel bars. The QHEI score for this sample reach of Tenmile Creek was 68.

There are no existing wetlands at Site OR-59. The majority of the soils are mapped as Hoytville clay loam (Ho) and Mermill loam (Mf) both of which are hydric. Other soils mapped on the site include: Metamora sandy loam, 0-3% slopes (MmA), which is nonhydric but may contain unmapped inclusions of hydric Mermill soils, and Nappanee loam, 0-3% slopes (NnA), which is nonhydric but may contain unmapped inclusions of the hydric Hoytville loam.

Stream Enhancement and Wetland Restoration Strategy

The following measures can be implemented to enhance the quality of the stream at this site:

Left bank of Tenmile Creek

- Repair severe streambank erosion. Areas in need of repair (particularly on outside of meanders) must be determined through a detailed survey (see *Restoration/Enhancement of Large Streams* concept).
- Widen the wooded riparian buffer to 50 feet from the top of each bank consistent with the *Restoration/Enhancement of Riparian Buffers* concept, and incorporate 20-foot wide maintenance access road along one bank.
- Implement limited sediment bar and selective snag removal per Ohio Drainage Manual guidelines.

Up to 72.8 acres of non-isolated wetland may be restored on this site. Restoration efforts could be accomplished in a series of smaller projects initially focused on the areas closest to Tenmile Creek. Depending on the amount of agricultural weeds present at the time restoration is initiated, a glyphosphate herbicide may be needed to eradicate these species. After this

application, some simple grading would be necessary prior to planting. This grading would create shallow rises and swales that would increase both floral and faunal diversity (see *Wetland Restoration/Enhancement on Clay Soils* concept). Grading would then be followed by seeding of herbaceous species that are adapted to this type of emergent community. A diverse emergent seed mix can be used at the site.

Streambank stabilization is best accomplished by installation of in-stream structures to reduce shear stress on the streambanks, including J-hooks, or other structures, accompanied by streambank regrading and stabilizing with grass and shrub plantings (bioengineering techniques). This site plan assumes that ten locations of severe streambank erosion will be identified, each 100 feet in length, each requiring installation of two J-hooks and 100 feet of streambank regrading and replanting.

Water quality at this site will benefit from efforts to reduce the amount of sediment inputs from surrounding land uses, and efforts to repair and maintain on-site septic systems that discharge to the stream.

Potential Stream Enhancement and Wetland Restoration Goals

Implementation of the measures described above will improve the quality of Tenmile Creek and the adjacent riparian habitat by:

- Restoring up to 72.8 acres of high quality Category 2 or 3 wetlands on the site;
- Stabilizing the existing stream bank; and
- Enhancing up 13.35 acres of riparian buffer.

These improvements should be reflected in:

- An increase in the QHEI of Tenmile Creek;
- A reduction into siltation and embeddedness in the stream;
- An increase in the diversity of vegetation within riparian zone; and
- An improvement in the quality of fish and macroinvertebrate communities in the creek.

Preliminary Cost Estimate

Various components of this project can be constructed independently of one another as funding opportunities become available. A summary of the estimated costs for this site are provided in Table 4-32.

SITE OR-59 STREAM AND NON-ISOLATED WETLAND RESTORATION

Table 4-32 Estimated Cost Summary for Site OR-59				
Project	Quantity	Unit	Unit Cost	Total Cost
Design and Install J-Hooks	20	each	$1,500	$30,000
Streambank Restoration and Vegetation (100 linear feet each)	10	each	$2,500	$25,000
Riparian Buffer Enhancement	13.35	acre	$11,000	$146,850
Wetland Restoration A - emergent	56.63	acre	$14,000	$782,820
Wetland Restoration B - forested	15.82	Acre	$16,000	$253,120
Estimated Total Construction Cost				**$1,247,790**

SITE OR-59
STREAM AND NON-ISOLATED WETLAND RESTORATION

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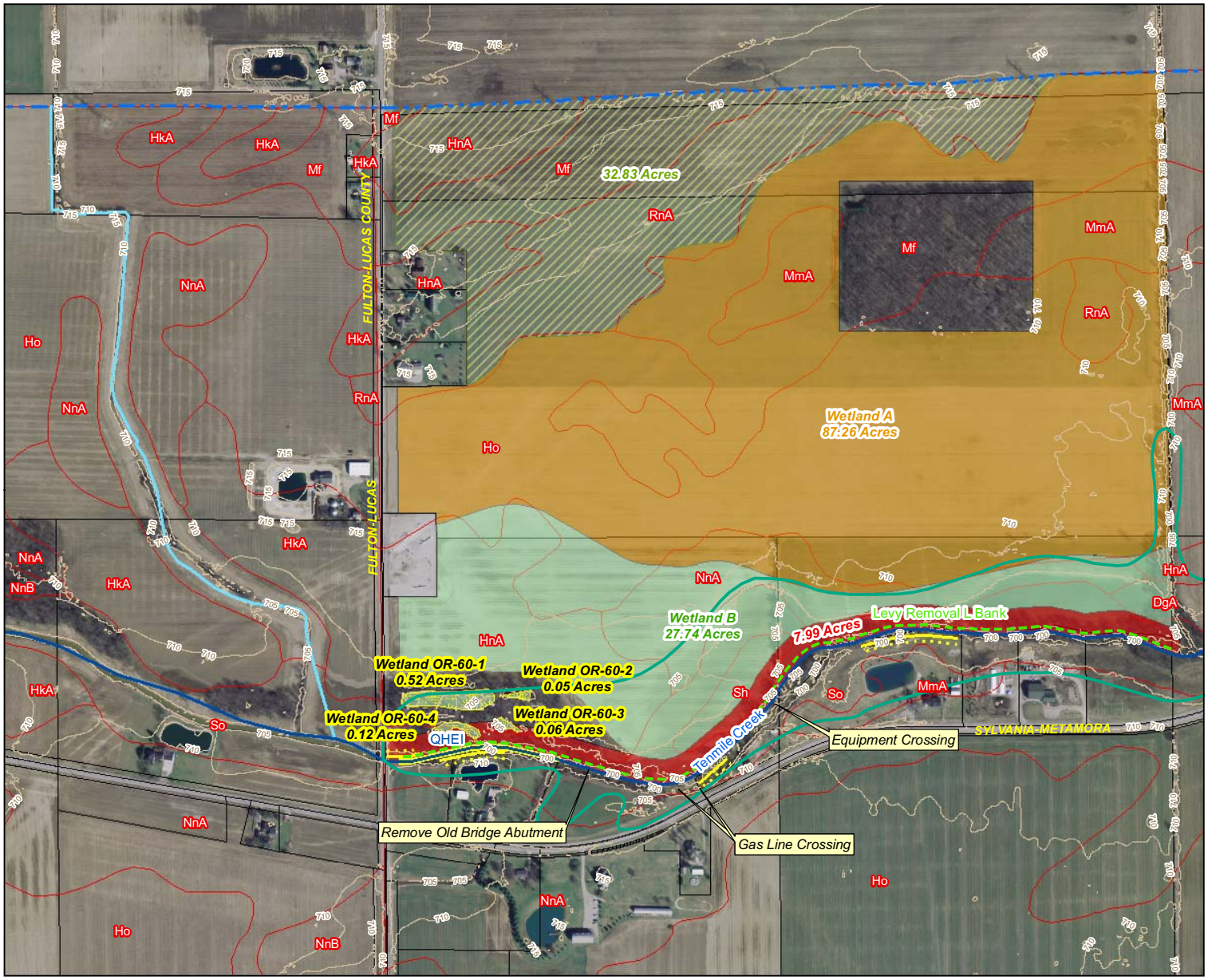
SITE OR-60



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

Prepared for:

Partners for Clean Streams

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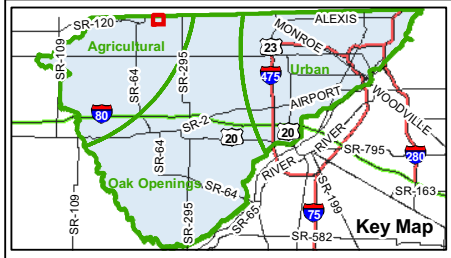


Legend

- Project Boundary
- Parcels
- Existing Wetlands

Wetland Restoration Areas

- Wildlife Enhancement
- Ditch/Linear Wetland Restoration
- Emergent Zone
- Deep Water Emergent Zone
- Floating-leaved Bed Zone
- Forested Zone
- Riparian Buffer Zone
- 100 year Floodplain
- 2005 Soil Classification
- Access Road/Trail
- 5' Contour

Streams

- QHEI
- HHEI
- Severe Bank Erosion

Ohio Rivers and Streams

- Streams
- Intermittent Stream

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-21
Restoration/Enhancement Plan for OR-60
Richfield Township, Lucas County, Ohio

County Map of Ohio

0 200 400 800 Feet

1:4,800

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: DAO002
File Name: DAO002_Concept2_Fig4-21_SiteOR-60.mxd
Date: March, 2009

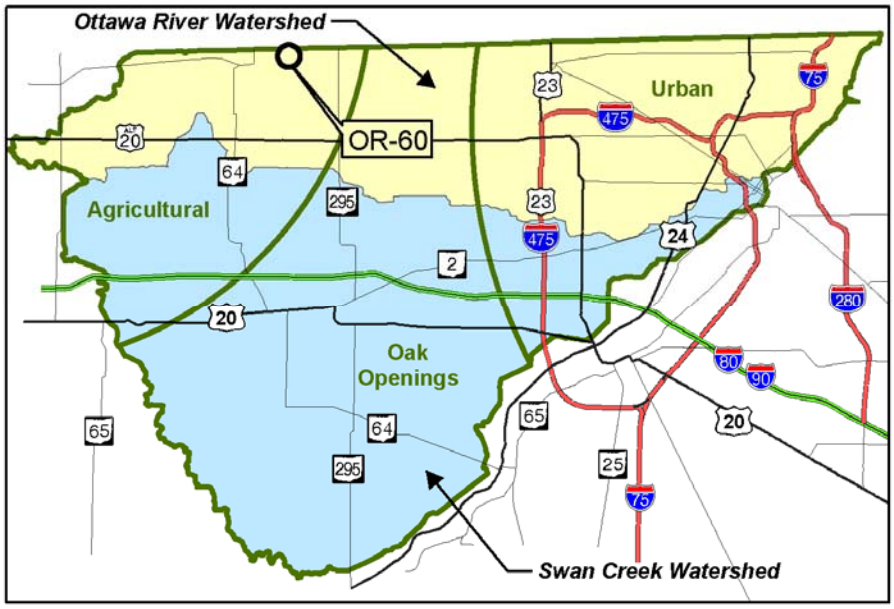
SITE OR-60
STREAM AND NON-ISOLATED WETLAND RESTORATION

Project Description:
Stabilize 3200 linear feet of streambank
Enhance 32.83 acres of upland buffer
Create up to 115 acres of palustrine wetland
Plant 7.99 acres (L bank only) of wooded riparian corridor

General Restoration/Enhancement Concept:
Restoration/Enhancement of Large Streams
Wetland Restoration/Enhancement on Clay Soils
Restoration/Enhancement of Riparian Buffers

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 25.9 sq. mi.
County: Lucas **Municipality**: Richfield Township **Location:** 83°52' 28.45"W 41°43' 00.87"N
Stream: Tenmile Creek
Watershed: Ottawa River HUC 0410000103 (Frontal Lake Erie)
Wetlands: OR-60-1 (palustrine emergent); OR-60-2 (palustrine emergent); OR-60-3 (palustrine emergent/shrub); OR-60-4 (palustrine emergent/shrub)
Stream buffers: Moderate; low to moderate (wooded) quality
Surrounding land use: Row crop and residential
Field-estimated gradient: 0.1%
Ohio Gazetteer published average gradient: 0.09% (4.7 feet per mile)



SITE OR-60 STREAM AND NON-ISOLATED WETLAND RESTORATION

Site Description

The site consists of up to six agricultural parcels comprising 181.65 acres, located north of Sylvania-Metamora Road and east of Fulton-Lucas County Road in Richfield Township, Lucas County, Ohio (Figure 4-21).

