Wolf Creek - Berger Ditch Corridor Restoration Plan
City of Oregon - Jerusalem Township, Ohio

March 2011
Toledo Metropolitan Area Council of Governments
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Executive Summary

Maumee Bay State Park (MBSP) is one of northwest Ohio’s recreational facilities, and an important tourist destination. It includes the only public Lake Erie beach between Port Clinton and Monroe, Michigan.

Since the late 1980s, high levels of fecal bacteria in beach waters have been recognized as an ongoing public health problem. When levels of bacteria at the beach exceed Ohio health standards, the beach is posted with a public health advisory. The Lake Erie beach has had advisory postings an average of 14 days per year, and as many as 50 out of a summer bathing season of about 100 days, which is a significant hindrance to public enjoyment of the park.

The Wolf Creek Committee (WCC), and its predecessor the Maumee Bay Bacteria Task Force (MBBTF) have been charged with identifying the causes of bacterial contamination, and recommending solutions. The sources of fecal bacteria are warm-blooded animals, including birds, wild and domestic mammals, and humans.

Bacteria from many sources enter Maumee Bay. However, studies conducted through the MBBTF have shown that the principal sources impacting the Lake Erie beach at MBSP are from Berger Ditch.

Berger Ditch is part of the Wolf Creek watershed, which starts in Northwood Ohio, in Wood County, and flows northeast through the City of Oregon and Jerusalem Township. When Wolf Creek reaches North Curtice Road, the stream turns north and follows the road, as Berger Ditch. Inside the park, Berger Ditch flows into Maumee Bay immediately adjacent to the Lake Erie beach.

The next objective for the MBBTF was to identify what are the sources of bacteria in the watershed, and what control measures are needed? The City of Oregon invested some $10.5 million in sanitary sewer extensions to reduce bacteria loadings to the stream by eliminating failed septic systems and “package” sewage treatment plants. The Toledo/Lucas County Health Department conducted tests on remaining septic systems, resulting in repair or replacement of malfunctioning systems.

While research continues on other watershed sources of bacteria, the WCC has focused on protecting the beach by reducing the bacteria levels in the stream. The current plan proposes stream corridor habitat and wetland projects that will treat the stream water before it reaches the bay. These projects will capture and/or destroy bacteria in the water. They will improve Lake Erie water quality by removing sediment and nutrients (e.g., phosphorus, nitrogen) from the stream. They will also provide coastal and riparian habitat that will further benefit the environment.

The proposed projects include:

- Sedimentation ponds along the south side of Wolf Creek between Corduroy and North Curtice Roads. The ponds will capture sediment and attached nutrients and bacteria from stream water.
- Broad floodplains along the same reach of Wolf Creek. These floodplains will be wetlands, whose vegetation will remove nutrients and bacteria from stream water.
- The site and configuration of the ponds will be designed to meet the project objectives and model results. Design constraints applied include up to a 25’ depth for sediment detention ponds and the total volume of soil of excavation for floodplains and ponds totaling 150,000 cu/yds.
- A multi-stage, or “terraced” wetland system on the west side of Berger Ditch in MBSP, at the northwest corner of North Curtice and Cedar Point Roads. The terraced wetland could be up to 25 acres. Storm and seiche events will flood the terraces at various levels, and vegetation will remove nutrients and bacteria. The terraces will be designed for flow through the soil after the creek has receded from a storm event. This subsurface flow will be especially effective for removing pathogens from stream water.
Streambank habitat restoration along the west side of Berger Ditch as it flows past the inland lake at MBSP. Streambank stabilization and vegetation will reduce erosion problems, as well as removing nutrients and bacteria from the water. The habitat corridor could cover about 8 acres with an average width of 100-150 feet.

Part of the property along Wolf Creek is owned by the City of Oregon. The City is presently in negotiation to buy or acquire a conservation easement in a privately-held parcel. The City will acquire property only from a willing seller; it will not use eminent domain to acquire property.

MBSP is owned by the Ohio Department of Natural Resources.

Total design, permitting, and construction cost for the habitat and wetland projects described above is estimated at $5.26 million. It would be ideal to construct these improvements as a simple project. However, with limited funding available, they could be split into individual phases and built separately.

Maintenance for the new habitat and wetland areas would be most needed in the first five years, until vegetation becomes established. After five years, maintenance will be minimal. Activities will include control of invasive species and replanting wetland vegetation as needed. Maintenance will cost an estimated $25,000/year — including both the Oregon and MBSP sites — for the first five years. Costs could be reduced by using volunteer labor or interns. The sediment ponds will eventually need to be dredged to remove sediment accumulated from the stream. It is estimated that dredging will be required in 20-30 years.

A number of state and federal agencies offer grants for habitat restoration and wetland construction. For some funding programs, Great Lakes coastal and riparian habitat are special priorities. While grantsmanship is time consuming and often complicated, the proposed projects should be well-positioned to qualify for funding.
Problem Statement and History

Maumee Bay State Park is one of northwest Ohio’s premier recreational facilities. It features camping, nature trails, horseback riding, golf, swimming, canoeing, and sailing on the shore of Lake Erie. There are not many other public bathing beaches in northwest Ohio. To the east, the nearest is in the Port Clinton area. To the west, the nearest public bathing beach is in Michigan. In the late 19th century, the place was known as Jamestown (1875 and 1900 maps), with public access to the lake at Nilosean Beach (1900).

In the early 1990s, the then-new park was plagued by reports of frequent and ongoing beach postings for high levels of fecal bacteria. Results from monitoring the bacterial water quality at the public beaches at Maumee Bay State Park have indicated a pattern of high fecal bacteria levels. The Lake Erie beaches at Maumee Bay State Park were posted for bacterial exceedences for at least two weeks in 12 summers since 1988. Besides indicating a water pollution problem, the postings deterred the public’s enjoyment of the park in all its facilities. As the postings were played up by the local media, local governments sought means by which they could find answers.

The Maumee Bay Bacteria Task Force was formed in 1995 to identify the causes of these high bacterial counts. The Task Force was an inter-agency committee that included the Toledo/Lucas County Health Department, the City of Toledo, the City of Oregon, the University of Toledo Lake Erie Research Center, Ohio DNR, and TMACOG.

Maumee Bay State Park offers public bathing both on the Lake Erie shoreline as well as an Inland Lake. The Lake Erie beaches are immediately west of the mouth of Berger Ditch (Wolf Creek); jetties line the

Figure 1 - Maumee Bay State Park
mouth of the stream, in which there is a marina. The Lake Erie beaches were constructed with imported sand, with six individual coves/beaches. The Inland Lake, a manmade waterbody, is just south of the Lake Erie beaches, and west of Berger Ditch.

Early on, the Maumee Bay Bacteria Task Force addressed postings both for the Lake Erie and Inland Lake beaches. It was soon discovered that the issues were different for the two beaches. Birds were found to be the principal source of contamination for the Inland Lake, but not the Lake Erie beaches. As a result of Inland Lake studies, park managers took a number of steps to reduce contamination, among which were discouraging the public from feeding the birds, and discouraging birds from flocking there. An outline of past studies is provided in the next section.

Most of the work of the Maumee Bay State Park focused on sources and control of bacteria at the Lake Erie beaches. These beaches were more complex than the Inland Lake. Ultimately it was found that the principal source impacting the Lake Erie beaches was the Berger Ditch / Wolf Creek watershed. From that watershed, the main source was incompletely treated discharges from onsite sewage systems. Other watershed sources may also be important contributors, such as agricultural land application of biosolids, stormwater runoff, and warm-blooded animals.

As the Maumee Bay Bacteria Task Force worked to address contamination issues, it recognized that there are additional environmental considerations which are important, but do not get headlines like beach postings. Many overarching and watershed plans for the area recognize the value of Lake Erie coastal wetlands for the control of nonpoint source pollution and providing critical aquatic habitat. Among the established plans that lend specific recognition to the north shore of Maumee Bay are the TMACOG “208” Areawide Water Quality Management Plan, the Maumee Area of Concern Stage 2 Watershed Restoration Plan, the Lake Erie Protection & Restoration Plan, and the Clean Ohio Fund Conservation Grant “District 12” (Lucas County) grant program. The Maumee Bay State Park further recognized that wetlands could play an effective role in capturing, controlling, and/or treating pathogens. Lake Erie coastal wetlands may not only help solve nonpoint source problems, but offer a solution to beach posting problem as well.

In 2009 the Maumee Bay Bacteria Task Force re-formed on a more formal basis as a standing committee of the Toledo Metropolitan Area Council of Governments (TMACOG), a Regional Council
covering five Ohio Counties, three Townships in Monroe County Michigan, and with approximately 140 members representing the region’s local governments, businesses, educational institutions, and non-profit agencies. The new Wolf Creek Committee includes members from the cities of Oregon and Northwood, Lucas and Wood Counties, and the University of Toledo Lake Erie Center. The mission of the committee is to protect and improve water quality of the watershed, safe water recreation in the watershed and the Maumee Bay State Park beaches, and coastal and riparian habitat.

**Figure 3 - Wolf Creek as it turns north to become Berger Ditch**

The Wolf Creek watershed’s headwaters are in Northwood, in Wood County, near Woodville Road at Woodville Mall. The stream flows northeast through Oregon, and into Jerusalem Township.

Originally, the stream flowed into Lake Erie through the coastal marshes of the Little Cedar Point area, in eastern Lucas County. Today, however, when Wolf Creek reaches North Curtice Road, the creek turns to the north, becoming a roadside ditch called Berger Ditch. This drainageway flows straight north, and enters Maumee Bay in the park. From maps provided by the Oregon Historical Society, the cutoff appears to have been constructed between 1875 and 1900, for the purpose of alleviating flooding problems. A concrete barrier at North Curtice Road deflects the flow of the water to the north.
Figure 4 - Wolf Creek/Berger Ditch Watershed
Seiche Effect and Lake Erie Western Basin Lacustuaries

A lacustrualy is a mixing area where a river joins with a large lake. The term applies to the Maumee River as it joins with Maumee Bay, and Berger Ditch as it flows into the bay. “Seiche” is a term used to describe the reverse flow of area streams during certain conditions, notably north/northeast winds. Many streams entering Maumee Bay can flow backward several miles under seiche conditions. The seiche affects Berger Ditch and Wolf Creek. Lake Erie seiche heights range from about 2.5 to 4.0 feet; the seiche typically extends as far as the intersection with Wolf Creek just upstream of the water treatment plant (4.0 feet). On rare higher seiche events (6.0 feet), backflow may extend as far as Corduroy Road.

The seiche effect occurs in area streams because of Lake Erie’s orientation, winds, and flat terrain. When areas near the lake have little slope, it does not take much water elevation to result in backward flow. An obvious result is coastal flooding. The flat terrain, subject to reverse flow and flooding, is the main reason why the Wolf Creek cutoff along North Curtice Road (Berger Ditch) was constructed. Flood control remains an important concern for residents.