Existing Site Conditions

At this location, Tenmile Creek is a low-gradient stream with agricultural tile influence; however, this stream has a large watershed and its hydrology and channel formation processes are driven by bankfull (not benchfull) flows. Row crops have been planted up to the edge of narrow (averaging 20-25 feet) riparian areas in some areas on the left bank. Residential parcels are located along the right bank (south). Gradient/stream power is evidently sufficient to move silt, sand and gravel substrates. Resulting substrates in riffles are moderately stable and dominated by sand and gravel with low embeddedness. There is evidence of lateral erosion and attempts at bank repair. The stream has moderate quality instream cover and fair to good channel morphological development. Pools dominate the stream patterning, although the depths of the pools are not sufficient to support predatory fish species. These pools are often shaded, providing fish refuge and water temperature

Wetland OR-60-1

Wetland OR-60-2

SITE OR-60 STREAM AND NON-ISOLATED WETLAND RESTORATION

control. The most noticeable instability and degrading influence on habitat quality is evidence of periodic torrential/flashy flows (not observed directly) that are confined to a moderately entrenched channel (<2.0) leading to high shear stresses and lateral scouring on the outside of meander bends and adjacent to transverse gravel bars. The QHEI score for this sample reach of Tenmile Creek was 51. Pool/glide and riffle/run quality were low, as well as channel morphology.

Wetland OR-60-3

There are four existing wetlands at Site OR-60, all located in the forested area just east of the Fulton-Lucas County Road. Wetland OR-60-1 is a nonisolated emergent wetland with some forested portions. It is dominated in the canopy by green ash (*Fraxinus pennsylvanica*) and in the herb layer by iris (*Iris versicolor*), beggar's ticks (*Bidens frondosa*), and moneywort (*Lysimachia nummularia*). Wetland OR-60-1 is located in an area mapped as Haskins loam, 0-3% slopes (HnA) a nonhydric soil unit that may contain unmapped inclusions of the hydric Mermill loam (Mf). In the field, soils were found to be hydric. Hydrology indicators at the time of evaluation included watermarks on trees, drainage patterns, and a positive FAC-neutral test. Wetland OR-60-1 is a Modified Category 2 wetland. The ORAM score was 43 and was strongly influenced by moderate buffers and hydrology.

Wetland B is a nonisolated emergent wetland with forested portions. It is dominated by box elder (*Acer negundo*) and swamp white oak (*Quercus bicolor*) in the canopy, poison ivy (*Toxicodendron radicans*) in the vine layer, and duckweed (*Lemna minor*) in the herb layer. Wetland B is located in an area mapped as HnA. Because the wetland was dominated by true aquatic species, a soil analysis was not performed. Hydrology indicators at the time of evaluation included inundation, saturated soils, water marks on trees, and a positive FAC-neutral test. Wetland or-60-2 is a Modified Category 2 wetland. The ORAM score was 41 and was strongly influenced by moderate buffers and hydrology.

Wetland OR-60-3 is a nonisolated emergent wetland with some scrub-shrub portions. The canopy is dominated by box elder and swamp white oak, and the herb layer is dominated by

lake sedge (*Carex lacustris*) and moneywort. Wetland OR-60-3 is located in an area mapped as HnA. This soil type was not confirmed in the field, as soils were found to be hydric. Hydrology indicators at the time of evaluation included water marks on trees, water-stained leaves, and a positive FAC-neutral test. Wetland OR-60-3 is a Modified Category 2 wetland. The ORAM score was 39 and was strongly influenced by wide buffers and hydrology.

Wetland OR-60-4 is an emergent wetland with some forested portions. The canopy is dominated by green ash and slippery elm (*Ulmus rubra*), the shrub layer by green ash, and the herb layer by moneywort. Wetland OR-60-4 is located in an area that is mapped as Sloan loam, occasionally flooded (So), a hydric soil unit. This soil type was confirmed in the field as soils were found to by hydric. Wetland OR-60-4 is a Modified Category 2 wetland. The ORAM score was 36 and was strongly influenced by wide buffers, hydrology, and habitat development.

The wetlands on this site appear to have been part of a natural stream channel that flowed southeast into Tenmile Creek. This stream channel was apparently abandoned when Tenmile Creek was routed through the culverted road crossing at the upstream end of the site.

Away from the four wetlands, the majority of the soils are mapped as Hoytville clay loam (Ho) and Mermill loam (Mf) both of which are hydric. Other soils mapped on the site include: Metamora sandy loam, 0-3% slopes (MmA), Nappanee loam, 0-3% slopes (NnA), and Rimer loamy fine sand, 0-3% slopes (RnA), which are non-hydric but may contain hydric inclusions.

Fish species observer at this location is listed in Table 4-33.

SITE OR-60 STREAM AND NON-ISOLATED WETLAND RESTORATION

Table 4-33 Fish Samples at Site OR-60 (Tenmile Creek)					
Common Name[1]	Species[1]	Feed Guild[2]	Tol.[3]	# of Fish	Avg. Wt. (grams)
Yellow Bullhead	*Ameiurus natalis*	I	T	1	95.00
Stoneroller	*Campostoma anomalum*	H	N/A	99	1150.00
Goldfish*	*Carassius auratus*	O	T	2	2400.00
White Sucker	*Catostomus commersonii*	O	T	103	68.10
Rainbow Darter	*Etheostoma caeruleum*	I	M	5	2.50
Johnny Darter	*Etheostoma nigrum*	I	N/A	88	3.00
Green Sunfish	*Lepomis cyanellus*	I	T	7	36.70
Bluegill Sunfish	*Lepomis macrochirus*	I	P	17	2.50
Largemouth Bass	*Micropterus salmoides salmoides*	C	M	1	51.80
Common Shiner	*Notropis cornutus*	I	N/A	78	21.40
Spotfin Shiner	*Notropis spilopterus*	I	N/A	124	1.00
Sand Shiner	*Notropis stramineus*	I	M	10	3.00
Blackside Darter	*Percina maculata*	I	N/A	8	2.74
Bluntnose Minnow	*Pimephales notatus*	O	T	337	10.30
Fathead Minnow	*Pimephales promelas*	O	T	179	10.30
Creek Chub	*Semotilus atromaculatus*	G	T	104	176.20

** Non-native*
[1] according to ODNR, Division of Wildlife guide http://www.dnr.state.oh.us/tabid/17913/Default.aspx
[2] Feeding Guild: P - Piscivore, F - Filter Feeder, V - Invertivore, I - Specialist Insectivore, O - Omnivore, G - Generalist, H - Herbivore, C - Carnivore, N/A = Not assigned.
[3] Tolerance Guild: R - Rare Intolerant, S - Special Intolerant, I - Common Intolerant, M - Moderately Intolerant (Headwaters), T - Highly Tolerant, P - Moderately Tolerant, N/A = Not assigned.

Macroinvertebrates observed at this location are listed in Table 4-34.

Table 4-34 Macroinvertebrate Samples at Site OR-60 (Tenmile Creek)				
Elevated Taxa	Lowest Taxa	Common Name	Tolerance	Number Collected
Crustacea	*Orconectes*	crayfish	6	3
Crustacea	*Asellus* sp.	isopod	8	3
Ephemeroptera	*Caenis* sp.	mayfly	7	2
Gastropoda	*Physa* sp.	snail	8	2
Pelecypoda	Pelecypoda	clam	6 to 8	2
Odonata	Undetermined	dragonfly	8	1
Odonata	*Enallagna* sp.	damselfly	8	1

SITE OR-60 STREAM AND NON-ISOLATED WETLAND RESTORATION

Stream and Wetland Enhancement and Wetland Restoration Strategy

The following measures can be implemented to enhance the quality of the stream at this site:

- Remove the 3- to 4-foot-tall levy that runs the entire length of the left or north bank of Tenmile Creek. This levy was presumably constructed from material dredged from the stream to protect the low-lying cropland on the left bank from flooding.
- Repair severe streambank erosion. Areas in need of repair (particularly on outside of meanders) must be determined through a detailed survey (see *Restoration/ Enhancement of Large Streams* concept).
- Widen the wooded riparian buffer to 50 feet from the top of the left bank consistent with the *Restoration/Enhancement of Riparian Buffers* concept.
- Implement limited sediment bar and selective snag removal per Ohio Drainage Manual guidelines.

Removal of the left bank levy will significantly enhance the hydrology of the existing wetlands, and also allow the floodplain areas currently in crops to revert to wetland. The four existing wetlands in the abandoned stream channel will be enhanced by levy removal and also by connecting them with the floodplain wetlands that will be restored on the left bank.

Up to 115 acres of non-isolated wetland can be restored on site. Restoration efforts could be accomplished in a series of smaller projects initially focused on the areas closest to Tenmile Creek. Depending on the amount of agricultural weeds presenting at the time restoration is initiated, a glyphosphate herbicide may be needed. After this application, some simple grading would be necessary prior to planting. This grading would create shallow hills and swales that would increase both floral and faunal diversity (see *Wetland Restoration/Enhancement on Clay Soils* concept). Grading would then be followed by seeding of herbaceous species that are adapted to this type of emergent community. A diverse emergent seed mix can be placed in this marsh.

Potential Stream Enhancement and Wetland Restoration Goals

Implementation of the measures described above will improve the quality of Tenmile Creek and the adjacent riparian habitat by:

- Removing a 3- to 4-foot high berm that runs the length of the stream;
- Restoring up to 115 acres of high quality Category 2 or 3 wetlands on the site;
- Enhancing up to 33 acres of upland wildlife habitat;
- Stabilizing up to 1,000 feet of the existing stream bank; and
- Enhancing up to 7.99 acres of riparian buffer.

SITE OR-60 STREAM AND NON-ISOLATED WETLAND RESTORATION

These improvements should be reflected in:

- An increase in the QHEI of 3 to 5 points;
- An increase in stream bank stability at needed locations to meet specific sediment and nutrient reduction targets;
- A reduction in the frequency of needed ditch cleanout; and
- And improvement in the quality of fish and macroinvertebrate communities in the creek.

Preliminary Cost Estimate

The estimated cost to construct the proposed projects is summarized in Table 4-35. Various portions of this project can be constructed independently of one another as funding opportunities become available. A summary of the estimated costs for this site are provided.

Table 4-35
Estimated Cost Summary for Site OR-60

Project	Quantity	Unit	Unit Cost	Total Cost
Remove Left-Bank Levy	3200	linear foot	$5	$16,000
Design and Install J-Hooks	20	each	$1,500	$30,000
Streambank Restoration and Vegetation (100 linear feet each)	10	each	$2,500	$25,000
Riparian Buffer Enhancement	7.99	acre	$11,000	$87,890
Wetland Restoration A - emergent	87.26	acre	$14,000	$1,221,640
Wetland Restoration B - forested	27.74	acre	$16,000	$443,840
Wildlife Enhancement (upland)	32.83	acre	$3,000	$98,490
Estimated Total Construction Cost				**$1,922,860**

SITE OR-60
STREAM AND NON-ISOLATED WETLAND RESTORATION

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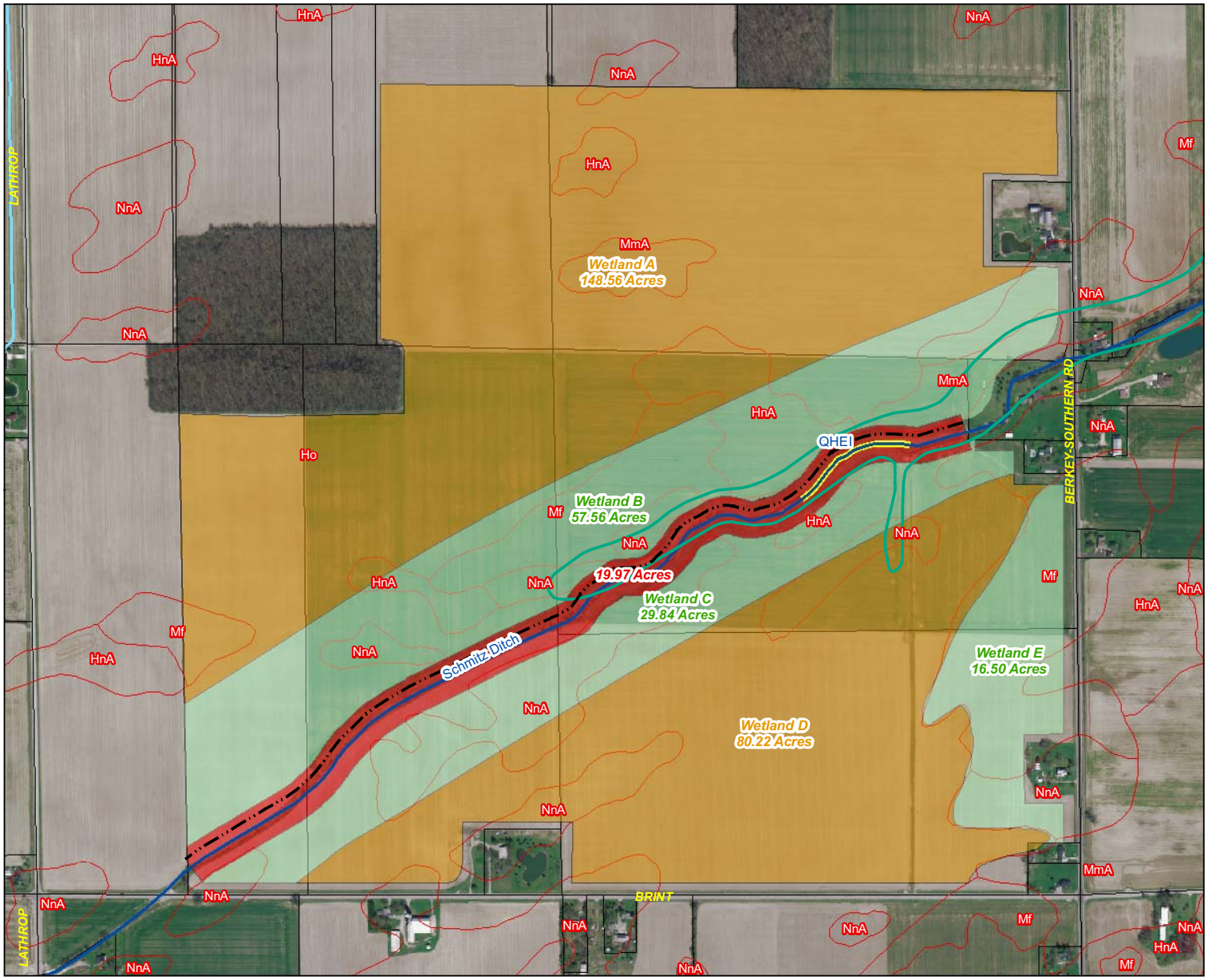
SITE OR-61



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

Prepared for:

Partners for Clean Streams

Partners for Clean Streams, Inc.
P.O. Box 822
Bowling Green, Ohio 43402
www.PartnersForCleanStreams.org

Prepared by:

Mannik & Smith Group, Inc.

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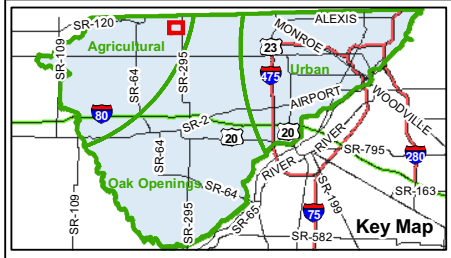


Legend

- Project Boundary
- Parcels
- Existing Wetlands

Wetland Restoration Areas

- Ditch/Linear Wetland Restoration
- Emergent Zone
- Deep Water Emergent Zone
- Floating-leaved Bed Zone
- Forested Zone
- Riparian Buffer Zone
- 100 year Floodplain
- 2005 Soil Classification
- Access Road/Trail

Streams

- QHEI
- HHEI
- Severe Bank Erosion

Ohio Rivers and Streams

- Streams
- Intermittent Stream

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-22
Restoration/Enhancement Plan for OR-61
Richfield Township, Lucas County, Ohio

County Map of Ohio

0 250 500 1,000 Feet

1:6,000

NOTES:
The Lucas County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: DAO002
File Name: DAO002_Concept2_Fig4-22_SiteOR-61.mxd
Date: March, 2009

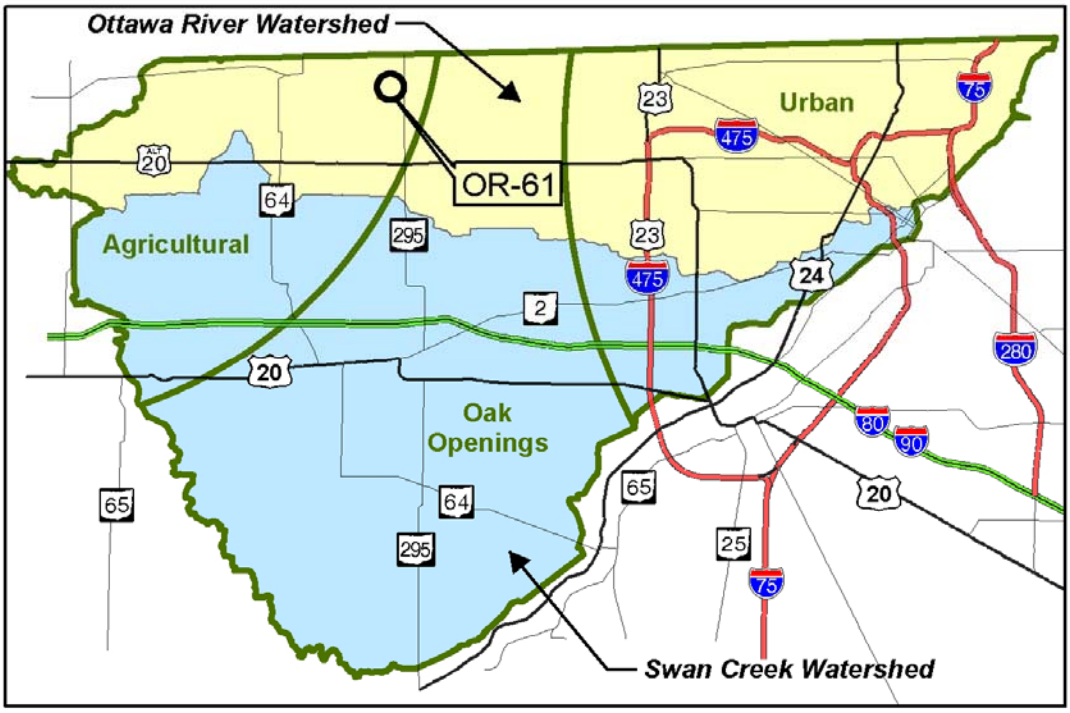
SITE OR-61
STREAM AND NON-ISOLATED WETLAND RESTORATION

Project Description:
Restore up to 333 acres of palustrine wetland
Restore 2500 feet of stream channel
Plant 20 acres of riparian corridor

General Restoration/Enhancement Concept:
Restoration/Enhancement of Large Streams
Wetland Restoration/Enhancement on Clay Soils
Restoration/Enhancement of Riparian Buffers

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 68.7 sq. mi.
County: Lucas **Municipality**: Waterville Township **Location:** 83°50' 50.38"W 41°42' 22.23"N
Stream: Schmidtz Ditch
Watershed: Ottawa River HUC 0410000103 (Frontal Lake Erie)
Wetland: None
Stream buffers: Narrow, low to moderate (wooded) quality
Surrounding land use: Residential, row crops
Field-estimated gradient: 0.1% (0.1 feet per hundred feet), low



SITE OR-61 STREAM AND NON-ISOLATED WETLAND RESTORATION

Site Description

The site consists of up to 11 agricultural parcels comprising 543.05 acres, located north of Brint Road in Richfield Township, Lucas County, Ohio (Figure 4-22).

Schmitz Ditch downstream sample reach and stream bank community

Existing Site Conditions

Schmitz Ditch is a low-gradient stream with significant agricultural tile influence; however, this stream has a large watershed and its hydrology and channel formation processes are driven by bankfull (not benchfull) flows. Row crop agriculture abuts the edge of low-quality, very narrow (averaging 8- to 10-foot) riparian areas on each bank. This stream was formerly a natural stream channel, but was modified to facilitate drainage in the area. It has been extensively hydrologically modified, and is maintained on a regular basis to remove accumulated sediments and restore sub-surface tile drainage from adjacent row-crop agriculture. The QHEI score for Schmitz Ditch was 39.5. Instream cover and buffer width/ quality were low, but higher than is typical for this type of stream.

A generalized channel cross-section (XS) for Schmitz Ditch is depicted in Figure 4-22. The cross-section was developed using the Digital Elevation Model (DEM) for Lucas County, Ohio. The generalized cross section shows the channel with its adjoining terraces (abandoned floodplains) on each bank, but the DEM is not sensitive enough to map active floodplain or provide detailed features of the channel such as bankfull features. The overall channel width (terrace to terrace) is about 35 feet, and the channel depth below the terraces is about 4.5 feet.

There are no existing wetlands at Site OR-61. The majority of the soils are mapped as Hoytville clay loam (Ho) and Mermill loam (Mf), both hydric soils, as well as Haskins loam, 0-3% slopes (HnA) which is non-hydric but may contain unmapped inclusions of the hydric Mermill loam unit.

SITE OR-61 STREAM AND NON-ISOLATED WETLAND RESTORATION

Stream Enhancement and Wetland Restoration Strategy

The following measures can be implemented to enhance the quality of Tenmile Creek in this area:

- Perform fluvial geomorphological survey and restore 2500 feet of stable stream planform, dimension and profile using natural channel design or other methods described in the *Restoration/Enhancement of Large Streams* concept.
- Widen the wooded riparian buffer to 50 feet from the top of each bank and incorporate 20-foot wide maintenance access track along one bank (see *Restoration/Enhancement of Riparian Buffers* concept).

Improvements in water quality can also be addressed by decreasing stormwater peak flow inputs and taking steps to decrease sediment and nutrient inputs from surrounding agricultural land uses.

Up to 130 acres of non-isolated wetland can also be restored at this site. Restoration efforts could be accomplished in a series of smaller projects initially focused on the areas closest to Schmitz Ditch. Depending on the amount of agricultural weeds presenting at the time restoration is initiated, a glyphosphate herbicide may need to be applied to the area. After this application, some simple grading would be necessary prior to planting. This grading would create shallow hills and swales that would increase both floral and faunal diversity (see *Wetland Restoration/ Enhancement on Clay Soils* concept). Grading would then be followed by seeding of herbaceous species that are adapted to this type of emergent community. A diverse emergent seed mix can be placed in wetland area 2.

Potential Stream Enhancement and Wetland Restoration Goals

Implementation of the measures described above will improve the quality of Tenmile Creek and the adjacent riparian habitat by:

- Enhancing up to 2,500 feet of existing stream channel;
- Restoring up to 130 acres of high quality Category 2 or 3 wetlands on the site; and
- Enhancing up to 20 acres of riparian buffer.

These improvements should be reflected in:

- An increase in the QHEI of 10 to 14 points;
- An increase in the Index of Biotic Integrity (IBI) by 3 to 6 points;
- A decrease in soil erosion from the site and a decrease in siltation of the stream;
- An increase in vegetation diversity within the riparian zone;
- A reduction in the frequency of needed stream cleanout; and
- An improvement in the quality of fish and macroinvertebrate communities in the creek.