Bacteria: Lake Erie Beaches

The Ohio Department of Health regularly tests the water at public beaches for fecal bacteria during the bathing season. Beaches tested in Lucas County include the Inland Lake and Lake Erie beaches at Maumee Bay State Park; Crane Creek State Park no longer has a public bathing beach. The next beaches sampled to the east are in the Port Clinton and Bass Island area, in eastern Ottawa County. Historical data for the Lake Erie Beaches at Maumee Bay State Park are shown in the table below. Similar monitoring has been conducted for the Inland Lake beach, also with many postings due to bacterial exceedences. This study, and the efforts of the Wolf Creek Committee, focus on the Lake Erie beaches. There are many potential sources of bacteria, and they are not controllable by measures taken at the park. By contrast, bacteria levels at the Inland Lake beach, as noted above, were found to result from birds, and park personnel have instituted management measures to control them.

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Nutrients: toxic algae blooms

Since the 1970s and the Clean Water Act of 1972, eutrophication has been recognized as a key environmental challenge to Lake Erie. In the 60s and 70s, the lake was plagued by blue-green algae blooms, which resulted in anoxic conditions and “dead zones” in the lake. Phosphorus was identified as the critical nutrient that controlled eutrophication. Instituting wastewater discharge regulations through NPDES permits, conservation tillage, and other best management practices, the water quality of Lake Erie improved.

In the past decade progress on phosphorus reduction has stalled, and nuisance algae blooms have returned. There are several species of cyanobacteria (“blue-green algae”) contributing to the nuisance blooms. The best known is *Microcystis*, which produces a toxin; hence these blooms are popularly called “toxic algae blooms.” Phosphorus loading is still viewed as the driving cause, with an emphasis on dissolved bioavailable phosphorus.1

Bacterial contamination is the main water quality issue within the watershed. However, the location of this watershed and its hydrology may make it well suited for wetlands that can make a significant contribution to reducing bioavailable phosphorus loadings to Lake Erie.

Coastal habitat

Coastal aquatic habitat, especially wetlands, play a special function in the biological productivity of the ecosystem. Coastal habitat provides spawning areas, food, and protection from predators. The Lake Erie LaMP stresses additional biological benefits when coastal wetlands are connected to the lake.2 Wetlands along Berger Ditch and lower Wolf Creek and offer the potential of controlling bacterial contamination, reducing phosphorus loading to Lake Erie, and providing coastal aquatic habitat. At Maumee Bay State Park particularly, coastal wetlands can be an attraction and educational opportunity for visitors, besides being aesthetically pleasing.

**Restoration Goals**

The Wolf Creek Committee has adopted the following watershed goals:

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Safe primary and secondary contact recreational use of Lake Erie beaches and Wolf Creek / Berger Ditch.

Protect and enhance coastal and riparian habitat to reduce loadings of nutrients, sediment and bacteria to Lake Erie, and foster native aquatic and plant species

Provide adequate drainage solutions that aid flood control, and do not exacerbate flooding problems

Wetland system designs that flow by gravity are strongly preferred; avoid reliance on pumps unless there is no better alternative.

Past Studies and Projects

Beach postings due to high bacteria levels came to the public’s attention in the mid 1990s. The original Maumee Bay Bacteria Task Force convened with little definite information on the causes. Early meetings involved extensive discussions of the many possible bacteria sources and other factors that could lead to beach postings. Discussion led to the development of numerous studies and projects investigating possible sources; or implementing control measures. The following summary shows where the Wolf Creek Committee has been to reach today’s recommended actions. The projects described are grouped by issue, and organized as much as possible chronologically.

- Early studies by the Maumee Bay Bacteria Task Force and its members analyzed sediments and water from the Inland Lake, the Maumee Bay nearshore area, and ditches flowing into the Bay in Oregon and Jerusalem Township within a few miles of the park. These studies concluded that high *E. coli* densities may be found in sediments when the water column does not show high levels. This suggests that the bacteria are surviving in sediment material, since input via water was not occurring.

- Studies identified birds as the main source of bacterial contamination at the Inland Lake beaches.
  
  - Early studies showed that birds were definitely contributors to the bacterial problems at Maumee Bay State Park, but are unlikely to be the main source in ditches. Their primary impact is at the Inland Lake beach, which does not receive flow from Berger Ditch. ODNR has worked to control birds and limit their feeding. Gulls and geese are a suspected source of bacterial contamination, especially at the Inland Lake beach.

- Studies were conducted of the feces of Canada Geese in the greater Toledo area, including Maumee Bay State Park, to determine what pathogenic microbes they contain. Highly infectious Cryptosporidium oocysts were detected in the feces that were sampled, thus suggesting that determining the source of fecal contamination of public waters is important relative to public health. By identifying the source(s) of *E. coli* and knowing the pathogens that are associated with each source, it may be possible to determine the types of health problems that could potentially arise by public exposure to source-specific disease agents in the contaminated water.

- *E. coli* DNA Fingerprinting
  
  - Aware of many potential sources of *E. coli*, the next line of investigation was to determine whether DNA fingerprinting techniques could identify the sources of *E. coli* impacting the beaches. This research identified approximately 600 different types of *E. coli*. The technique did not link specific sources with *E. coli* found in the park area, but did confirm birds (particularly gulls and geese) as a significant source, particularly for the Inland Lake. As a result of these findings, Maumee Bay State Park began conducting

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3 Glatzer, 1995  
4 Bisesi, 2000  
5 Glatzer and Sinsabaugh, 1999
programs to harass and frighten birds away from the beach areas, and posted warnings against feeding the birds.

- In 1996, Ohio EPA conducted limited water column studies in the bay near the park. The samples collected showed higher concentrations of *E. coli* along the shore than further out into the bay. This provided evidence that high *E. coli* levels may be a nearshore phenomenon.
  - The Lake Erie beaches at the park are divided into distinct coves. In 1996, Maumee Bay State Park and the City of Toledo conducted a study of *E. coli* levels in the water column at each of the Lake Erie beach coves. Near the eastern edge of the beaches, Wolf Creek/Berger Ditch enters the bay. Moving west, away from the mouth of Wolf Creek, it was found that *E. coli* levels declined. This study led to the hypothesis that Wolf Creek may be a significant source of *E. coli* impacting the Lake Erie beaches. As a result of these findings, the Toledo/Lucas County Health Department undertook a watershed study of septic systems in the area, particularly the Wolf Creek watershed. Many failed septic systems were identified and upgraded. This study also supported extension of sanitary sewer service to the area.
  - Further studies of sediment, weather, wind, and *E. coli* levels showed correlations between water turbidity and *E. coli*, between rain events and turbidity, and wind direction and *E. coli* (i.e., highest *E. coli* levels were found when winds are from the north, northeast, or northwest). This study confirmed findings from beach studies in other areas that high *E. coli* levels are a weather-related phenomenon, and supported the hypothesis that high *E. coli* levels at the Lake Erie beaches may be due to resuspension of sediments containing bacteria.
  - Surface water testing for 1996 included Berger Ditch as well as Norden Road (McHenry) and Cousino Road (Sautter) Ditches. Water quality violations of bacterial standards were common in all three. From April through October of 1996, over 90% of surface water samples from Berger Ditch exceeded water quality standards. Results for other sampling were similar. The mouth of Berger Ditch is closest to the Lake Erie beach.

- Toledo/Lucas County Health Department sanitary survey and onsite system repairs
  - Health Department testing indicates that septic system failure is very common in the area. Some areas are densely settled enough to require public sewers. In 1998-99 the Lucas County Health Department conducted a stream and septic system-testing program in Oregon and Jerusalem Township. In Oregon 11 of 19 stream sites showed levels of bacteria in excess of water quality standards.

- DNA tracking (Lake Erie Center, University of Toledo)
  - The Lake Erie Center conducted a DNA and membrane analysis study to identify *E. coli* strains and match them with upstream sources.

- Wolf Creek study by the Lake Erie Center: in the summer of 2000 experiments using microcosms of Wolf Creek sediments gave the following results:
  - *E. coli* in sediment were high throughout stream
  - *E. coli* hot spots were identified, but they moved from one location to another over time
  - Rainstorms stir up sediment and bacteria together

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6 Hatfield, 2000, 2001
- *E. coli* survive in sediments for a month with a population drop of 97%—but still a health risk
- Fecal contamination remains in the sediments as long as they are under water or moist
- There are high *E. coli* levels upstream of the seiche, indicating that the stream is the source, rather than the stream being contaminated by the lake

- **City of Oregon stream and nearshore sampling**
  - In 2001, extensive water column studies were conducted to investigate *E. coli* concentrations in Maumee Bay waters and identify sources. In offshore sampling, geometric mean *E. coli* concentrations were highest at sites closest to the mouth of the Maumee River and lowest at the sites farthest offshore. The ditches had higher *E. coli* concentrations than the ditch/lake mixing zones. At Maumee Bay State Park, exceedences generally occurred in the summer when winds were from a northerly direction, turbidity values were elevated, and (or) a rain event with at least 0.5 inches occurred in the 24-hour period before sampling. These data again suggest that there are multiple sources of *E. coli* that enter the Bay, and that sediment-associated *E. coli* that are suspended by weather events are the primary source of contamination for the Bay's beaches.

- **City of Oregon Wolf Creek watershed sanitary sewer extensions**
  - Trunk sewers were built along Stadium Road, Seaman Road from Lallendorf to Wolf Creek, and Stadium between Pickle and Corduroy Roads between 2001-2005. The Seaman and Stadium trunk sewer project is approximately seven (7) miles long with a service area of 5,350 acres or 8.4 square miles. The cost of the project was $7.6 million. These sewers eliminated hundreds of septic systems and three package sewage treatment plants.
  - In 2004, the City also constructed the Pickle & Wynn local sewer project, which is 3 miles long, at a cost of $2.5 million. This project serves approximately 200 households in the Wolf Creek Watershed that previously had septic systems.
  - In 2006/7 Oregon also constructed the Coy Road sanitary sewer project, 3,300 feet long, at a cost of $400,000. This project eliminated approximately 30 failing septic systems.

- **The City of Oregon Biosolids Program**
  - The City of Oregon’s wastewater treatment facility produces biosolids as a byproduct of the treatment process. The biosolids are digested aerobically to a “Class B” standard defined by EPA; digestion kills most of the pathogens. Biosolids are recycled by application to agricultural land. Doing so returns productive nutrients to the soil, and benefits crops.
  - Oregon applies biosolids to EPA inspected and approved sites in accordance with EPA regulations. To protect streams from any runoff, Oregon applies biosolids with isolation distances that are 20-30% above required distances. The biosolids are injected to a depth of 6-8” below the surface. This depth is intended to be deep enough to prevent surface runoff and shallow enough to prevent leaching into field tiles. Typical minimum depth of field tile is 24-36” from the surface.

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8 Bob Martin, City of Oregon, 2002, written communication
During the period of 2000-2009, biosolids were applied to agricultural land in the watershed in six years (no applications in 2000, 2002, 2006, or 2009). Biosolids were applied to two fields in the watershed in 2010.

Oregon has biosolids application sites in the Wolf Creek Watershed, but also sites in the neighboring Big Ditch, Johlin Ditch, Heckman Ditch, and Tobias Ditch watersheds that enter Lake Erie west of the park. Comparing biosolids applications in 2004 with the results of USGS water quality testing (see below) shows that 81% of the biosolids land-applied that year were in the neighboring watersheds. Tests found lower *E. coli* numbers associated with these streams than with Wolf Creek.