SITE OR-61 STREAM AND NON-ISOLATED WETLAND RESTORATION

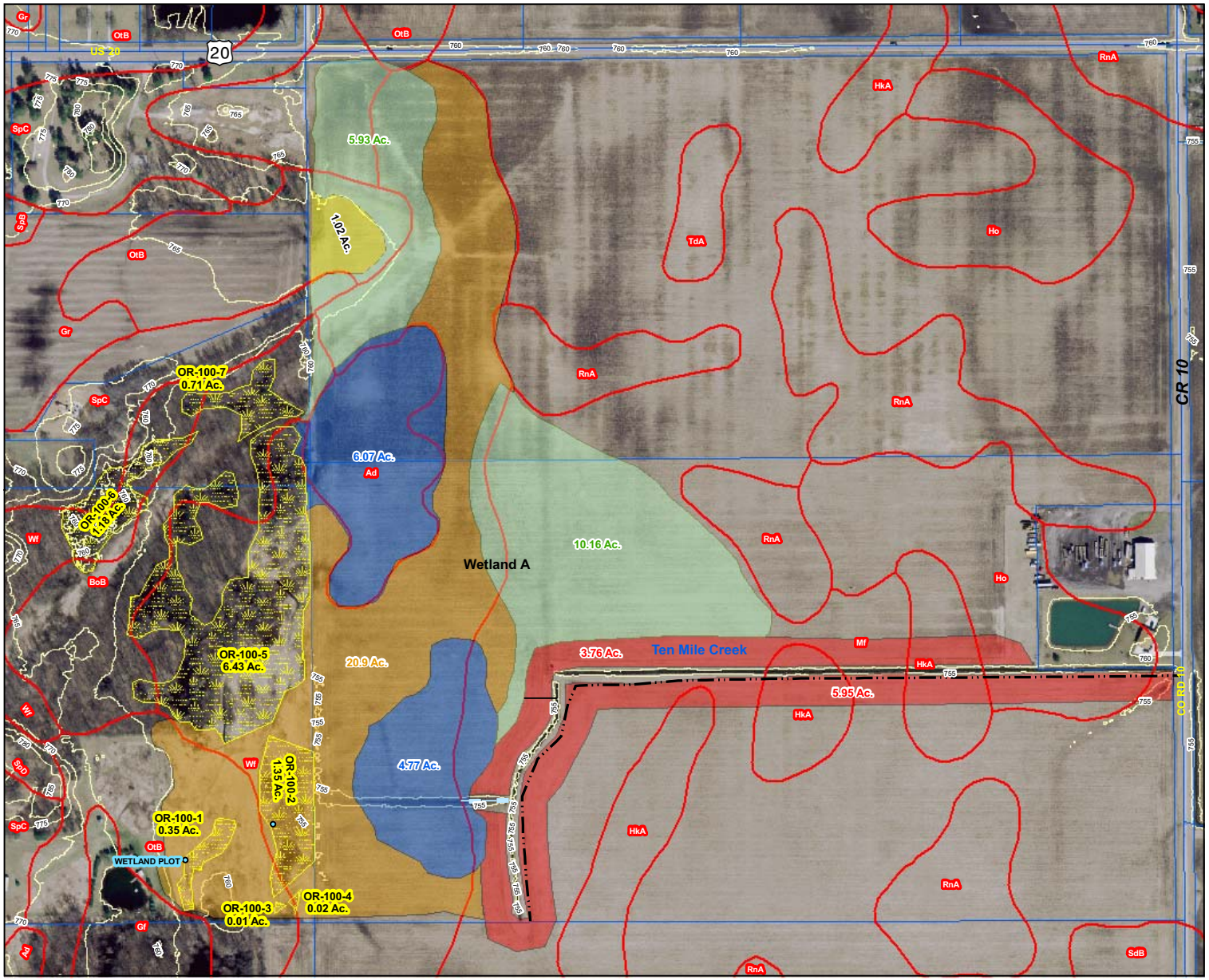
Preliminary Cost Estimate

The estimated cost to construct the proposed projects is summarized in Table 4-36. This project can be constructed in phases as funding opportunities become available.

Table 4-36
Estimated Cost Summary for Site OR-61

Project	Quantity	Unit	Unit Cost	Total Cost
Natural Channel Restoration	2500	linear foot	$275	$687,500
Riparian Buffer Enhancement	19.97	acre	$11,000	$219,670
Annual Maintenance (natural channel)	2500	linear foot	$2	$5,000
Wetland Restoration A - emergent	148.56	acre	$14,000	$2,079,840
Wetland Restoration B - forested	57.56	acre	$16,000	$920,960
Wetland Restoration C - forested	29.84	acre	$16,000	$477.440
Wetland Restoration D - emergent	80.22	acre	$14,000	$1,123,080
Wetland Restoration E - forested	16.50	acre	$14,000	$231,000
Estimated Total Construction Cost				**$5,744,490**

SITE OR-100



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

Prepared for:

Partners for Clean Streams, Inc.
P.O. Box 822
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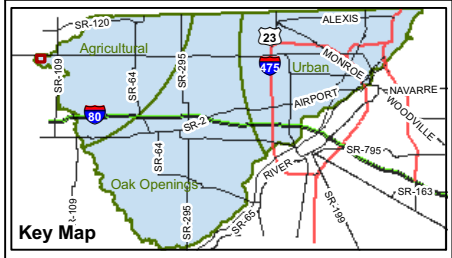


Legend

- Sample Plot
- 2005 Soils Classification
- Existing Wetland
- Parcel Line
- QHEI
- HHEI
- 5' Contour

Proposed Wetland Enhancement

- Wildlife Restoration
- Ditch Restoration
- Emergent
- Deep Water Emergent
- Floating-leaved Bed
- Forested
- Riparian Buffer
- OutFlow Structure
- Trail/Access Road

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-23
Restoration/Enhancement Plan for OR-100
Royalton Township, Fulton County, Ohio

County Map of Ohio

0 150 300 600 Feet

1:3,600

NOTES:
The Fulton County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: P163A1A
File Name: P163A1A_FultonSites.mxd
Date: February 19, 2009

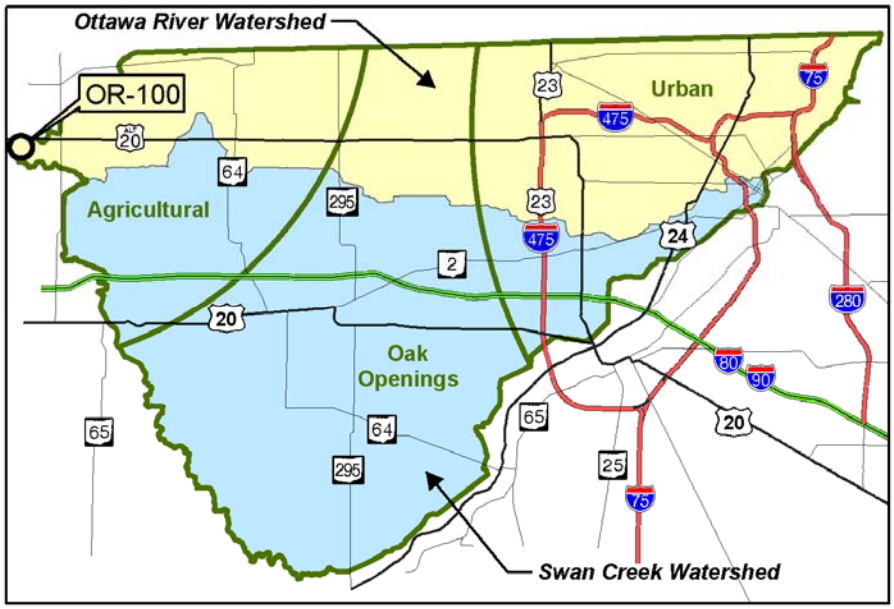
SITE OR-100
STREAM, ISOLATED AND NON-ISOLATED WETLAND RESTORATION

Project Description:
Restore 46.1 acres of palustrine wetland
Enhance 1.73 acres of emergent wetland
Plant 9.71 acres of riparian corridor
Enhance 2600 feet of Tenmile Creek
Enhance 1.02 acres of upland buffer

General Restoration/Enhancement Concept:
Historically Channelized Waterways in Sandy Soils
Wetland Restoration/Enhancement on Sandy Soils

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 0.19 sq. mi.
County: Fulton **Municipality**: Royalton Township **Location:** 84°03' 46.74"W 41°39' 57.93"N
Stream: Unnamed tributary to Tenmile Creek (QHEI = 21.5)
Watershed: Ottawa River HUC 0410000103 (Frontal Lake Erie)
Wetlands: OR-100-1 (invasive-dominated emergent); OR-100-2 (invasive-dominated emergent); OR-100-3 (invasive-dominated emergent); OR-100-4 (invasive-dominated emergent); OR-100-5 (invasive-dominated emergent and forested); OR-100-6 (forested depression) and OR-100-7 (forested depression); combined ORAM 27.5
Stream buffers: Narrow, low to moderate (wooded) quality
Surrounding land use: Row crop, residential
Field-estimated gradient: 0.1% (0.1 feet per hundred feet), low



SITE OR-100 STREAM, ISOLATED AND NON-ISOLATED WETLAND RESTORATION

Site Description

The site is divided into three large parcels located at the headwaters of Tenmile Creek. The restoration area is located immediately south of US 20 and east of County Road 10-3 and west of County Road 10 in Royalton Township, Fulton County (Figure 4-23). Approximately a quarter of the site is comprised of old field and wetlands along the western edge of a large residence. This abuts two large agricultural fields to the east. One of these two fields contains the ultimate headwaters of Tenmile Creek.

Spring-fed pond, flows out to the western wetlands.

Existing Site Conditions

Seven wetlands were identified at the site. These wetlands vary from 0.01 acre to 6.43 acres in size. Wetlands OR-100-1 through OR-100-4 are palustrine emergent wetlands that are heavily infested with reed canary grass (*Phalaris arundinacea*). Wetland OR-100-5 also has a large invasive dominated portion of the wetland. Wetlands OR-100-6 and OR-100-7 are high quality swamp forests.

The majority of the existing soils are mapped as the hydric Adrian muck (Ad), Mermill loam (Mf) and Wauseon fine sandy loam (Wf). Other soils types present were Ottokee fine sand, 0 to 6 percent slopes (OtB) and Blount-Rimer complex (BoB) fine sand, 0 to 3 percent slopes. These other soils

Old field area intermixed with small wetlands

SITE OR-100 STREAM, ISOLATED AND NON-ISOLATED WETLAND RESTORATION

are listed as non-hydric; however, they may contain hydric inclusions according to Fulton County.

The HHEI score for this stream was a 51 due to the depth of the ditched stream and the 7-foot average width. The non-existent buffer through the agricultural fields is not calculated into the HHEI as it is in the QHEI. This relatively high HHEI would have not correlated to a high QHEI. Although this has a calculated drainage area of only 0.19 square mile, it seems to receive water from the spring-fed pond to the west, which would feed it a constant water supply.

Wetland OR-100-1 is a 0.34 acre wetland dominated by narrow-leaved cat-tail (*Typha angustifolia*) and reed canary grass. Wetland OR-100-2 (1.35 acres), Wetland OR-100-3 (0.01 acre) and Wetland OR-100-4 (0.02 acre) are similar wetlands separated by small patches of Canada goldenrod (*Solidago canadensis*) and tall fescue (*Festuca arundinacea*). Soils sampled were characterized as black (10YR 2/1) sandy loam followed by at least 6 inches of dark gray (10YR 4/1) or dark grayish brown (10YR 4/2) sandy loam. Also, these wetlands all receive ground water from the spring fed pond. Wetland OR-100-5 also has a reed canary grass dominated area. The wetland then continues into the large forested area to the north where it contains a large vernal pool. Wetlands OR-100-6 and OR-100-7 are high quality diverse swamp forests. The ORAM score for all these wetlands was a 66.5, which correlates to a Category 3 wetland. This is a high quality wetland based on its size, several vegetation communities, a lack of disturbance to the hydrology and vegetation communities and several sources of hydrology.

Fish species observed at this location are listed in Table 4-37.

Table 4-37
Fish Samples at Site OR-100 (Tenmile Creek)

Common Name[1]	Species[1]	Feed Guild[2]	Tol.[3]	# of Fish	Avg. Wt. (grams)
Yellow Bullhead	*Ameiurus natalis*	I	T	1	-
Stoneroller	*Campostoma anomalum*	H	N/A	11	-
Goldfish*	*Carassius auratus*	O	T	5	-
White Sucker	*Catostomus commersonii*	O	T	19	-
Green Sunfish	*Lepomis cyanellus*	I	T	5	-
Largemouth Bass	*Micropterus salmoides salmoides*	C	N/A	12	-
Bluntnose Minnow	*Pimephales notatus*	O	T	12	-
Fathead Minnow	*Pimephales promelas*	O	T	7	-
Creek Chub	*Semotilus atromaculatus*	G	T	14	-

** Non-native*
[1] according to ODNR, Division of Wildlife guide http://www.dnr.state.oh.us/tabid/17913/Default.aspx
[2] Feeding Guild: P - Piscivore, F - Filter Feeder, V - Invertivore, I - Specialist Insectivore, O - Omnivore, G - Generalist, H - Herbivore, C - Carnivore, N/A = Not assigned.
[3] Tolerance Guild: R - Rare Intolerant, S - Special Intolerant, I - Common Intolerant, M - Moderately Intolerant (Headwaters), T - Highly Tolerant, P - Moderately Tolerant, N/A = Not assigned.

SITE OR-100 STREAM, ISOLATED AND NON-ISOLATED WETLAND RESTORATION

Macroinvertebrates observed at this location are listed in Table 4-38.

Table 4-38
Macroinvertebrate Samples at Site OR-100 (Tenmile Creek)

Elevated Taxa	Lowest Taxa	Common Name	Tolerance	Number Collected
Annelida	Oligochaeta	segmented worm	8	1
Annelida	Hirudinea	leech	6	3
Annelida	Hirudinea	leech	6	1
Coleoptera	Hydrophilidae	beetle	5	1
Crustacea	*Orconectes* sp *propiquus*	crayfish	6	2
Gastropoda	*Physa* sp.	snail	8	2
Gastropoda	*Helisoma*sp.	snail	6	2
Hemiptera	Corixidae	water bug	5	1
Hemiptera	Hemiptera	water bug	-	1
Odonata	*Anax* sp.	darner	8?	2

Restoration/Enhancement Strategy

Site OR-100 provides wetland restoration, enhancement and buffer restoration opportunities. The wetland enhancement and restoration can be combined to provide maximum benefit. Small-scale wetland enhancements can also be achieved without the wetland restoration by eliminating invasive species.