**UT Lake Erie Center Agricultural biosolids application studies**

- Biosolids samples were collected from the Oregon Waste Water Treatment Plant and analyzed for *E. coli* using Colilert™ and total heterotrophic bacteria using dilution plating methods.
- Soil from three sampling sites in the field and water from drainage tile was collected from 32-A’s drainage tile prior to application of biosolids to determine background levels of *E. coli*. Water samples from 32-A’s (Field is located at the Wolf Creek and Berger Ditch confluence) drainage tile were collected after the first rainfall that produced drainage and was continued thru the spring to determine bacterial re-growth. Conclusions, inconclusive due to unsuitable field conditions resulting from precipitation events flooding the ditch and drainage tile.
- Collected samples from field on Norden Rd, Oregon pre- and post-biosolid application of field and up and downstream in Wolf Creek. Conclusions, no significant increase in water or sediment samples.

**Maumee Bay Bacteria Study 2003-5 (USGS)⁹:** this study examined Maumee Bay and its nearshore areas to confirm or dismiss a number of potential bacteria sources.

- Factors dismissed as not significantly influencing bacteria levels:
  - Rainfall 2 or 3 days ago
  - Number of birds (time of sampling)
  - Number of bathers
  - Water temperature
  - UV index (yesterday)

- Factors that were found to affect *E. coli*:
  - Rainfall in the previous 24 hours
  - Turbidity (water clarity)
  - Wave height
  - Wind direction

- The study’s conclusions were:
  - The Toledo Harbor shipping channel acts as a depositional area for *E. coli*
  - Remote sources — sewer overflows from Toledo and Perrysburg, effluent discharges from the Toledo, Oregon, Perrysburg, and Lucas County wastewater plants — were not important contributors of *E. coli* at there Maumee Bay State Park Lake Erie beaches
  - Heated effluent from Toledo Edison did not result in elevated *E. coli* concentrations

Berger Ditch is a principal source of E. coli to Maumee Bay and Maumee Bay State Park

At the end of 2005, taking the cumulative study results, the Maumee Bay Bacteria Task Force had reached these conclusions:

- Contamination at the Inland Lake beach results from birds, and management measures are taken to control them.
- The principal source of bacteria that result in the contamination of the Lake Erie beaches is Wolf Creek / Berger Ditch.
- The City of Oregon has constructed three sanitary sewer projects in the watershed, eliminating hundreds of septic systems and several package plants.
- The Toledo/Lucas County Health Department has surveyed the remaining septic systems. Residents repaired or replaced failed systems that were detected.
- Clear before-and-after studies were not conducted to determine how much Oregon and Health Department actions have reduced bacteria loadings or impacts at the Lake Erie beaches. They have eliminated a large number of sewage discharges into the watershed: these projects can only help. However, bacteria levels at the Lake Erie beaches are strongly related to wind and weather, so it is not a simple matter to determine the benefits of sewer extensions. The biggest sewer extension projects were completed in 2004-5. From 2000-4 the beaches were posted an average of 28 days/season; from 2005-9 they were posted an average of 12 days. However, there this is not proof that the sewer extensions reduced bacteria loadings, leading to the decrease in postings.
- Regardless of any benefits from sewer extensions and septic system replacements, these actions have not eliminated the bacterial contamination at the Lake Erie beaches. The Maumee Bay Bacteria Task Force concluded that we are not likely to solve this problem by addressing increasingly diverse non-point watershed sources. While these sources should be remediated where possible, the Maumee Bay Bacteria Task Force decided to pursue capture and treatment of stream water to protect the beaches. The mechanism to accomplish this goal will be wetland systems in the lower watershed.

Maumee Bay State Park Wetland Restoration Implementation Plan\(^{10}\): The Maumee Bay Bacteria Task Force commissioned Hull & Associates to develop a conceptual plan for wetland systems to capture and treat E. coli from the stream water.

- Analyzing stream and beach data, the study observed:
  - \textit{E. coli} levels in Berger Ditch are elevated following small storm events as well as large ones.
  - \textit{E. coli} levels in Berger Ditch are highly correlated with suspended solids and peak in the summer months.
  - \textit{E. coli} levels in Berger Ditch over 10,000 cfu/100 ml appear to correspond to beach advisory levels over 235 cfu/100 ml
  - A wetland treatment system would need to control bacteria and suspended solids loadings at very low flows as well as high flows.

\(^{10}\) Hull and Associates, 2008

Beach advisories may occur even at times when *E. coli* levels in Berger Ditch are not elevated.

- The study recommended and provided costs and conceptual designs for a two-stage wetland system:
  - The upstream wetland would be along Wolf Creek on property owned by the City of Oregon, where the water treatment plant is located. The site is just west of North Curtice Road, where Wolf Creek turns north and becomes Berger Ditch. The upstream wetland’s purpose would be to facilitate the settling of suspended sediment out of stream water. This serves two purposes: first, some of the *E. coli* loading is attached to fine sediment particles that are suspended in the water column. Removing these sediments would decrease some of the *E. coli* load. Second, removing the sediment upstream protects the downstream wetlands from sediment accumulation.
  - The downstream wetlands would be located in Maumee Bay State Park, property owned by Ohio DNR. The Hull report proposed a multi-stage channel design with floodplain wetlands to capture or treat *E. coli* in the water at a wide range of flow levels.
  - The conceptual design suggested a 3-acre wetland and 6 acres of habitat restoration at the upstream site with an estimated cost of $812,138. It suggested 8 acres of wetlands and 16 acres of habitat restoration at the downstream site with a cost of $1,894,665. With monitoring, design, construction administration, and one year of operation and maintenance, the costs for the two stages were estimated at $2,956,803.

- City of Oregon Wolf Creek Riparian Corridor Acquisition
  - In 2009-2010, the City of Oregon received an ODNR Coastal Management grant to acquire properties along Wolf Creek that could be restored as wetlands and riparian habitat. One property under negotiation is 4½ acres north of Corduroy Road. This location is about half a mile upstream of the water treatment plant; it would provide the same sediment management and habitat function as a wetland on the water treatment plant property. Habitat restoration along Wolf Creek on the Oregon water treatment plant property remains an additional option.
  - Another 1.0 acre site closer to the water treatment plant, already owned by the City, was included in the site design.

**Proposed Wetland System for *E. coli* Control**

In conducting this series of studies to understand causes and sources of bacterial contamination, the Maumee Bay Bacteria Task Force reached these conclusions:

- Bacterial postings are an issue for all public beaches in northwest Ohio. The Lake Erie beaches at Maumee Bay State Park are a special case because the facility is high profile and its Lake Erie beaches have more frequent postings than most other northwest Ohio beaches.

- Of the many sources of fecal bacteria entering Maumee Bay, the Wolf Creek / Berger Ditch watershed has the greatest impact on the Lake Erie beaches at Maumee Bay State Park. On this basis, the Maumee Bay Bacteria Task Force re-formed as the Wolf Creek Committee.
• There are many potential sources of fecal bacteria in the Wolf Creek watershed, which include human sewage sources (e.g. failed onsite sewage systems, runoff from land application of biosolids or septage) and warm-blooded animals of all descriptions (e.g. mammals — wild or domestic — and birds).
  o Human sewage sources can be controlled by extending public sewers or repairing/replacing failed onsite systems. Wherever possible, these improvements are beneficial and worthwhile.
  o Animal sources can be controlled to a degree, based on preventing their droppings from reaching waterways. Maumee Bay State Park has set rules against feeding the birds, and harasses geese to keep them away from the beaches. Riparian habitat throughout the watershed could provide buffer strip barriers to help prevent pollutants from reaching streams and ditches. Stormwater best management practices, such as ponds to retain runoff and enhance water quality, can also help.
  o With all these efforts, source controls may not achieve enough reduction in bacterial loadings to provide safe beach access within a reasonable time frame.

• As individual agencies continue to pursue source controls, the Wolf Creek Committee has decided as a group to focus on watershed solutions. The strategy agreed to is to develop a wetland system to treat the stream water before it reaches Maumee Bay.

Considerations for Wetland System Designs

The overall goal of the wetland system is to reduce the loadings of bacteria and suspended solids entering Maumee Bay. In order to achieve this goal, the wetland system will be designed using two stages. The purpose of the first stage is to detain suspended solids in such a way that they can be easily removed from the stream system, and the purpose of the second stage is to destroy and remove bacteria. The first stage will provide two functions: (1) Reduce bacteria loadings. Bacteria commonly are attached to the fine soil particles suspended in the water column. Settling out the suspended solids will reduce the loadings of bacteria that reach the bay. (2) Protect the second stage from sediment accumulation. If the stream water reaching the second stage wetland contains a large amount of suspended solids, accumulation of settled solids could impair effective biological processes. The recommended location of the first stage wetland is along the lower end of Wolf Creek, either on property owned by the City of Oregon at its water treatment plant, or nearby on property acquired in 2010. The second treatment stage will function to destroy or remove bacteria from water by several mechanisms, including exposure to sunlight, filtration through aquatic plants in shallow wetland areas, and biological action. The recommended location of the second stage wetland is along Berger Ditch in MBSP.

Studies indicate that E. coli may be attached or unattached to solid particles in aqueous solutions (Muirhead et al. 2005; Muirhead et al. 2006). The University of Toledo recently has been investigating the percentage of E. coli that is attached to suspended solids in Berger Ditch. Using the methods developed by Muirhead et al. (2005), 12 samples have been analyzed. The results indicate that 62% of the total E. coli present in samples collected from the Berger Ditch stream gauge is attached to suspended solids.11 Using current data (Table 1) that have been collected at the proposed locations for each stage of the wetland (first stage in Wolf Creek and second stage in Berger Ditch), it is suggested that a 50% reduction in the suspended solids entering the second stage will decrease the loadings of E. coli from 2.6613 x 10^{14} CFU to 1.8363 x 10^{14} CFU, which is a 31% decrease. The grain size


distributions of the suspended solids at the two proposed locations for the wetland system are presented in Table 2. The suspended solids in Wolf Creek have a higher percentage of sand-sized particles, which means that slowing down the velocity of the stream may significantly reduce the sediment load that reaches the second stage of the wetland system. The suspended solids in Berger Ditch have a higher percentage of clay. This means that the second stage will function as a filtering system to capture fine-grained solids that are not be retained in the first stage.

**Table 2: Cumulative loadings for *E. coli* and suspended solids in Berger Ditch and Wolf Creek during the time period 4/12/10 to 7/14/10.**

<table>
<thead>
<tr>
<th>Loadings</th>
<th>Berger Ditch</th>
<th>Wolf Creek</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. coli</em> (CFU)</td>
<td>2.6613 x 10¹⁴</td>
<td>3.6603 x 10¹⁴</td>
</tr>
<tr>
<td>Suspended solids (metric tons)</td>
<td>877.3</td>
<td>1420.4</td>
</tr>
</tbody>
</table>

**Table 3: Grain size distributions for suspended solids collected in Berger Ditch and Wolf Creek.**

<table>
<thead>
<tr>
<th></th>
<th>Berger Ditch</th>
<th>Wolf Creek</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand (%)</td>
<td>3.55</td>
<td>42.15</td>
</tr>
<tr>
<td>Silt (%)</td>
<td>47.20</td>
<td>54.72</td>
</tr>
<tr>
<td>Clay (%)</td>
<td>49.25</td>
<td>3.14</td>
</tr>
</tbody>
</table>

Each wetland stage is described in more detail below. The general design considerations for each include:

- Layout and configuration of restoration for most effective function
- Hydrological modeling for design of volumes, elevations, and retention times for effective settling
- Ecological design: plants, erosion protection
- Flow control structures, if needed
- Construction costs
- Annual costs and specific maintenance activities needed

Research indicates the effectiveness of surface and subsurface flow wetlands in removing phosphorus and bacteria from various types of water flows (Table 4).
Table 4: Wetland Effectiveness in Removing Bacteria and Phosphorus

<table>
<thead>
<tr>
<th>Wetland type</th>
<th>Material</th>
<th>Removal Efficiency (%)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface flow</td>
<td>Wastewater</td>
<td>Bacteria (&gt;97)</td>
<td>Rivera et al. 1995</td>
</tr>
<tr>
<td></td>
<td>Wastewater</td>
<td>Bacteria (96-99)</td>
<td>Decamp and Warren 2000</td>
</tr>
<tr>
<td></td>
<td>Wastewater</td>
<td>Bacteria (23-39)</td>
<td>Hench et al. 2003</td>
</tr>
<tr>
<td></td>
<td>Wastewater</td>
<td>Bacteria (95-99)</td>
<td>Molleda et al. 2008</td>
</tr>
<tr>
<td></td>
<td>Wastewater</td>
<td>Bacteria (72)</td>
<td>Reinoso et al. 2008</td>
</tr>
<tr>
<td>Surface flow</td>
<td>River water</td>
<td>Phosphorus (53-92)</td>
<td>Mitsch et al. 1995</td>
</tr>
<tr>
<td></td>
<td>River water</td>
<td>Phosphorus (56-59)</td>
<td>Nairn and Mitsch 2000</td>
</tr>
<tr>
<td></td>
<td>Stream water</td>
<td>Phosphorus (21-44)</td>
<td>Braskerud 2002</td>
</tr>
<tr>
<td></td>
<td>Agricultural runoff</td>
<td>Phosphorus (59)</td>
<td>Lu et al. 2009</td>
</tr>
</tbody>
</table>


Wetlands versus Active Treatment for Pathogen Control

Pathogen treatment in creek water could employ a biological approach, such as wetlands, or active treatment using chemicals, mechanical/electric equipment; or a combination of biological and active treatment.

The two most commonly-used methods of active water disinfection are chlorination and ultraviolet.

Chlorination is accomplished by mixing chlorine, in granular, liquid, or gaseous form, with the water. To be effective, a 30 minute contact time is required, and a contact tank big enough to hold 30 minutes’ peak flow. Using a Wolf Creek peak flow rate of 250 cfs, the contact chamber would need to hold 3.37 million gallons. Chlorine has a drawback of reacting with organic compounds found in creek water to form trihalomethanes, which are considered carcinogenic. Because residual chlorine can be toxic to aquatic animals, the chlorine would have to be removed before releasing the water to Lake Erie. This process is called dechlorination, which uses a chemical agent, such sulfur dioxide or a sulfite salt, to remove chlorine from water.

In summary, chlorination/dechlorination would require mixing chambers, a large contact tank for chlorination, and dosing and mixing equipment for chlorination and dechlorination. Operating the equipment would require delivery, handling, and storage of chlorination and dechlorination chemicals. Chlorination/dechlorination will not be considered further because of high capital and high operational costs.

Ultraviolet light can be an effective alternative wastewater disinfectant. Since it uses light, not chemicals, to inactivate/destroy pathogens, ultraviolet does not have the drawback of undesired chemical reactions, nor does it require chemical supplies, dosing and mixing facilities. Operational requirements of ultraviolet disinfection include electricity, and replacement of lamps and ballasts as needed. The ultraviolet lamps must be kept clean to retain effectiveness; self-cleaning equipment is available.

While ultraviolet disinfection has been proven effective on treated wastewater, using it to treat stream water is a different application with significant drawbacks. Wastewater effluent is water that has been treated to meet discharge standards: its content of organic matter and suspended solids (turbidity) are low. Stream water, on the other hand, is untreated, containing decaying plant and animal matter from watershed runoff. Wolf Creek water is usually turbid, around 120 NTU, ranging from 7.5 to 946 NTU, due to organics and suspended soil particles, especially silt and clay. Both organic content and turbidity block ultraviolet light penetrating the water, and reduce or prevent its effectiveness as a disinfectant.

Cost is a factor for active disinfection, on two fronts. First, construction and equipment cost. The initial capital outlay may be covered by grant funding. An ultraviolet disinfection system to treat the peak flow of 250 cfs would cost approximately $9.7 million. But secondly, active disinfection requires continuous maintenance to be effective: electricity, supplies, replacement parts, and labor. These costs are not insignificant, and would have to be borne by the owner of the disinfection system. That would probably be the City of Oregon or Lucas County, neither of which is under a legal obligation to install this equipment. Another option would be to establish a Conservancy District under Ohio Revised Code.

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12 Data for the stream gage in Wolf Creek from 4/12/10 - 10/14/10 shows that peak flow reached 334 cfs; on 4/26, average flow for that day was 291 cfs. The 100 year 24 hour storm for this watershed is 556 cfs. It will not be feasible to treat all of Wolf Creek’s flow; final sediment pond design will be based treating stream flow to protect the wetlands at Maumee Bay State Park and reduce pathogen loading reaching the lake.

13 Personal communication November 30 2010, Dr. Kristopher Barnswell, University of Toledo Lake Erie Center. These data summarize 1206 samples taken between 7/27/07 and 7/26/08.

14 Personal communication, Pelton Environmental Products November 2010: a rule of thumb cost being $60,000 (installed) per mgd of peak flow capacity. The power consumption would be approximately 4 kW / mgd of total flow. Site specifics and detailed design would be required to determine firm cost estimates.
§6101: such a district could own and operate treatment equipment, its costs funded by a special tax on property owners of the watershed. It seems unlikely that Lucas County, the City of Oregon, or the property owners of the watershed would voluntarily pay these ongoing costs. Establishment of a Conservancy District for this purpose is not recommended. Due to capital and operation costs, an ultraviolet disinfection system is not recommended.

A wetlands system requires less maintenance, discussed below. In addition to controlling pathogens, wetlands reduce sediment and pathogen loadings to Lake Erie, provide valuable coastal habitat, and are aesthetically pleasing.

**First Stage Wetland - Upstream at City of Oregon Site**

The Hull report of 2008 recommended locating the first stage of the wetland system, the sediment detention ponds, along Wolf Creek on property owned by the City of Oregon (Figure 5). The site mentioned was on the north side of Wolf Creek, south of the city’s water treatment plant on North Curtice Road. This site is just upstream of where Wolf Creek turns 90º to the north, joining Berger Ditch. In November 2010, the City was negotiating for acquisition of another property on the north side of Wolf Creek, less than a mile upstream, north of Corduroy Road. Additionally, the City owns property connecting these two parcels. The three adjoining properties are recommended for siting the sediment detention ponds.

The design for the first stage will allow the normal flow of Wolf Creek to remain within the existing stream channel. However, the modifications to natural morphology will include: (1) the east bank of the stream will be cut to form a floodplain that widens the channel to reduce the stream velocity and height during storm events. (2) Offline deep water pockets (i.e. detention ponds or wet ponds) will be excavated within the floodplain area to increase the volume of solids that can be detained during higher flow events as well as to improve the floodplain storage capacity.

This plan will consider two potential locations for the first stage wetland. The primary site would be partially on land presently in private ownership. Should negotiations between the City and the owner to acquire the site voluntarily not reach fruition, the alternative site could be used instead. The alternative site is on property already owned by the City of Oregon. Throughout the plan, reference to the first stage wetland is based on the primary site unless otherwise noted. Actual size and configuration of the floodplain and pond(s) on either property will be designed to meet the overall project objective, and are based on an excavation of an approximate volume of soil (i.e. 150,000 cu/yds) for either scenario.

**Primary Site**

The primary site would provide new floodplain with sediment detention ponds between Corduroy and North Curtice Roads. The ponds would be located in the two parcels noted above. These are the furthest upstream, and under negotiation for acquisition is parcel 4440180. The center portion, parcel 4440184, where Wolf Creek is joined by another ditch from the west, is already owned by the City of Oregon; and the third and furthest downstream parcel 4440187 is Oregon property, on which the water treatment plant is located north of Wolf Creek. Ponding areas on the water plant parcel would be restricted to the north side of the creek; the south side is in private ownership and will be unaffected.

In the site map, two ponds are shown. In the final design, the number of ponds could be increased or decreased. Increasing the pond volume will increase the amount of sediment and bacteria that can be removed from the stream.

**Alternate Site**

The alternate site would provide new floodplain and a one acre sediment pond. The alternate site is entirely on City of Oregon property, parcels 4440184 and 4440187,
First Stage Wetland Considerations Applicable to Both Sites

The first stage would be designed so that Wolf Creek would overflow into the sediment ponds at about the level of a one-year storm. Based on the limited data available, that would be a flow depth of roughly 2.5 to 4.5 feet.

The sediment detention ponds are not intended to develop into wetlands, but to remove suspended solids and the attached bacteria, thereby protecting the second stage wetland that is located downstream from accumulating sediment. The plant mixture that will be established in the floodplain area will consist of native woody and non-woody species. The woody species (e.g., button bush, silky dogwood, red maple, and willow) will be used to provide shade and increase plant water uptake. The non-woody species (e.g., blue joint grass, plains oval sedge, prairie cord grass, and Virginia wild rye grass) will provide surface cover that prevents soil erosion. The sediment ponds themselves will be open water with no vegetation.

The sediment ponds will need to be dredged periodically to maintain sedimentation function over time. The dredged sediment may be reused beneficially on nearby property whose owners are willing to accept the material. Access will be provided for maintenance of the sediment ponds: for the primary site, Corduroy Road via parcel 4440180; for the alternate site, from North Curtice Road. The North Curtice Road access point would offer a second access point for the primary site.
Note: The size and configuration of the ponds and floodplain will be based upon the model results, and the excavation of 150,000 cu/yds of soils.
Figure 6 - Oregon Sediment Ponds & Floodplain: Alternate Site Conceptual Design

Note: The size and configuration of the ponds and floodplain will be based upon the model results, and the excavation of 150,000 cu/yds of soils.
Second Stage Wetland - Downstream at Maumee Bay State Park

The Hull conceptual plan of 2008 suggested wetland and habitat restoration along Berger Ditch through the park following a corridor of more or less even width. There are several infrastructure barriers that wetland restoration work should avoid, but there are substantial additional areas that have restoration potential. In all, approximately 33 acres may be able to provide wetland, habitat, and flood control benefits.