Archeological finds on property by land owner.

Enhancement opportunities can be achieved by improving Wetlands OR-100-1, OR-100-2, OR-100-3, OR-100-4 and a portion of OR-100-5. These wetlands can be enhanced by spraying the vegetation with a non-species specific glyphosate herbicide. Removal of the invasive species can then be paired with the planting of sedges and grasses that are adapted to this type of emergent community. A diverse emergent seed mix can be placed in this area (see *Wetland Restoration on Sandy Soils* concept).

SITE OR-100 STREAM, ISOLATED AND NON-ISOLATED WETLAND RESTORATION

Up to 46 acres of wetland can be restored on the site. Since this is such a large site and is on the line between two geographic zones (the Oak Openings region and the Black Swamp) a mixed restoration approached can be utilized. Grading this site to form large, deeper water emergent zones dominated by robust sedges and other species typical of the clay soil areas can be used in combination with the sedge meadow mixture used in the sandy soils concepts. Water depths may vary from saturated soil conditions (forested) to 4-12 inches of water (deep water emergent). As shown on the attached figure, such an approach would create 16.09 acres of forested wetland, 20.9 acres of emergent wetland and 10.84 acres of deep water emergent wetland. At these varying water depths, the wetland would have more water holding capacity to ease potential flooding downstream and increase both floral and faunal diversity (see *Wetland Restoration/Enhancement on Sandy Soils* concept).

The stream restoration site is an approximately 2600-foot long and 100-foot wide linear corridor along a headwater segment of Tenmile Creek. The restoration of this approximately 9.71-acre stream buffer would involve the creation of a forested/shrub boundary to shade the stream surface, slow surface run-off and inhibit blowing soils from the neighboring agricultural fields. Planting this area with woody species would slow sedimentation and erosion problems observed in the field (see *Restoration/Enhancement of Riparian Buffers* concept). The northwestern portion of this stream restoration would be continuous with the wetland restoration. It is expected that species such as American elm (*Ulmus americana*), eastern cottonwood (*Populus deltoides*), and several species of dogwood (*Cornus* spp.) and willow (*Salix* spp.) would come in naturally. Reconfiguring the shape of the stream as in the *Restoration/Enhancement of Historically Channelized Waterways in Sandy Soils* concept would allow for a wider bank full width, limit the amount of erosion within the channel, and improve the quality of substrate.

Potential Restoration Goals

Implementation of the measures described above will improve the quality of Tenmile Creek and the adjacent riparian habitat by:

- Enhancing up to 2,600 feet of existing stream channel;
- Restoring up to 46 acres of high quality Category 2 or 3 wetlands;
- Enhancing 1.73 acres of existing wetland;
- Enhancing up to 10 acres of riparian buffer; and
- Enhancing 1 acre of upland habitat for wildlife.

These improvements should be reflected in:

- An increase in the HHEI of 5 to 9 points;
- A decrease in soil erosion from the site and a decrease in siltation of the stream;
- An increase in vegetation diversity within the riparian zone;
- A reduction in the frequency of needed stream cleanout; and

SITE OR-100 STREAM, ISOLATED AND NON-ISOLATED WETLAND RESTORATION

- An improvement in the quality of fish and macroinvertebrate communities in the creek.

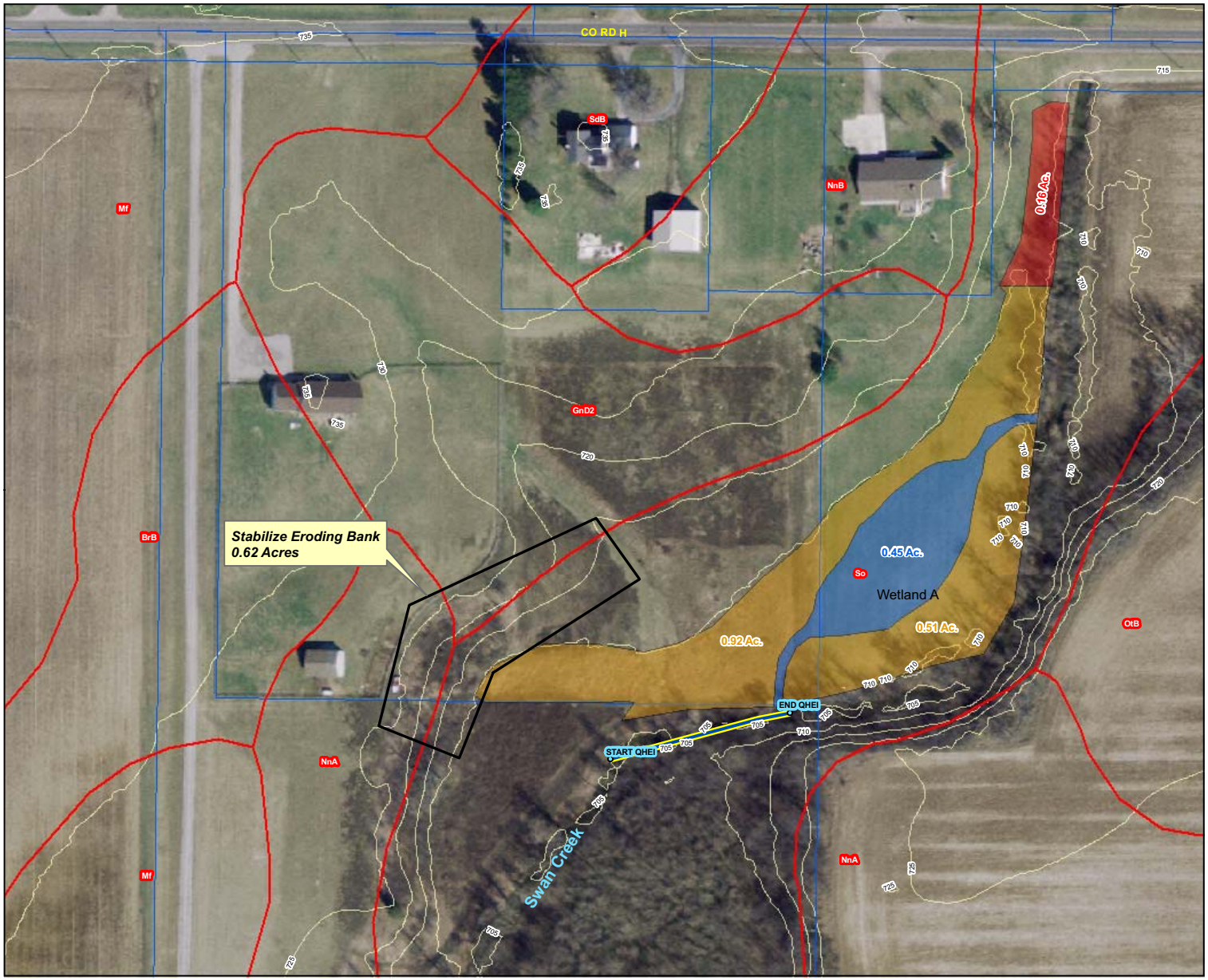
Preliminary Cost Estimate

The estimated cost to construct all three of the proposed projects (2600-foot buffer enhancement, wetland enhancement, and wetland restorations) would be approximately $887,510 depending primarily on the number of projects that would be undertaken. Various components of this project can easily be constructed independently of one another as additional funding becomes available. A summary of the estimated costs for this site are provided in Table 4-39.

Table 4-39
Estimated Cost Summary for Site OR-100

Project	Quantity	Unit	Unit Cost	Total Cost
Wetland Enhancement W100-1 to W100-4	1.73	acre	$14,000	$24,220
Headwater Stream Enhancement	2600	linear foot	$25	$65,000
Riparian Buffer Enhancement	9.71	acre	$11,000	$106,810
Wetland Restoration A - emergent	19.17	acre	$14,000	$268,380
Wetland Restoration deep water emergent	10.84	acre	$15,000	$162,600
Wetland Restoration forested (Area A)	16.09	acre	$16,000	$257,440
Wildlife Enhancement (upland)	1.02	acre	$3,000	$3,060
			Estimated Total Construction Cost	**$887,510**

SITE SC-13



Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

Prepared for:

Partners for Clean Streams

Partners for Clean Streams, Inc.
P.O. Box 822
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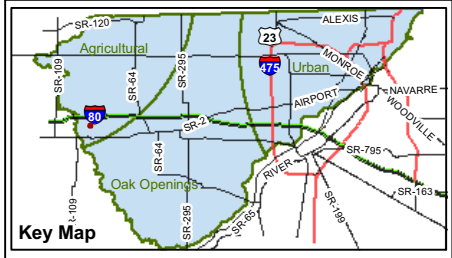


Legend

- QHEI
- 2005 Soils Classification
- Existing Wetland
- Parcel Line
- QHEI
- HHEI
- 5' Contour

Proposed Wetland Enhancement

- Wildlife Restoration
- Ditch Restoration
- Emergent
- Deep Water Emergent
- Floating-leaved Bed
- Forested
- Riparian Buffer
- OutFlow Structure
- Trail/Access Road

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-24
Restoration/Enhancement Plan for SC-13
Swan Creek Township, Fulton County, Ohio

County Map of Ohio

0 50 100 200 Feet

1:1,200

NOTES:
The Fulton County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: P163A1A
File Name: P163A1A_FultonSites.mxd
Date: February 19, 2009

SITE SC-13
STREAM AND NON-ISOLATED WETLAND RESTORATION

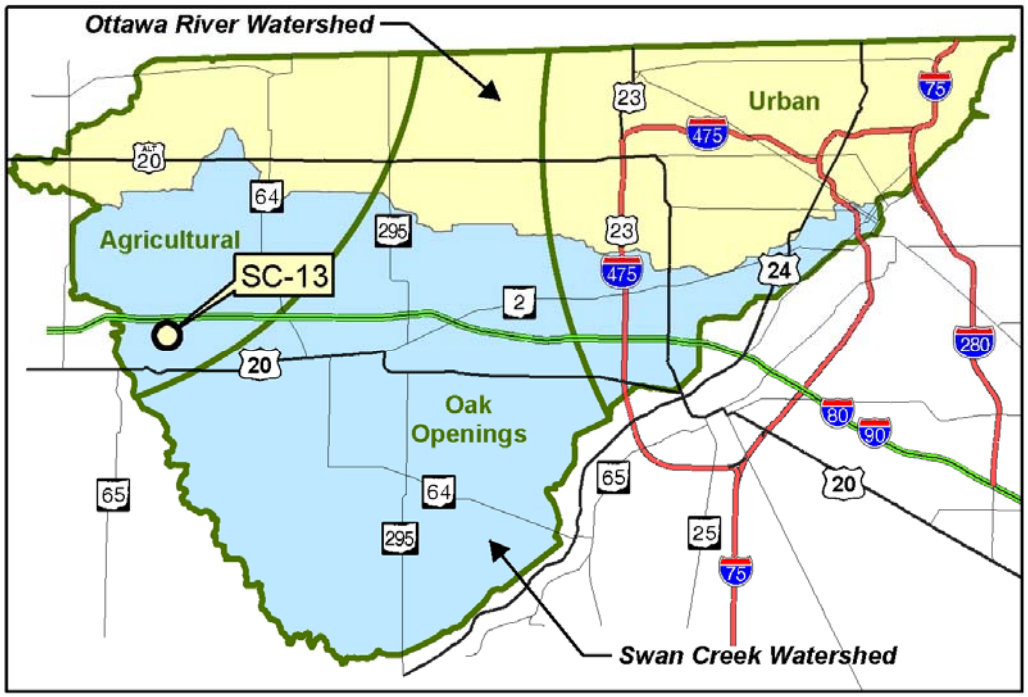
Agricultural Subregion

Project Description:
Restore 1.88 acres of palustrine wetland
Stabilize 0.62 acres of eroding bank
Plant 900 feet (0.16 acre) of riparian corridor

General Restoration/Enhancement Concept:
Restoration/Enhancement of Large Streams
Wetland Restoration/Enhancement on Clay Soils
Restoration/Enhancement of Riparian Buffers

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 9.69 sq. mi.
County: Fulton **Municipality**: Swan Creek Township **Location:** 83°58' 45.47"W 41°35' 15.24"N
Stream: Swan Creek (QHEI = 43.5)
Watershed: Swan Creek HUC 0410000907 (Upper Swan Creek)
Wetland: None
Stream buffers: Narrow, low to moderate (wooded) quality
Surrounding land use: Row crop, small forested area
Field-estimated gradient: 0.1% (0.1 feet per hundred feet), low



SITE SC-13 STREAM AND NON-ISOLATED WETLAND RESTORATION

Site Description

The site is located south of County Road H and approximately 0.6 mile east of County Road 6.2 in Swan Creek Township, Fulton County (Figure 4-24). Based on information provided by the Swan Creek Technical Advisory Committee, Site SC-13 lies adjacent to a Priority Agricultural Area.