The park infrastructure to avoid includes:

- Water line — follows Berger Ditch on its east side nearly the entire south-north length of the park. Stream channel excavation and habitat restoration should not cross the water line; therefore, restoration will need to be only west of the waterline, and mostly on the west side of the ditch.

- Sanitary sewer — a force main from the lodge and other park facilities crosses Berger Ditch near its north end. The force main runs west-southwest, crossing the water line and ditch, and then under the Inland Lake toward a connection with the City of Oregon system. A buffer zone should be left on both sides of the force main in which no excavation is done.

- Pond pumping stations and storm sewers — two storm sewers connect the Inland Lake with smaller ponds on the east side of the road into the park. These storm sewers and pumps are used for lake and pond level control. A buffer zone should be left around the northern most pump station, in which there is no excavation. Restoration work could be done around the storm sewers, but the pipes themselves should be left undisturbed.

- North Curtice Road — originally ran due north along the east side of Berger Ditch. The roadbed still exists, though it is buried, and has been replaced by the curving park entrance road. The roadway does not present a barrier, and is no longer of any use, but it should be anticipated in final design and costs.

Four specific areas along Berger Ditch have restoration potential. Three are narrow areas on the west side of the ditch. When the park was developed and the Inland Lake was constructed, the soil was used to build hills between the ditch and the lake. Stream channel restoration could extend into the hills by moving the soil. These three areas have been labeled “Berger Restoration” #1, #2, and #3, and are approximately 2, 1, and 5 acres respectively. They are divided into three sites by gaps to avoid disturbing infrastructure. These areas presently have erosion problems; habitat restoration should be selected and installed to stabilize the banks. Wetland restoration for these sites would feature the additional benefit of solving these erosion problems.

The fourth restoration area is by far the largest, located at the northwest corner of North Curtice Road and Cedar Point Road, at the park entrance. This area is generally flat, with a watershed divide between Berger Ditch and McHenry Ditch (Norden Road) near the tree line. A wetland in this area could capture and treat E. coli from the flow of Berger Ditch. The Berger Ditch channel on the east side of the wetland area would be excavated into terraced profile, with multiple “benches” and “troughs” at several levels. This design would allow storm flows and Lake Erie seiche events of various heights to pond in the troughs, exposing pathogens to destruction by biological and ultraviolet action, and to drain through subsurface flow wetlands (benches) subjecting bacteria and pathogens to anaerobic conditions and further removal. The conceptual design for the site envisions parallel broad bands of alternating surface flow and subsurface flow wetlands running parallel to the ditch. During high flows, water would be captured in the surface flow wetland areas at several bench heights. Upon recession of water stage in the ditch, water from the surface flow wetlands would then flow through the subsurface flow wetlands into the next lower surface flow wetland area. The shape of the wetland restoration area will vary hydrologically because of the strong, frequent Lake Erie seiche effect which can cause very high water elevations in Berger Ditch even under low flow conditions.
Based on current available data, Berger Ditch typically has 2.2 to 2.5 feet water depth in summer. The lowest floodplain level, shown in the conceptual profile, Figure 6, would be 3.5 feet. In a period between April and July 2008 depths in Berger ditch exceeded 3.5 feet (lowest floodplain) 5 times; at that rate, the lowest floodplain level could be submerged at least 10 to 12 times per year. The other floodplain levels will be inundated less frequently. The heights of the subsurface terraces will need to be adjusted in the final design after using the HEC-RAS model currently in development. The terraced wetland will be designed to treat a wide range of flows due to storm events and high water due to seiches. The terraced wetland system may collect fine sediments, as any natural wetland would in this geomorphic setting. The terraced wetland system should function without ongoing sediment removal. However, over time the subsurface flow soils may lose that function as they become blocked with fine sediments. The subsurface terrace function may have a limited life span — perhaps 20-30 years, depending on the porosity of soils used in their construction.

Potential wetland restoration at MBSP along Berger Ditch covers approximately 33 acres. It may not be impossible to secure funding for that much restoration at one time, but it is not likely. It will probably be necessary to divide MBSP wetland restoration into multiple projects to fit available funding. The overall project could be broken into sub-projects as follows:

- Stream restoration — Berger Ditch restoration area #1 (2 acre of wetlands, 450 feet of stream channel restoration)
- Stream restoration — Berger Ditch restoration area #2 (1 acre of wetlands, 350 feet of stream channel restoration)
- Stream restoration — Berger Ditch restoration area #3 (5 acres of wetlands, 1500 feet of stream channel restoration)
- North Curtice / Cedar Point Road terraced wetland — benches of alternating surface and subsurface flow, as described above (25 acres of wetland restoration)

The design of the second stage, terraced wetland will require the natural morphology of Berger Ditch to be re-configured into a multistage ditch with floodplain wetlands. The floodplains will include both surface and subsurface wetlands. The build up of soil to construct the floodplain berms (refer to Figure 7) will comprise the subsurface wetlands that will promote bacteria adsorption to the soil and filtration by roots of the aquatic plants, and the surface wetlands will facilitate the destruction of the bacteria by exposure to sunlight. The soil used to build the subsurface flow wetlands/floodplain berms will have a coarse grain size (e.g., fine gravel or sand) to promote a constant flow of subsurface water. The surface wetlands will contain a mixture of sub-emergent and emergent native plants (e.g., cardinal flower, marsh marigold, swamp milkweed) as well as the non-woody species in the first stage of the wetland. The subsurface flow wetlands will support deeper-rooting wetland species including shrubs and trees.

Berger Ditch Restoration areas 1, 2, and 3 are influenced by several design constraints. The east side of the ditch is paralleled by a drinking water supply main for the park while the west side is constrained by a large lake and paved walking path. Because of these factors full restoration of floodplain conditions is not possible. The ditch is influenced by the typical flow of water to the north carrying drainage from Wolf Creek watershed, but at times can also convey water southward from Lake Erie. Berger Ditch is currently a deep trapezoidal ditch with moderate to severe erosion on its banks from the flow of water. The restoration/stabilization design proposed will help to restore some floodplain function thereby reducing erosive velocities and stabilize the channel. The proposed method employs the placement of large, single stones coupled with live stakes of native woody shrubs, such as red osier dogwood or sandbar willow (many native wetland species can be used). The stones, classified in the area by local quarries as large armor rip-rap should be in the 2 to 3 ton range. Stones are placed in the bank with their horizontal axis centered at the normal water level. During stone installation, live stakes should be
placed on either side of the stone as noted in the diagram. The west bank may be excavated out to serve as a small floodplain where space allows. The floodplain should be planted with native riparian type grasses. Grade control in Berger Ditch can also be achieved using the same stone material if necessary. The stone should be trenched in across the stream, placed at the desired elevation and keyed into the banks east and west for stability. Grade control should be placed at approximately 100° intervals along the length of the ditch.

Figure 7 - Berger Ditch Restoration areas: Conceptual Design
Figure 8: Maumee Bay State Park Terraced Wetlands & Restoration

<table>
<thead>
<tr>
<th>Name</th>
<th>Area</th>
<th>Units</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berger Restoration 1</td>
<td>2.0</td>
<td>Acres</td>
<td>Stream Restoration</td>
</tr>
<tr>
<td>Berger Restoration 2</td>
<td>1.0</td>
<td>Acres</td>
<td>Stream Restoration</td>
</tr>
<tr>
<td>Berger Restoration 3</td>
<td>5.0</td>
<td>Acres</td>
<td>Stream Restoration</td>
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<tr>
<td>Terrace Bench</td>
<td>3.0</td>
<td>Acres</td>
<td>Surface Flow</td>
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<td>Terrace Bench</td>
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</tr>
<tr>
<td>Terrace Bench</td>
<td>1.0</td>
<td>Acres</td>
<td>Surface Flow</td>
</tr>
</tbody>
</table>

Legend:
- Streams
- Wetlands - proposed
- Type
  - Stream Restoration
  - Surface Flow
  - Subsurface Flow
- Pipes
  - Sanitary
  - Storm
  - Water

Note: pipeline locations shown are approximate

Conceptual Profile
Terraced Wetland Restoration
Flow: Alternating surface and subsurface
Existing Profile
Proposed Profile
Recommended Project Costs

Overall project costs and descriptions of activities to complete it are given in the table below. A significant portion of the construction costs are for excavation and hauling of soil that is removed to create floodplains, wetlands, and sediment ponds. The size of both the first and second stage wetlands will be determined in final design, and will depend on approval by the City of Oregon and Ohio DNR, and availability of funding.

Construction cost estimated use the assumption that excavated soil will need to be hauled less than two miles. If the soil can be reused on-site or nearby, such as at MBSP, construction costs may be lower. Final costs will depend on detailed design: costs are given as a range with an estimated cost, and ±25% range.

Table 5: Planning and Construction Costs

Wolf Creek - Berger Ditch Wetland Restoration
Estimated Planning and Construction Costs

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
<th>Low Range Cost</th>
<th>High Range Cost</th>
<th>Estimated Cost</th>
</tr>
</thead>
</table>
| Planning / Design / Permitting  | ♦ Project meetings  
♦ Grant preparation  
♦ Site characterization study including subsurface exploration to support the design of the floodplain restoration with incorporated sediment retention ponds at the City site  
♦ Same for terraced wetlands at the Maumee Bay State Park site  
♦ Design and permitting for both sites  
♦ Preparation of the bid specification package and assistance for contractor selection |
|                                 | $418,000                                                                                                         | $696,000       | $556,000       |
| Construction                    | ♦ Floodplain restoration with incorporated sediment retention ponds at the City site  
♦ Terraced wetland at the Maumee Bay State Park site  
♦ Construction oversight and documentation for both sites |
|                                 | $3,434,000                                                                                                       | $5,724,000     | $4,580,000     |
| Post-Construction               | ♦ Certification of the constructed floodplain restoration with incorporated sediment retention ponds at the City site  
♦ Same for a terraced wetland at the Maumee Bay State Park site  
♦ Operation and maintenance for both sites, which may include the removal of sediment, replanting of vegetation, etc. |
|                                 | $96,000                                                                                                         | $150,000       | $120,000       |
| Total Costs                     |                                                                                                                | $3,948,000     | $6,570,000     | $5,256,000     |
Project Phases

The preferred approach to implement this watershed restoration plan would be as a single project. Such an approach would allow evaluating watershed-wide aspects of the study — such as hydrological modeling — in a holistic fashion. Design and permitting would be most effectively done on a whole-project basis. Whether the entire plan can be implemented as a single project will depend on funding.

However, this section is based on availability of only smaller amounts of funding from different agencies and grant programs, making it necessary to divide the project into separate phases. One basis for phasing comes from split ownership — the City of Oregon and Ohio DNR. Finally, portions of the overall restoration plan are physically separated — stream channel restoration near the mouth of Berger Ditch, terraced wetlands at the corner of North Curtice Road and Cedar Point Road, and sedimentation ponds along Wolf Creek between Corduroy Road and North Curtice Road.