Non-flowing water upstream from dam

Existing Site Conditions

Site SC-13 consists of several residential properties along the south side of County Road H in Fulton County. Swan Creek winds along the southern third of these properties before heading north and crossing County Road H.

The majority of soils on the site are mapped as hydric Sloan silt loam, frequently flooded (So). Other soils types reported to be present include Ottokee fine sand, 0 to 6 percent slopes (OtB), Nappanee loam, 0 to 2 percent slopes (NnA) and Glynwood loam, 12 to 18 percent (GnD2). These soils are listed as non-hydric soils that may contain hydric inclusions (Fulton County LSWCD, 1984).

Swan Creek flows intermittently through this area. The QHEI score was 43.5, which is low but typical for a low gradient stream in this watershed. The low QHEI score was due to the narrow buffers, the presence of agricultural fields adjacent to the stream, highly pulsed water flow, very little instream cover and moderate erosion. Since this is a highly pulsed, intermittent portion of Swan Creek, habitat structures would not be used to their highest benefit until water flow through this area is stabilized.

SITE SC-13 STREAM AND NON-ISOLATED WETLAND RESTORATION

Recommended Restoration/Enhancement Strategy

Site SC-13 provides both wetland and riparian habitat restoration opportunities. Instream improvements that consist of bank stabilization can help with erosional problems (see *Restoration/ Enhancement of Large Streams* concept). Approximately ten acres of high quality wetland can be restored on the site, in the area depicted on Figure 4.24. Designed properly, this wetland would receive floodwaters from Swan Creek during periods of high water.

Swan Creek though thinly forested corridor; start of QHEI

The wetland restoration area can be restored to an emergent sedge meadow that, over time, would convert to a scrub/shrub/forested wetland complex. To increase the water retention, a deep water emergent wetland can also be constructed on the site. Adding this type of wetland habitat would increase the diversity of wetland plant communities, and create a more diverse habitat for wildlife use.

Slope with severe erosion; wooded corridor with Swan Creek in background

Water levels can be controlled by an outflow structure that can be adjusted to regulate the maximum water elevation in the wetland. A one to two-foot high clay berm would need to be place around much of the wetland to retain the water and prevent flooding on adjacent parcels (see *Wetland Restoration/Enhancement on Clay Soils* concept).

SITE SC-13 STREAM AND NON-ISOLATED WETLAND RESTORATION

The available stream restoration site is an approximately 200-foot long by 50 to 100-foot wide linear corridor along the western edge of Swan Creek. Restoration of this approximately 0.16-acre riparian buffer would require the creation of a forested/shrub boundary to shade the stream surface and slow surface runoff. In addition to planting species that would be specified for the area, species such as American elm (*Ulmus americana*), box-elder (*Acer negundo*), eastern cottonwood (*Populus deltoides*), and several species of dogwoods (*Cornus* spp.) and willows (*Salix* spp.) would come in naturally (see *Restoration/Enhancement of Riparian Buffers* concept).

This is a highly segment portion of Swan Creek. Spring rains will elevate Swan Creek over the 6 to 8-foot banks and in the summer, the creek is intermittent forming several scattered pools. Buffering wetlands that help control this highly pulsed flow would temper these severe fluctuations. Until these fluctuations are tempered, instream improvements other than bank stabilization would not be feasible.

This site also contains a large unstable slope that contains many erosional channels and several drainage pipes from the residential area that discharge into the stream. Silt washing off of the slope flows quickly into Swan Creek. To stabilize the bank, the slope should be planted with tolerant, native grasses that, once established, will anchor the soils. At the base of the slope, the above mentioned wetland would be present to further decrease the amount of silt reaching the creek.

Potential Restoration Goals

Implementation of the measures described above will improve the quality of Swan Creek and the adjacent riparian habitat by:

- Restoring up to 1.9 acres of high quality Category 2 or 3 wetlands;
- Enhancing up to up to 0.16 acre of riparian buffer; and
- Enhancing up to 0.62 acre of upland habitat for wildlife.

These improvements should be reflected in:

- An increase in the QHEI of 5 to 7 points; and
- An improvement in the quality of fish and macroinvertebrate communities in the creek.

Preliminary Cost Estimate

The estimated cost to construct all phases of the proposed projects is approximately $330,390, depending primarily on the number of projects that would be undertaken. This project could easily be constructed in stages as funding opportunities become available. A summary of the estimated costs for this site are provided in Table 4-40.

SITE SC-13
STREAM AND NON-ISOLATED WETLAND RESTORATION

Table 4-40 Estimated Cost Summary for Site SC-13				
Project	Quantity	Unit	Unit Cost	Total Cost
Wetland Restoration: Deep Water Emergent	0.45	acre	$15,000	$6,750
Wetland Restoration: Emergent	1.43	acre	$14,000	$20,020
Riparian Buffer Enhancement: Site SC-13	0.16	acre	$11,000	$1,760
Slope Stabilization (wildlife enhancement)	0.62	acre	$3,000	$1,860
Estimated Total Construction Cost				**$330,390**

SITE SC-13
STREAM AND NON-ISOLATED WETLAND RESTORATION

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SITE SC-14

Wetland & Riparian Inventory & Restoration Plans for Swan Creek & Ottawa River

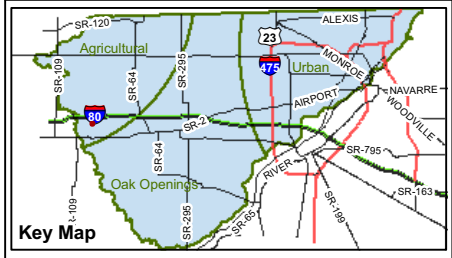
Prepared for:

Partners for Clean Streams, Inc.
P.O. Box 822
Bowling Green, Ohio 43402
www.PartnersForCleanStreams.org

Prepared by:

Mannik & Smith Group, Inc.

Hull & Associates, Inc.



Key Map

Legend

- Sample Plot
- 2005 Soils Classification
- Existing Wetland
- Parcel Line
- QHEI
- HHEI
- 5' Contour

Proposed Wetland Enhancement

- Wildlife Restoration
- Ditch Restoration
- Emergent
- Deep Water Emergent
- Floating-leaved Bed
- Forested
- Riparian Buffer
- OutFlow Structure
- Trail/Access Road

All proposed wetland areas are to be investigated for subsurface tiles.

Figure 4-25
Restoration/Enhancement Plan for SC-14
Fulton Township, Fulton County, Ohio

County Map of Ohio

0 50 100 200 Feet

1:1,200

NOTES:
The Fulton County photography was provided by OGRIP as part of the Ohio Statewide Imagery Program.
Project Number: P163A1A
File Name: P163A1A_FultonSites.mxd
Date: February 19, 2009

SITE SC-14
STREAM AND NON-ISOLATED WETLAND RESTORATION

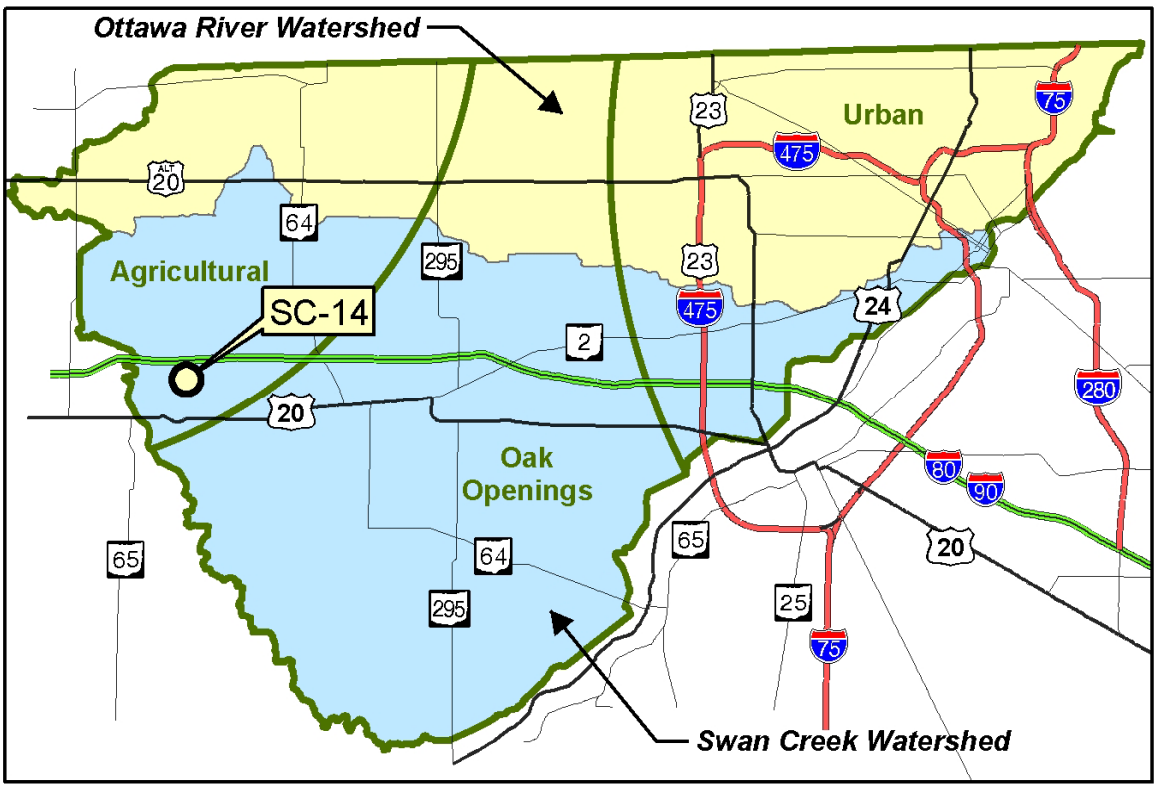
Agricultural Subregion

Project Description:
Create 3.19 acres of palustrine wetland on hydric soil

General Restoration/Enhancement Concept:
Wetland Restoration/Enhancement on Clay Soils
Restoration/Enhancement of Large Streams

Beneficial Use Impairments (BUI) Addressed:
BUI #3: Degradation of fish and wildlife populations
BUI #6: Degradation of benthos
BUI #14: Loss of fish and wildlife habitat

Drainage Area: 9.56 sq. mi.
County: Fulton **Municipality**: Fulton **Location:** 83°58' 36.76"W 41°35' 21.33"N
Stream: Swan Creek (QHEI = 33.5)
Watershed: Swan Creek HUC 0410000907 (Upper Swan Creek)
Wetland: SC-14-1 (palustrine forested); ORAM 48.5
Stream buffers: Narrow, low to moderate (wooded, old field, residential quality
Surrounding land use: Row crop, small forest
Field-estimated gradient: 0.1% (0.1 feet per hundred feet), low



SITE SC-14 STREAM AND NON-ISOLATED WETLAND RESTORATION

Site Description

The site is located north of County Road H and approximately 0.6 mile east of County Road 6.2 in Fulton Township, Fulton County (Figure 4-25). Based on information provided by the Swan Creek Technical Advisory Committee, the site overlaps with Priority Conservation Areas in the Swan Creek Watershed.

Intermittent portion of Swan Creek

Existing Site Conditions

Site SC-14 consists of several residential properties along the north side of County Road H in Fulton County. Swan Creek winds through these parcels separating the residential structures from the undeveloped portion of the property along the road. The combined driveway to the residences passes over Swan Creek, as the creek runs though an 8-foot culvert.

The majority of the existing soil is mapped as hydric Sloan silt loam, frequently flooded (So). Other soils types present were Ottokee fine sand, 0 to 6 percent slopes (OtB) and Glynwood loam, 12 to 18 percent (GnD2). These other soils are listed as non-hydric but with hydric inclusions according to Fulton County (FSWCD, 1984).

The QHEI was 33.5, which is typical for a low gradient drainage ditch in the study area. The score of 33.5 was due to the narrow to non-existent buffers through the pasture and agricultural fields, very little in-stream cover and moderate erosion.