Each phase should include required elements: design, permitting, construction, and post-construction. Hydrological modeling will need to be done jointly for all phases, because hydrology applies to a watershed, and does not lend itself to being broken down into individual projects. A hydrological model will be needed to determine design specifications, for example, elevations of the berm between Wolf Creek and the sedimentation ponds, and elevations of the wetland terraces at MBSP. Similarly, the model will be needed to design retention volumes and sedimentation. A model is a prerequisite to construction of any of the project phases. It is anticipated that a preliminary model, adequate to size project phases for potential funding, will be available in early 2011. The hydrological model will probably change during the course of the project. As more data become available from the two gauging stations, the model will be refined. Also, construction of the restoration projects themselves will alter the stream flow behavior, also changing the hydrological model.

It would be most cost effective to do design and permitting work for the entire set of projects at once, but 1) grants might not pay for design and permitting work if they are not directly connected with construction, and 2) since it may take some time to secure funding for the different phases, designs could become outdated, and permits could expire in the interim. How to phase the work will depend upon the funding available, timing of funding sources, and what each funding source will or won’t pay for.

To construct and restore these wetlands, the following phases are recommended:

Oregon Site Phases

- Phase 1 – Ponds. The sediment ponds, and floodplain areas to connect them hydraulically to the stream, are needed to protect the downstream wetlands from sedimentation, and should be built first. They will be cost effective in terms of the quantity of sediment and bacteria they will remove.

- Phase 2 – Floodplain. Constructing additional floodplain areas, providing habitat along the stream and planting as wetlands could be done at the same time as construction of the sediment ponds, or as a later phase.

Maumee Bay State Park Phases

- Phase 1 – Berger Ditch Corridor Restoration. Habitat restoration and stream bank stabilization along Berger Ditch near its mouth could be done as a single phase, or three small individual phases. Constructing them all at once would be most cost effective; however, if only limited funding is available, it would be possible to undertake them as three separate projects. The phase divisions could be the different restoration areas described previously, based on areas split by pipeline.

- Phase 2 – Terraced Wetlands. The terraced wetland system near the park entrance at North Curtice and Cedar Point Roads would be a large single project, but there is no practical way to divide it into
smaller phases. The MBSP terraced wetland and corridor restoration phases could be constructed in any order, depending on available funding.

The following table lists total estimated costs for the Oregon and MBSP sites individually. Depending on funding availability, it may be necessary to subdivide each into smaller phases. Note that by doing so, the total cost will likely be greater than constructing everything in one large project.
Table 6: Design and Construction Costs

Wolf Creek - Berger Ditch Wetland Restoration
Estimated Design and Construction Costs

<table>
<thead>
<tr>
<th>Project Site</th>
<th>Phase</th>
<th>Low Range Cost</th>
<th>High Range Cost</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oregon - Wolf Creek</td>
<td>Wolf Creek floodplain wetlands and Sedimentation Ponds</td>
<td>$1,387,125.00</td>
<td>$2,311,875.00</td>
<td>$1,849,500.00</td>
</tr>
<tr>
<td>Maumee Bay State Park</td>
<td>Berger Ditch Corridor Restoration (3 sites together) and Terraced wetland at park entrance</td>
<td>$2,628,956.25</td>
<td>$4,381,593.75</td>
<td>$3,505,275.00</td>
</tr>
<tr>
<td><strong>Total Estimated Costs</strong></td>
<td></td>
<td><strong>$4,016,081.25</strong></td>
<td><strong>$6,693,468.75</strong></td>
<td><strong>$5,354,775.00</strong></td>
</tr>
</tbody>
</table>

**Project Implementation**

**Lead agency**

The lead agency for each of the two wetland projects would:

- Fund or arrange for funding of the wetland construction: both through grants and securing, coordinating, and documenting matching funds or in-kind services
- Undertake design and construction of the wetland or let and manage contracts
- Own the site and the wetland
- Be responsible for operation and maintenance

The lead agency for the first stage wetland would be the City of Oregon.
The lead agency for the second stage wetland would be Ohio DNR Division of Parks

**Supporting agencies and roles**

In addition to the lead agency, other agencies would serve as partners and play supporting roles through the Wolf Creek Committee:

- University of Toledo: Environmental design assistance and monitoring
- Consulting Firm: Wetland and stream channel engineering and environmental design; permitting, contract management.
- City of Oregon (for the second stage wetland) Engineering assistance; hydrology and topographic data
- Lucas County Engineer: Hydrology and watershed mapping assistance
- TMACOG: Public involvement and interagency coordination

**Permits required**

Several permits would be required for both projects. These include:

- US Army Corps of Engineers, Buffalo District: Clean Water Act Section 404 Nationwide Permit 27 (Aquatic Habitat Restoration, Establishment, and Enhancement Activities)
• Ohio EPA: a Clean Water Act Section 401 Water Quality Certification may be required.

• Ohio EPA: an NPDES General Permit for Construction Site Stormwater will be required; a permit and its associated Stormwater Pollution Prevention Plan must be completed 21 days prior to construction.

• Archaeological Study: An S106 Phase I Survey will be required to identify and describe archaeological sites within the project area, and if they are present, to determine the significance or potential significance of the site that could be impacted by the proposed project. This involves making recommendations regarding eligibility or potential eligibility for listing in the National Register of Historic Places. A transect of the agricultural area will be plowed and left bare through a few rain events. The surveyor will then walk the transect and look for any artifacts. In MBSP test holes will be dug at regular intervals to look for artifacts. The results of the Phase I survey will be incorporated into a report for the Ohio Historic Preservation Office (OHPO). The report serves as the basis for comment by the OHPO on the adequacy of the Phase I survey and the need for additional work. If no archaeological resources are discovered and the report reflects an adequate consideration of the potential for archaeological resources, the OHPO will recommend that no further investigations are needed. If resources are discovered, the final project area could be shifted. A previous S106 study was conducted when Maumee Bay State Park was established in 1974.

Timeline
Several steps are necessary for the construction of both wetland stages.

• Funding — securing the finances to proceed with the project is likely to be the most time-consuming and unpredictable step. And yet, none of the subsequent steps can proceed until the money is available. There are several potential grants and other funding sources that can be used to restore wetlands. They are listed as a table in the next section, discussing the potential funds available, restrictions on use of those funds, matching fund requirements, and grant cycles and other timing issues.

• Final design — detailed design will be needed before construction. Design must address engineering and hydraulic issues: flow rates, drainage, and grade to avoid dependence on pumping. Wetlands and ponds will need to be designed with adequate detention time to allow sediment to settle, and help prevent flooding. In addition, biological design will have to be addressed: layout, size, and flow regime for an effective wetland system, as well as selection of plants to uptake nutrients and facilitate destruction of pathogens. Another issue to address is where to put soil excavated from the wetland sites, and how to reuse it. It is anticipated that excavated soil could be used locally: at Maumee Bay State Park or given to nearby landowners who are willing to accept it. Finally, detail design will include costs and construction methods and schedule.

• Construction — the amount of time needed to secure permits, excavate, dispense with soil removed, regrade, construct flow control structures, and plant wetland vegetation will depend on the project size, and how many phases the Oregon and MBSP projects are divided into. Taking the sedimentation ponds at the Oregon site as an example, planning, permitting, and final design would take two years, and construction a year. With available funding, and no significant project delays, about three years. The terraced wetland at MBSP, being larger and more complex, could take longer. Stream restoration near the mouth of Berger Ditch could take less.

• As the function of the ponds in Oregon will be to protect the downstream wetlands from sediment accumulation, the Oregon ponds should be built at the same time as, or before the terraced wetlands in MBSP. Stream restoration projects in the park near the mouth of Berger Ditch could be constructed at any time.
**Wetland Maintenance and Continuing Research**

Wetlands will require maintenance to sustain their function.

- The proposed designs will not require pumping at either site.
- Some wetland vegetation may need to be replanted periodically when plants do not survive the winter, or are eaten by deer.
- Noxious weeds and invasive species will need to be removed, as these do not provide the required habitat function, and displace the desired species. Invasive species will need to be removed by digging out the roots or spraying.
  - Removing undesirable species will be critical during the first five years of a wetland. By that time, desired wetland species will become established, and less maintenance will be needed. Phragmites, for example, is shade intolerant; established wetland plants will block its spread.
  - Species control for both sites together will require two people, two weeks per year. The work could be done by interns or volunteers, but pesticide training would be required. An herbicide than breaks down quickly, and is certified for use near surface water should be used.
  - Annual maintenance costs for the Oregon and MBSP sites together are estimated at $25,000 for the first five years. Once the wetlands are established, little maintenance will be required.
- Sediment removal will be needed for the ponds along Wolf Creek in Oregon. As their function will be to protect the MBSP wetlands from sediment that would interfere with their biological function, dredging should be considered a normal part of maintenance. Since these ponds will not be wetlands, sediments may be dredged without violating US Army Corps of Engineers 404 regulations. The estimated frequency for dredging would be 20 to 30 years, at a cost of approximately $70,000.
  - Based on the experience of a lake in another park in the region, it is anticipated that these ponds would function as effective stream sediment removal for more than twenty years, after which dredging would be required. Hill Ditch, a tributary of the Ottawa River, flows through the middle of the lake in the other park cited above; that lake silted up after 15 years of flow. In the case of Wolf Creek, the stream will overflow into the sediment pond, rather than flow through it continuously.
- Wetlands will not lead to proliferation of mosquitoes. A wetland is an area that is saturated at least two weeks out of the year, but during much of the year, it may be dry. Wetlands will provide habitat for a variety of animals that prey on mosquitoes. Fish, which eat mosquito eggs and larvae, will live in the sediment ponds. Amphibians, such as frogs and salamanders, will live in and near the ponds and wet areas. Bushes and tree cover will provide habitat for birds and bats, which eat mosquitoes.
- Ongoing monitoring will be needed to determine the effectiveness of the sediment pond and downstream wetlands in trapping pathogens, removing sediment and nutrients from the stream, and pollutant load reductions achieved.
- All phases will present opportunities for research leading to a better understanding of wetland design for pathogen control, design and maintenance of Lake Erie coastal habitat, relationships between nearshore currents and predictive modeling of bacteria levels at the Lake Erie beaches. Future studies will be broadly transferable to Lake Erie’s many coastal streams, especially along the western basin.
Ongoing maintenance requirements are outlined below.

<table>
<thead>
<tr>
<th>Maintenance Function</th>
<th>Oregon Sedimentation Ponds</th>
<th>Maumee Bay State Park Terraced Wetlands</th>
<th>Maumee Bay State Park Berger Ditch Restoration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetation replanting</td>
<td></td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Invasive species control</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Sediment dredging</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

**Potential Funding Sources**

Many potential sources of funding may be available for constructing these projects. They are listed in the following table. Grant sources have many intricacies that restrict how funds may be used, by whom or where they may be used, and when the funds are available. Another important grant criterion is the requirement of matching funds. Grants usually require the applicant to pay for part — sometimes a large part — of a project with non-grant funds. When a grant comes from a federal source, matching funds usually have to be state or local. In most cases, matching funds can be in the form of in-kind services rather than cash. Finally, nearly all grants are competitive, so applicants must demonstrate that their proposed project will be effective in carrying out the funding agency’s goals. Finally, and not least — does a funding source offer enough money to construct one or more of the project phases?