One small, 0.19-acre wetland was identified in accordance with the *1987 Corps of Engineers Wetlands Delineation Manual*. This forested wetland is a vernal depression (shallow backwater) area within the floodplain of the creek. This wetland was dominated by shoreline sedge (*Carex hyalinolepis*), riverside grape (*Vitis riparia*), moonseed (*Menispermum canadense*), shellback hickory (*Carya laciniosa*), American elm (*Ulmus americana*) and box-elder (*Acer negundo*) along the banks. Hydrology included water-stained leaves, a positive FAC-neutral test drift lines, sediment deposits and water marks up to five inches above the soil. The ORAM score for this wetland was a 48.5, which correlates to a Category 2 wetland. This moderate quality

SITE SC-14 STREAM AND NON-ISOLATED WETLAND RESTORATION

wetland was graded on its small size, narrow buffers, one vegetation community but good position on the landscape.

Recommended Restoration/Enhancement Strategy

Site SC-16 provides both wetland and streams restoration and enhancement opportunities.

The restoration portion of this site could create up to 10 acres of wetland. Since this area would be excavated, a glyphosate herbicide should not be needed. Grading would be necessary prior to planting, to create deeper pools (up to one-foot deep) for deep water emergent areas indicated on the figure. The shallower areas of the excavated depression can be used for the emergent community of the wetland. These areas would be planted with different seeding mixes as discussed in the *Wetland Restoration/Enhancement on Clay Soils* concept.

The in-stream portion of Swan Creek can be improved by using methods discussed in the *Restoration/Enhancement of Large Streams* concept. In a conversation with the landowner, spring rains will elevate Swan Creek to overtop the driveway of the residence. Swan Creek currently flows through an eight-foot culvert. In the summer, the

Concrete along streambank

Swan Creek though thinly forested corridor; start of QHEI

SITE SC-14 STREAM AND NON-ISOLATED WETLAND RESTORATION

creek is intermittent, forming several scattered pools. Buffering wetlands that help control this highly pulsed flow may temper these severe fluctuations. Until these fluctuations are tempered, instream improvements other than bank stabilization are not recommended.

Potential Restoration Goals

Implementation of the measures described above will improve the quality of Swan Creek and the adjacent riparian habitat by:

- Restoring up to 10 acres of high quality, Category 2 or 3 wetlands;
- Enhancing up to up to 0.16 acre of riparian buffer; and
- Enhancing up to 0.62 acre of upland habitat for wildlife.

These improvements should be reflected in an increase in the QHEI of 6 to 9 points.

Wooded, seasonally flooded forest.

Preliminary Cost Estimate

The estimated cost to construct all three of the proposed projects (all restorations/ enhancements) would be approximately $46,450 depending primarily on the number of projects that would be undertaken. This project could easily be constructed in phases as funding opportunities become available. A summary of the estimated costs for this site are provided in Table 4-41.

Table 4-41
Estimated Cost Summary for Site SC-14

Project	Quantity	Unit	Unit Cost	Total Cost
Wetland Restoration: Deep Water Emergent	0.71	acre	$15,000	$10,650
Wetland Restoration: Forested	0.27	acre	$18,000	$4,860
Wetland Restoration: Emergent	2.21	acre	$14,000	$30,940
Estimated Total Construction Cost				**$46,450**

CHAPTER 5
COMPARATIVE MATRIX

COMPARATIVE MATRIX

COMPARATIVE MATRIX

Site	Wetland Restoration (acres)	Wetland Enhancement (acres)	Wildlife Enhancement (acres)	Riparian Buffer Enhancement (acres)	Streambank Slope Stabilization (linear feet)	Instream Enhancement (linear feet)	Instream Enhancement (Number)	Ditch Enhancement (linear feet)	Estimated Cost
OR-21		1.35						1250	$81,400
OR-101	16.30			0.52					$262,930
OR-102		1.42					6		$23,760
SC-18			3.93				5		$16,500
OR-3	3.37		0.54	0.33				700	$69,930
OR-16	27.33	0.84		6.45				1500	$502,830
OR-31	4.74		0.6					650	$84,410
SC-6	95.51		101.14	15.6	6800				$1,999,160
SC-7	3.84	0.26		0.27				250	$63,680
SC-8	55.06	0.84	3.95	11.12	2400				$1,065,070
SC-17	1.06			2.14		1500			$75,880
SC-20	97.83		45.27	12.49		2500			$2,371,060
SC-34								900	$22,500
SC-45	44.66		6.79						$645,610
SC-49	9.81	1.39		6.91				2600	$297,810
SC-62	109.34		36.66	7.5	1600				$1,823,740
SC-64	81.3		13.75	10.33		2200			$1,958,085
SC-70	1.95			3.11				250	$63,190
OR-58	52.53		26.77	10.17		2100			$1,584,300
OR-59	72.45			13.35	1000		20		$1,247,790
OR-60	115.0		32.83	7.99	1000	3200	20		$1,922,860
OR-61	332.68			19.97		2500			$5,744,490
OR-100	46.1	1.73	1.02	9.71				2600	$889,510
SC-13	1.88		0.62	0.16					$30,390
SC-14	3.19								$46,450
Totals	1175.53	7.83	273.87	138.12	12,800	14,000	51	10,700	$22,893,335.00

Urban Oak Openings Agricultural

COMPARATIVE MATRIX

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CHAPTER 6
IMPLEMENTATION

IMPLEMENTATION

The twenty-five wetland and/or stream restoration/enhancement plans that have been presented in this report were developed after carefully evaluating a multitude of geographical, physical and biological factors within the two watersheds (see Chapter 2: Project Overview/Methodology). As such, Partners for Clean Streams believes that the sites contained within this report represent twenty-five of the best locations to implement wetland and/or stream restoration/enhancement plans in the Tenmile Creek/Ottawa River and Swan Creek watersheds, in order to enhance Beneficial Use Impairment (BUI) #3 (Degradation of fish and wildlife populations), BUI #6 (Degradation of Benthos) and BUI #14 (Loss of fish and wildlife habitats). However, since the twenty-five restoration/enhancement plans that are included in this report are conceptual in nature, a number of important additional activities need to be completed before these projects can be constructed. These include the following:

Negotiation of agreements with land owners

PCS has not negotiated any agreements with land owners that would allow for the use of their properties for implementation of the projects. As a result, project sponsors will be required to obtain written agreements with landowners prior to the development of detailed design plans for a given project.

Completion of more detailed environmental site evaluations (e.g., Phase I and Phase II Environmental Site Assessments

For some sites, it may be necessary to perform a Phase Environmental Site Assessment (ESA), in order to evaluate potential releases of hazardous materials or petroleum based substances, and to qualify for certain provisions of the innocent landowner defense under CERCLA. If the Phase I ESA indicates that a release has occurred, it may then be necessary to perform a Phase II ESA to characterize the extent of the release and to develop an appropriate course of action to address the situation. Project sponsors are strongly encouraged to seek the assistance of a qualified environmental professional to determine when such studies are necessary and to carry out these investigations.

Detailed topographic and boundary surveys

A topographic and boundary survey should be completed as part of the preliminary design activities for every wetland enhancement/restoration project contained within this report. The topographic survey should be completed so that contours are presented at 0.5-foot intervals. Property boundaries should also be identified, as well as all underground utilities and easements that exist on or adjacent to the property. This information should be clearly shown on a site drawing so that these existing features can be considered during the design of the enhancement/restoration project.

Depending on the intended scope of the stream restoration/enhancement project, it may also be necessary to survey the profile and develop cross sections at regular intervals along the stream segment.

Geotechnical evaluations

At some sites, it may be necessary to conduct geotechnical investigations to characterize the permeability of soils on the site. This is strongly encouraged in areas where clay and sandy

soils are intermingled and where the intent is to design a perched wetland system that will rely on surface water for its main source of hydrology. The presence of sand seams and lenses on a site may make it difficult to create a perched wetland system, particularly if the bottom of the wetland intercepts this more permeable soil layer.

Hydrologic monitoring and modeling

In many of the wetland restoration/enhancement projects, it will be necessary to model the hydrology of the site in order to determine the water budget for the wetland. A number of methods are available for this purpose. A qualified wetlands consultant with expertise in hydrologic modeling should be consulted to assist with the evaluation of the site.

Development of detailed construction plans, specifications and bid packages

Detailed construction plans and specifications should be prepared for each site that will require a contractor, in order to ensure that the site is constructed in accordance with the overall project objectives. Plans and specifications will also be required if a federal or state waterways permit will be required prior to construction (see below). If competitive bids are being sought for construction of the project, then bid packages should be prepared to ensure that construction estimates are comparable among contractors.

Preparation of regulatory permit application packages (e.g., Section 404 and 401 permit applications, NPDES permits, Isolated Wetland Permit Applications)

Project sponsors are encouraged to contact the U.S. Army Corps of Engineers and Ohio EPA early in the development of detailed plans for a given site, to determine whether federal or state waterways permits (Section 404, 401 and isolated wetland permits) will be required prior to construction of the project. In addition, an authorization for storm water discharges associated with construction activity under the National Pollutant Discharge Elimination System (Ohio EPA Permit No. OHC000003) may also be required from Ohio EPA.

Obtaining funds to construct the project

Project sponsors are encouraged to prepare detailed cost estimates so that adequate funding can be obtained to construct their project. Funding may be available through private donations, from project sponsors of other projects that require wetland or stream mitigation credits, or from a variety of grant opportunities, which are listed in Table 6-1.

Table 6-1
Potential Funding Sources for Implementation of Wetland and Stream Restoration Activities in the Swan Creek and Ottawa River Watersheds

Funding Source	Amount of Fund	Match	Description	Due Date	Contact
Public Funding					
Water Resources Restoration Sponsor Program	Approximately $15 million is proposed for financing WRRSP projects annually. Past projects have ranged from $300,000 - $6 million.	Need to partner with a WPCLF applicant	WRRSP provides funds through the Water Pollution 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. The following are examples of types of projects that may be funded: • riparian buffer acquisition, enhancement, expansion or restoration • conservation easements • Category 3 wetland purchases • wetland buffer extension/restoration • wetland restoration in conjunction with an adjoining high quality water resource • streambank stabilization/natural channel design techniques • reestablishment of native plant communities on modified properties • in-stream habitat enhancements/dam removals	Letters of intent from WRSSP project sponsors and implementers were due January 2009	Ohio Environmental Protection Agency Division of Environmental and Financial Assistance PO Box 1049 Columbus, Ohio 43216-1049 ATTN.: Dave Reiff PHONE: (614) 644-3646 FAX (614) 644-3687 dave.reiff@epa.state.oh.us

Funding Source	Amount of Fund	Match	Description	Due Date	Contact
Clean Ohio Conservation Fund	GRANT Round 5 underway. District 12 has $1,012,864 to distribute.	25% match	Provides up to 75% of the project costs. The local match can be in-kind contributions, local, private, federal, or other state funds. District 12 (Lucas County) priorities mainly focused on land preservation/acquisition - restoration would need to be thoroughly considered for competitiveness. Funding based on recommendations from the OPWC District 12's Natural Resources Assistance Council (NRAC). (Each NRAC evaluates and scores applications using a locally developed methodology, approved by the commission, based on criteria listed in Chapter 164 of the Ohio Revised Code.)	Round 5 Deadline was February 6, 2009; Award decisions in March 2009	District 12 NRAC Liaison: Kurt Erichsen, TMACOG, 419-241-9155
Ohio EPA 319 Grants	GRANT FY 2010 program - anticipate that will have $3.5 million available for grant awards. Up to $400,000 for stream restoration/renaturalization; $500,000 for wetland restoration; $400,000 for agricultural BMPs; $400,000 for acid mine drainage abatement projects; and $400,000 for riparian restoration projects.	40% match required	Grants are targeted to areas where NPS pollution is a significant cause of aquatic life use impairments and where proposed projects can eliminate those impairments or restore impaired waters. 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 first consideration over projects submitted from watersheds without any of the above plans. Projects that protect restored areas with conservation easements or other protective measures will receive additional consideration.	5/7/2009	Ohio Environmental Protection Agency Division of Surface Water Attention: Russ Gibson, NPS Program Manager 50 West Town Street, Suite 700 Columbus, Ohio 43216-1049

Funding Source	Amount of Fund	Match	Description	Due Date	Contact
Great Lakes Watershed Restoration Program through the National Fish and Wildlife Foundation	Grants range between $35,000 and $100,000 (in 2007: 38 submitted totaling $2.7 million in requests. 22 projects selected totaling $1.1 million in federal funds).	1:1 match is required for this program. Matching funds must be non-federal and may be generated through contributions of funds, goods or services (including in-kind contributions) from project partners. In exceptional cases, the review committee may consider projects that have less than the required match.	Provides grants to community organizations, state and local governments and others working on the local level to protect and improve watershed in the Great Lakes. Supports habitat restoration and protection, water quality improvement, and watershed planning and management. Projects that include education, training or community outreach are encouraged. Preference will be given to projects that 1) demonstrate measurable ecological or environmental benefits resulting from completion of the project, 2) include specific provisions for long-term management and protection, as appropriate, and 3) support implementation of a local or regional habitat plan. This program is designed to support the implementation of the Great Lakes Regional Collaboration.	Last year's timeframe: Deadline: November 17, 2008Anticipated announcement of awards: April 15, 2009 Eligible applicants are either non-profit 501(c)(3) organizations, tribes, or state and local governments (i.e., counties, townships, cities, boroughs, conservation districts, planning districts, utility districts, school districts or other units of local government) from the Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, or Wisconsin portions of the Great Lakes watershed.	National Fish and Wildlife FoundationAttn: Great Lakes Watershed Restoration Grants Program1 Federal DriveFt. Snelling, MN 55111
North American Wetlands Conservation Act Grants Programs	STANDARD GRANT: up to $1,000,000 (U.S. program current round $48.8 million). SMALL GRANT (Current round for small grant, minimum of $2 million [authorized for up to $5 million], each grant may not exceed $75,000)	1:1 match (can count eligible expenses up to 2 years prior to grant submittal)	Actions supported by the NAWCA include acquisition, establishment, enhancement, and restoration of wetlands and wetland-associated uplands. The goal is to preserve long-term conservation of North American wetland ecosystems, the waterfowl, other migratory birds, and fish and wildlife which depend on the habitat.	Standard Grants Deadline: March 6 and July 31, 2009. Small Grants: October 29, 2009. This is an annually funded program.	Small Grants: Ken Kriese (ken_kriese@fws.gov) (703) 358-1888 Large Grants: David Buie Wildlife Biologist (301) 497-5870

Funding Source	Amount of Fund	Match	Description	Due Date	Contact
NRCS Wetland Reserve Program	Payments for permanent or 30-year easements or restoration cost share	Per-acre payments for easements or restoration cost share	The Wetlands Reserve Program (WRP) is a voluntary conservation program that offers landowners the means and opportunity to protect, restore, and enhance wetlands on their property through perpetual easements, 30 year easements or Land Treatment Contracts. The USDA Natural Resources Conservation Service (NRCS) manages the program as well as provides technical and financial support to help landowners who participate in WRP. To offer a conservation easement, you must have owned the land for at least 1 year prior to enrollment, with limited exceptions. To participate in the 10-year restoration cost-share agreement, you need only show evidence of ownership.	Ongoing	John Armentano, WRP CoordinatorNatural Resources Conservation Service200 North High Street, Room 522 Columbus, Ohio 43215Phone: 614-255-2469 E-mail: john.armentano@oh.usda.gov
Ohio State Acres for Wildlife Enhancement (SAFE) (CP38)	Incentives, improvement cost shares and rental payments available to landowners on property that must be legally and physically capable of producing a crop and must be owned for at least 1 year prior to submitting an offer.	Variety of incentives/cost share	Kitty Todd/Oak Openings Savannah Priority Area targeted as 1 of 8 areas in Ohio. Seeks to enroll 11,600 acres of cropland in certain townships surrounding selected ODNR and TNC priority focus areas into CP38 areas for 10-15 years to benefit wetland and grassland wildlife and restore native grassland, wetland complexes and oak savannahs.	Ongoing	United States Department of Agriculture Ohio Farm Service Agency 200 North High St. Room 540 Columbus, OH 43215 (614)255-2441
ODNR NatureWorks Parks Grant	GRANT $72,155 available in 2009 for all Lucas County projects and $14,877 for Fulton County projects (could be one or multiple projects in each county). 25% match required, (20% must be local funds), reimbursement grant.	25% match	Eligible projects include development of recreational trails and support facilities, including access, parking and restrooms or acquisition of land for recreational or habitat preservation purposes. Could fund site planning, construction, demolition, site preparation, architectural and/or engineering services directly connected to project. Political subdivisions of the state are eligible to apply. Up to 75% reimbursement grants. Eligible government agencies within each county compete for grants. All projects must be completed within 1.5-2 years.	3/1 annually	Mary Fitch, ODNR Division of Real Estate and Land Management, (614) 265-6477

Funding Source	Amount of Fund	Match	Description	Due Date	Contact
Land & Water Conservation Fund	GRANT Maximum amount for 2009 program: $75,000 Funding levels vary each year.	50% match, in-kind considered if land donation or new construction materials provided	Acquisition, rehabilitation or development of public park and recreation facilities. (It must be a public area.) Political subdivisions of the state are eligible to apply. Up to 50% reimbursement grants. All projects must be completed within approximately 3 years.	4/1 annually	Mary Fitch, ODNR Division of Real Estate and Land Management, (614) 265-6477
NOAA Coastal and Marine Habitat Restoration Project Grants under the American Recovery and Reinvestment Act	GRANT NOAA expects up to $170 million could be available; typical awards are expected to range between $1.5M - $10M	No match is required, but match and/or partnerships are typically leveraged	Funds mid-scale, shovel ready marine and coastal habitat restoration projects. High priority for projects with the greatest potential to achieve ecological benefits and maximize job creation/preservation; can begin within 90 days of award start date; can be completed within 12-18 months.	April 6, 2009	Craig Woolcott or Melanie Gange (301) 713-0174
NOAA Great Lakes Habitat Restoration Program Partnership Grant	GRANT Last year's program: funding up to $1 million may be available, anticipate funding up to 4 projects		Funds are to establish one or more regional habitat restoration partnerships for 1 to 3 years. The objective of this program is to fund one or more partner(s) that is regionally-based and has an ecosystem-approach restoration plan focused on an Area of Concern (AOC). The partnerships are expected to catalyze the implementation of habitat restoration projects that will benefit coastal resources through improved Great Lakes habitat quality. The centerpiece of the program will be a focus on one or more restoration projects in an AOC that: are based on strong science and data availability; are ecosystem focused; and, will address fish, wildlife and open lake habitat beneficial use impairments.	Last year's public notification of funding availability: 7/03/07; deadline: 8/31/2007	Steve Drescher Policy Advisor (301) 713-0926

Funding Source	Amount of Fund	Match	Description	Due Date	Contact
PRIVATE FUNDING - Here are just a few examples, many other foundations exist that give to habitat restoration activities					
Joyce Foundation	GRANT		4 step application process: Letter of Inquiry, Initial Review (if the project does fit within the guidelines, the program officer may invite the applicant to submit a full proposal), Review and Recommendation, and Board Action. The Joyce Foundation will seek and support funding opportunities to restore and protect the Great Lakes in the following areas: a) On the ground protection and restoration efforts; b) Efforts to drive policy development; c) Efforts to advocate at the local, state, and national levels for these collectively developed policies. The Foundation will consider proposals at the local, state, regional, and national levels that address the following four areas: reduce polluted, non-point source runoff from agricultural lands and urban/suburban/exurban lands; protect and restore critical habitats; improve coastal health particularly through the increased use of green infrastructure and through new means of financing conventional infrastructure; implement the Great Lakes-St. Lawrence River Basin Water Resources Compact.	Grant proposals are considered at meetings of the Foundation's Board of Directors in April, July, and December. Last year's deadlines: Board Meeting / Proposal Deadline April 2009 / December 9, 2008 July 2009 / April 13, 2009 December 2009 / August 19, 2009 April 2010 / December 8, 2009	The Joyce Foundation 70 West Madison Street Suite 2750 Chicago, Illinois 60602 Phone: (312) 782-2464 Fax: (312) 782-4160

Funding Source	Amount of Fund	Match	Description	Due Date	Contact
The George Gund Foundation	GRANT		The Foundation makes grants to organizations that address environmental issues in Northeast Ohio. In addition, they support efforts to restore and preserve the Lake Erie ecosystem. Within the broad range of environmental issues, the Foundation focuses on promoting alternatives to urban sprawl, decreasing energy consumption and waste, conserving ecosystems and biodiversity, reducing environmental health hazards, increasing public awareness of environmental issues and building the skills of nonprofit environmental leaders. The Foundation encourages inquiries about the application of its funding guidelines to specific ideas in advance of the submission of formal proposals. Foundation staff welcomes the opportunity to provide guidance, suggest alternatives and recommend partners.	Proposals are considered by the Foundation's Trustees in March, June, September and December. Deadlines for submitting proposals for consideration at the next regularly scheduled meeting of the Trustees are December 15, March 15, June 15 and September 15. Proposals are due the next business day if a deadline falls on a weekend.	The George Gund Foundation 1845 Guildhall Building 45 Prospect Avenue, West Cleveland, Ohio 44115 Phone 216 241.3114 Fax 216 241.6560 Email info@gundfdn.org
Mitigation	Project-specific and variable	None, although successful mitigations often have a significant in-kind component	Funding in the form of project-specific mitigation required by Clean Water Act Section 404 permits or Ohio Isolated Wetland Permits. An alternative is to set up an in-lieu fee program structure pursuant to 2008 USACE rules on mitigation.	N/A	N/A

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CHAPTER 7
REFERENCES

REFERENCES

REFERENCES

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ACRONYM GLOSSARY

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319	Ohio EPA 319 Grants
A	
AMDAT	Acid Mine Drainage Abatement and Treatment
ACOE	Army Corps of Engineers
AOC	Area of Concern
B	
BMP	Best Management Practice
BUI	Beneficial Use Impairment
C	
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSO	Combined Sewer Overflow
D	
DELT	Deformities, Eroded Fins, Lesions & Tumors
DEM	Digital Elevation Model
DOF	Division of Forestry (within ODNR)
DNAP	Division of Natural Areas and Preserves (within ODNR)
DNR	Department of Natural Resources
E	
EPT	Ephemeroptera, Plecoptera and Trichoptera
EPA	Environmental Protection Agency
F	
FAC	Facultative plant
FACU	Facultative upland plant
FACW	Facultative wetland plant
FEMA	Federal Emergency Management Agency
FQAI	Floristic Quality Assessment Index
FY	
G	
GIS	Geographical Information Systems
GLC	Great Lakes Commission
GLNPO	Great Lakes National Program Office
GLPF	Great Lakes Protection Fund
GLWQA	Great Lakes Water Quality Agreement
GPS	Global Positioning System
H	
HELP	Huron/Erie Lake Plains (ecoregion)
HHEI	Headwater Habitat Evaluation Index
HUC	Hydrologic Unit Code

Hull	Hull & Associates

I

IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index

J

K

L

LAMP	Lake Erie Management Plan
LEPF	Lake Erie Protection Fund
LRW	Limited Resource Water Habitat

M

MAOC	Maumee Area of Concern
MGD	Million Gallons per Day
MiWB	Modified Index of Well-Being
MSG	The Mannik & Smith Group, Inc
MWH	Modified Warm Water Habitat

N

NAIP	
NHD	Natural Heritage Database
NLCD	National Land Cover Data
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	Non Point Source
NRAC	Natural Resources Assistance Council
NRCS	Natural Resources Conservation Service (f.k.a. Soil Conservation Service)
NWI	National Wetlands Inventory

O

OBL	Obligate wetland plant
ODNR	Ohio Department of Natural Resources
OEEF	Ohio Environmental Education Fund
OEPA	Ohio Environmental Protection Agency
OO	Oak Openings
OR	Ottawa River watershed
ORAM	Ohio Rapid Assessment Method
OSIP	Ohio Statewide Imagery Program
OWI	Ohio Wetlands Inventory

P

PCA	Priority Conservation Area
PDA	Priority Development Area
PMT	Project Management Team

Q

QHEI	Qualitative Habitat Evaluation Index

R

RAP	Remedial Action Plan
RM	River Mile
RPM	Rapid Propagation Method

S

SC	Swan Creek watershed
SCS	Soil Conservation Service (currently USDA-NRCS)
SWCD	Soil and Water Conservation District

T

TMACOG	Toledo Metropolitan Area Council of Governments
TMDL	Total Maximum Daily Load Limits

U

UPL	Upland plant
USDA	United States Department of Agriculture
US EPA	United States Environmental Protection Agency
US F&W	United States Fish and Wildlife Service
USGS	United States Geological Survey
UT	University of Toledo

V

VIBI	Vegetation Index of Biotic Integrity

W

WIRP	Wetland Identification and Restoration Plan
WPCLF	Water Pollution Control Loan Fund (Ohio EPA)
WRDA	Water Resources Development Act
WRP	Wetland Reserve Program
WRRSP	Water Resource Restoration Sponsorship Program
WWH	Warm Water Habitat

X

Y

Z