These details are important in lining up a grant funding source with a project. Currently available funding sources have been color-coded in the table that follows. Green indicates a funding source that may be a good match for the Wolf Creek / Berger Ditch projects; yellow indicates a possible match but with questions or complications; red indicates a grant program that will probably not be able to assist.
## Table 8: Potential Funding Sources for Implementation

<table>
<thead>
<tr>
<th>Funding Source</th>
<th>Amount of Fund</th>
<th>Match</th>
<th>Description</th>
<th>Due Date</th>
<th>Contact</th>
<th>Applicability to this project</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sustain Our Great Lakes Program - Stewardship Grants</strong></td>
<td>Grant awards will range from $150,001 to $1,500,000.</td>
<td>Minimum of $150,001 in matching contributions.</td>
<td>Restore, enhance and protect habitats, wetlands, riparian corridors.</td>
<td>10/1/2009</td>
<td>[<a href="http://www.fws.gov/birdhabitat/awards/">http://www.fws.gov/birdhabitat/awards/</a></td>
<td>Good; high match</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ratio of matching funds offered is one criterion; projects that meet or exceed a 1:1 match ratio will be more competitive.</td>
<td>Restore the threat from terrestrial and aquatic invasive species in the Great Lakes basin.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Sustain Our Great Lakes - Community Grants</strong></td>
<td>Grants range between $25,000 and $150,000. Total $1.6 million anticipated.</td>
<td>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.</td>
<td>Protect and improve watersheds in the Great Lakes. Habitat restoration, water quality improvement, watershed planning, and applied research. Projects that include education, training or community outreach are encouraged.</td>
<td>15-Oct-09</td>
<td>[<a href="http://www.nsfef.org/AIM/Template.cfm?Section=Charter_Programs_List&amp;Template=/TaggedPageDisplay.cfm&amp;TPLID=60">http://www.nsfef.org/AIM/Template.cfm?Section=Charter_Programs_List&amp;Template=/TaggedPageDisplay.cfm&amp;TPLID=60</a> &amp;ContentID=13631</td>
<td>Good; high match</td>
</tr>
<tr>
<td><strong>Water Resources Restoration Sponsor Program</strong></td>
<td>12 million was proposed for financing WRRSP from 2009 funds. Past projects have ranged from $300,000 - $6 million.</td>
<td>Need to partner with a WPCLF applicant.</td>
<td>WRRSP provides funds through the Water Pollution Control Loan Fund (WPCLF) loans to finance projects that protect or restore water resources. The following are examples of types of projects that may be funded:</td>
<td>Post deadlines were October</td>
<td>[<a href="http://www.epa.ohio.gov/dsw/OHWEB/ohio/epa/ohio/DEFA/">http://www.epa.ohio.gov/dsw/OHWEB/ohio/epa/ohio/DEFA/</a></td>
<td>Good; requires sponsoring WPCLF applicant</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>• riparian buffer acquisition, enhancement, expansion or restoration</td>
<td>for submission of a nomination form. To be considered for funding, WRRSP projects need to be sponsored by direct loan projects identified as ready to proceed to construction during the Program Year. These direct loan projects must already be on the WPCLF Project Priority List or must submit a nomination form by the deadline as well (past deadlines were October).</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>North American Wetlands Conservation Act Grants Programs</strong></td>
<td>STANDARD GRANT: up to $1,000,000; barring “extraordinary circumstances” (Total FY 2009 is $48.8 million; typical avg has been $480,000). SMALL GRANT FY2009 amount for small grant may not exceed $50,000.</td>
<td>1:1 match (can count eligible expenses up to 2 years prior to grant submittal)</td>
<td>must involve long-term protection, restoration, and/or enhancement of wetlands and associated uplands habitats. In Mexico, projects may also include technical training, environmental education and outreach, organizational infrastructure development, and sustainable-use studies.</td>
<td>Standard Grants Deadline: March 5, and July 30, 2010. Small Grants: This is an annually funded program.</td>
<td>[<a href="http://www.fws.gov/birdhabitat/grants/NAWCA/index.shtml">http://www.fws.gov/birdhabitat/grants/NAWCA/index.shtml</a></td>
<td>Good for “Standard Grant”; high match. Could fund entire wetland system if recognized as an “extraordinary circumstance”</td>
</tr>
<tr>
<td><strong>Ohio EPA 319 Grants</strong></td>
<td>(Based on FY 2011 program, up to $3,000,000 for restoration projects. Maximum project size: $500,000. In past years, max was smaller.</td>
<td>40% match required in past years; in FY’11 it was 20%.</td>
<td>projects that are identified within completed TMDL reports, state endorsed watershed plans and/or AMDAT plans that eliminate impairments receive first consideration.</td>
<td>anticipated May annually (based on previous program deadlines)</td>
<td>[<a href="http://www.epa.ohio.gov/dsw/nps/index.aspx">http://www.epa.ohio.gov/dsw/nps/index.aspx</a></td>
<td>Good, if match stays at 20% and project size stays at $500,000 or greater</td>
</tr>
<tr>
<td><strong>NRCS Wetland Reserve Program - Special Projects</strong></td>
<td>$25 million total</td>
<td>5% match</td>
<td>enhance conservation outcomes on wetlands and adjacent lands. WREP targets and leverages resources to carry out high priority wetland protection, restoration, and enhancement activities and improve wildlife habitat through agreements with States (including a political subdivision or agency of a State), nongovernmental organizations, and Indian tribes.</td>
<td>May 24, 2010.</td>
<td>[<a href="http://www.nrcs.usda.gov/programs/wrp/">http://www.nrcs.usda.gov/programs/wrp/</a></td>
<td>Good? May be restricted to property in private ownership</td>
</tr>
<tr>
<td><strong>Coastal and Estuarine Land Conservation Program</strong></td>
<td>$25 million total for FY 11; has varied from $8M to $50M. Each project may include up to $3M in federal funds.</td>
<td>50% match</td>
<td>Protection and preservation of significant natural coastal resources as described in the State of Ohio’s Coastal and Estuarine Land Conservation Program Plan</td>
<td>April 9, 2010</td>
<td>[<a href="http://coastalmanagement.noaa.gov/land/welcome.html">http://coastalmanagement.noaa.gov/land/welcome.html</a></td>
<td>Good; high match</td>
</tr>
<tr>
<td><strong>Supplemental Environmental (mitigation) project through OEP</strong></td>
<td>In some circumstances, an entity facing an environmental fine from OEP or US EPA may be offered the opportunity to fund an SEP instead. Selection of an SEP project is by the entity facing the fine, subject to approval by OEP or US EPA</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
<td>Good, should the opportunity arise</td>
</tr>
</tbody>
</table>

Wolf Creek – Berger Ditch Corridor Restoration Plan
City of Oregon – Jerusalem Township, Ohio
<table>
<thead>
<tr>
<th>Funding Source</th>
<th>Amount of Fund</th>
<th>Match</th>
<th>Description</th>
<th>Due Date</th>
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<th>Applicability to this project</th>
</tr>
</thead>
<tbody>
<tr>
<td>State of Ohio Biennial Capital Improvement Budget</td>
<td>Determined by the Ohio General Assembly by June 30 of even-numbered years</td>
<td>No matching funds required in 2010</td>
<td>Address the most significant Great Lakes ecosystem problems and efforts in five major focus areas: • Toxic Substances and Areas of Concern • Invasive Species • Nearshore Health and Nonpoint Source Pollution • Habitat and Wildlife Protection and Restoration, including bringing wetlands and other habitat back to life. • Accountability, Education, Monitoring, Evaluation, Communication and Partnerships Competitive projects must demonstrate water quality improvement.</td>
<td>Annually: first deadline was January 2010</td>
<td><a href="http://www.epa.gov/glnpo/glri/index.html">http://www.epa.gov/glnpo/glri/index.html</a></td>
<td>Good, subject to budget funds being appropriated by the Ohio General Assembly.</td>
</tr>
<tr>
<td>GLRI Nearshore Health</td>
<td>$475M for all of the GLRI program in 2010; same amount requested in 2011, but a decreased appropriation is anticipated</td>
<td></td>
<td>GLRI may provide appropriate funding through any of several new or existing federal grant programs. Through US EPA, GLNPO for nearshore health and bacteria projects, or through NOAA or FWI for wetlands/habitat restoration.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CICEET (The Cooperative Institute for Coastal and Estuarine Environmental Technology) Mitigating Shoreline and Estuarine Environmental Technology</td>
<td>CICEET estimates that up to $2 million will be available to fund Phase 1 of two to four proposals, approximately $2 million will be available to fund Phase 2 of meritorious projects. CICEET anticipates that approximately $2 million will be available to fund Phase 3 of meritorious projects.</td>
<td>VES seeks to provide a better understanding of how to use different erosion prevention measures to protect sheltered coastlines from the impacts of rising sea levels and waves generated extreme weather, as well as to protect, preserve, and restore ecosystem function.</td>
<td></td>
<td>September 25th, 2007 by 1:00pm</td>
<td>Kalle Matso Program Manager (603) 862-3508</td>
<td>Good if program still exists.</td>
</tr>
<tr>
<td>CICEET (The Cooperative Institute for Coastal and Estuarine Environmental Technology) Environmental Technology Development and Demonstration Funding Opportunity</td>
<td>Up to $2 million available shared between 5-10 projects. Annual budget averages between $15,000 and $220,000.</td>
<td></td>
<td>The goals of this opportunity are two-fold. First, to develop and/or demonstrate technology to detect and quantify the impacts of human activity on coastal water quality, species, and habitats. Secondly, to develop and/or demonstrate technology to protect coastal water quality and/or restore costal habitats.</td>
<td>September 18th, 2007 by 1:00pm</td>
<td>Kalle Matso Program Manager (603) 862-3508</td>
<td>Good if program still exists.</td>
</tr>
<tr>
<td>FishAmerica Foundation and NOAA Restoration Center Community-based Habitat Restoration Projects</td>
<td>Between $10,000 and $75,000 per project.</td>
<td></td>
<td>All applicants should seek to provide at least a 50% match of non-federal contributions. However, the most competitive projects will include matching contributions at 100% (or greater) of the approved award amount. Match may consist of cash, in-kind services, and/or volunteer time.</td>
<td>6/10/2010</td>
<td>FishAmerica Foundation at 703-516-4651 ext 247 or <a href="mailto:egeorge@fishamericafoundation.org">egeorge@fishamericafoundation.org</a></td>
<td>Project funding too small.</td>
</tr>
<tr>
<td>Lake Erie Protection Fund Small Grants</td>
<td>Maximum: $15,000 (total budget for distribution in 2007: $200,000) at least a 25% match required</td>
<td></td>
<td>Funding priorities are to assist in implementing at least one of the 84 priorities addressed in the Lake Erie Protection and Restoration Plan: water quality, pollutant sources, habitat, coastal recreation, boating, fishing, beaches, tourism and shipping.</td>
<td>Quarterly, at Ohio Lake Erie Commission meetings</td>
<td>Ed Hammel, Ohio Lake Erie Commission, One Maritime Plaza, 4th Floor Toledo, OH 43604 419-245-2514</td>
<td>Project funding too small.</td>
</tr>
<tr>
<td>U.S. Fish and Wildlife Service: National Coastal Wetlands Conservation Grant Program</td>
<td>Typically distribute $18M - $21M annually nationwide. Max Award Per Project: $1,000,000 50% match required by state. If state has a dedicated funding source for wetland acquisition, etc., federal share could be 75%</td>
<td></td>
<td>Long term conservation of coastal wetland ecosystems; acquire, restore, and enhance wetlands in Coastal States (Great Lakes states are eligible). States apply for these funds.</td>
<td>Annual program, awards announced in December; Deadline: June 7</td>
<td><a href="http://lakeerie.ohio.gov/LakeErieProtectionFund.aspx">http://lakeerie.ohio.gov/LakeErieProtectionFund.aspx</a></td>
<td>Project funding is borderline; high match.</td>
</tr>
<tr>
<td>US EPA Wetland Program Development Grants</td>
<td>Approximately $1,900,000 available in 2010 ~4-10 grants. Typical awards likely: $50,000 to $500,000. 25% of total project cost. Match must come from non-federal sources</td>
<td></td>
<td>Projects that promote the coordination and acceleration of research, investigations, experiments, training, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, reduction, and elimination of water pollution.</td>
<td>28-May-10</td>
<td><a href="http://www.epa.gov/wetlands/grantguidelines">http://www.epa.gov/wetlands/grantguidelines</a></td>
<td>Program development not applicable.</td>
</tr>
<tr>
<td>Funding Source</td>
<td>Amount of Fund</td>
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<td>Contact</td>
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<tr>
<td>U.S. Fish and Wildlife Service: Great Lakes Fish and Wildlife Restoration Act Grant</td>
<td>Recent successful proposals ranged from $12,000 to $223,000, with the average proposal at $72,000.</td>
<td>25% non-federal match</td>
<td>Competitive grants to states, tribes and other interested entities to encourage cooperative conservation, restoration and management of fish and wildlife resources and their habitat in the Great Lakes basin. Non-governmental organizations and conservation organizations may receive funding if sponsored. Pre-proposals were due on Friday, January 22, 2010.</td>
<td><a href="http://www.fws.gov/midwest/fisheries/glfwra-grants.html">http://www.fws.gov/midwest/fisheries/glfwra-grants.html</a></td>
<td>Project funding too small</td>
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<td>US EPA Five Star Restoration Program</td>
<td>Grant awards are between $10,000 and $40,000. The average grant is about $20,000. Large and small grant categories.</td>
<td>25% match</td>
<td>Funding, land, technical assistance, workforce support, and/or other in-kind services required for strong on-the-ground wetland, riparian, or coastal habitat restoration component; include training, education, outreach, monitoring, and community stewardship components. Must include at least five types of project partners.</td>
<td>Annual Program - last deadline: February 11, 2010.</td>
<td><a href="http://www.epa.gov/Wetlands/restore/starr/">http://www.epa.gov/Wetlands/restore/starr/</a> and <a href="http://www.rff.org/AM/Template.cfm?Section=CharterPrograms_List&amp;Template=TaggedPage&amp;TaggedPageDisplay.cfm&amp;TPLID=60&amp;ContentID=14767">http://www.rff.org/AM/Template.cfm?Section=CharterPrograms_List&amp;Template=TaggedPage&amp;TaggedPageDisplay.cfm&amp;TPLID=60&amp;ContentID=14767</a></td>
<td>Project funding too small</td>
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<td>Clean Ohio Conservation Fund</td>
<td>Round 7 Program may be available 2011; funding awarded by Ohio General Assembly. In previous rounds, District 12 was allocated $1,266,080.</td>
<td>25% match</td>
<td>District 12 priorities are for land preservation/acquisition; restoration of land being acquired would qualify. 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.</td>
<td>Deadline set by Ohio Public Works Commission</td>
<td>District 12 NRAC Liaison: Kurt Erichsen, TMACOG, 419-241-9155</td>
<td>Requires acquisition of property as part of the project</td>
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<tr>
<td>ODNR NatureWorks Parks Grant</td>
<td>$57,967 available in 2010 for all Lucas County projects (could be one or multiple projects).</td>
<td>25% match</td>
<td>Development of recreational trails and support facilities directly connected to project. Political subdivisions of the state are eligible to apply. Up to 75% reimbursement grants.</td>
<td>February 1, 2010</td>
<td><a href="http://dnr.state.oh.us/tabiid/10762/Default.aspx">http://dnr.state.oh.us/tabiid/10762/Default.aspx</a></td>
<td>Project funding too small</td>
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<td>Land &amp; Water Conservation Fund</td>
<td>Maximum amount: $70,000. Funding levels vary each year.</td>
<td>50% match, in-kind considered if land donation or new construction materials provided.</td>
<td>Acquisition, rehabilitation or development of public park. Political subdivisions of the state are eligible to apply. All projects must be completed within approximately 3 years. Same application as NatureWorks.</td>
<td>February 1, 2010</td>
<td><a href="http://dnr.state.oh.us/tabiid/10762/Default.aspx">http://dnr.state.oh.us/tabiid/10762/Default.aspx</a></td>
<td>Project funding too small</td>
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<tr>
<td>NOAA Great Lakes Habitat Restoration Program Partnership Grant</td>
<td>Funding up to $1 million may be available, anticipate funding up to 4 projects</td>
<td>25% match</td>
<td>Establish habitat restoration partnerships for 1 to 3 years focused on an AOC. 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.</td>
<td>7/2/2007 last date on web page, 5/2010</td>
<td><a href="http://www.nmfs.noaa.gov/habitat/restoration/programs/crp/partners_funding/crplpartnersprojects5.html">http://www.nmfs.noaa.gov/habitat/restoration/programs/crp/partners_funding/crplpartnersprojects5.html</a></td>
<td>Project funding is borderline</td>
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<td>NRCS Wildlife Habitat Incentives Program (WHIP)</td>
<td>Cost-sharing will reimburse up to 75 percent of costs. Generally the total cost share cannot exceed $15,000 per contract. The cost-share agreement normally lasts from 5 - 10 years.</td>
<td>25% match</td>
<td>Provides technical assistance and cost-sharing to restore wildlife habitat. In Ohio, over 20 different conservation practices are available, ranging from creating a fish passage, to establishing a riparian buffer. Special priority is given to habitat that benefits species of national or State significance, including declining and endangered species. Eligible practices: <a href="http://www.oh.nrcs.usda.gov/programs/whip/whip_practices.html">http://www.oh.nrcs.usda.gov/programs/whip/whip_practices.html</a></td>
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<td><a href="http://www.oh.nrcs.usda.gov/program/whip/whip_2010.html">http://www.oh.nrcs.usda.gov/program/whip/whip_2010.html</a></td>
<td>Project funding too small</td>
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<tr>
<td>Funding Source</td>
<td>Amount of Fund</td>
<td>Match</td>
<td>Description</td>
<td>Due Date</td>
<td>Contact</td>
<td>Applicability to this project</td>
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<td>NRCS Wetlands Reserve Program (WRP)</td>
<td>NRCS pays acquisition costs, and implements wetland restoration plans. WRP contracts last as long as landowner wishes.</td>
<td>Permanent Easement is a conservation easement in perpetuity. USDA pays 100 percent of the easement value and up to 100 percent of the restoration costs. For shorter contracts, NRCS pays lower percentages.</td>
<td><a href="http://www.oh.nrcs.usda.gov/programs/wrp/wetlands_reserve_program.html">http://www.oh.nrcs.usda.gov/programs/wrp/wetlands_reserve_program.html</a></td>
<td>Available only on privately owned land.</td>
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<td>NRCS Environmental Quality Incentives Program (EQIP)</td>
<td>Supports production agriculture and environmental-quality as compatible goals. Agricultural producers may receive financial and technical help with structural and management conservation practices on agricultural land. EQIP offers contracts with a minimum term that ends one year after the implementation of the last scheduled practice and a maximum term of ten years.</td>
<td>There are two aspects to eligibility for WRP, one is landowner eligibility and the other is land eligibility. Landowner eligibility: 1. Own the property for at least 7 years (there are some limited exceptions granted), and 2. Adjusted Gross Income less than 1 million dollars, and 3. No wetland violations or Highly Erodible Land violations.</td>
<td>February 16, 2010</td>
<td><a href="http://www.oh.nrcs.usda.gov/programs/equip/equip2010.html">http://www.oh.nrcs.usda.gov/programs/equip/equip2010.html</a></td>
<td>EQIP projects could support bacteria control projects, but would not fund wetland restoration on non-agricultural public lands.</td>
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<td>OWDA R&amp;D grants</td>
<td>Research and development related to water resources. Must use innovative practices / technologies. Applications benefit from a state agency’s sponsorship.</td>
<td>Normally not to exceed $200k</td>
<td>None required in 2010, the program's first year</td>
<td>June 1, 2010</td>
<td><a href="http://owda.org/owda0001.asp?PgID=pi-randdgrants">http://owda.org/owda0001.asp?PgID=pi-randdgrants</a></td>
<td>Project funding too small</td>
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<td>ODNR coastal Management</td>
<td>Up to about $50k</td>
<td>Water resource studies or projects affecting Ohio’s Coastal Management Zone</td>
<td>None required in 2010, the program's first year</td>
<td>Annually, in November</td>
<td><a href="http://www.ohiodnr.com/LakeErie/Grants_CMAQ/tabid/9337/Default.aspx">http://www.ohiodnr.com/LakeErie/Grants_CMAQ/tabid/9337/Default.aspx</a></td>
<td>Project funding too small</td>
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<td>Surface Water Improvement Fund (SWIF), Ohio EPA</td>
<td>Implementation funding for water quality improvement projects including</td>
<td>Total funding $1.25M up to $150k</td>
<td>None required in 2010, the program's first year</td>
<td>February 15, 2010</td>
<td><a href="http://epa.ohio.gov/dsw/nps/swif.aspx">http://epa.ohio.gov/dsw/nps/swif.aspx</a></td>
<td>Project funding too small</td>
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<td>Ohio Public Works Commission</td>
<td>Ohio Public Works Commission was created to assist in financing local public infrastructure improvements under the State Capital Improvement Program (ICIP) and the Local Transportation Improvements Program (LTIP). These programs provide financial assistance to local communities for the improvement of their basic infrastructure systems. Through the two programs, the Commission provides grants, loans, and financing for local debt support and credit enhancement. Eligible projects include improvements to roads, bridges, culverts, water supply systems, wastewater systems, storm water collection systems, and solid waste disposal facilities.</td>
<td>The State may issue up to $120 million through Program Year 25 and then $150 million in Program Years 26 through 30</td>
<td>District 12 methodology: <a href="http://www.gwc.state.oh.us/Meth/Dist12.5ICIP.LTIP.pdf">http://www.gwc.state.oh.us/Meth/Dist12.5ICIP.LTIP.pdf</a></td>
<td>Liaison: Mark E. Drennen <a href="mailto:mdrennen@co.lucas.oh.us">mdrennen@co.lucas.oh.us</a></td>
<td>The program is primarily geared toward infrastructure. Habitat restoration would probably not be competitive; follow the District 12 methodology carefully.</td>
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