Lake Erie Shore Erosion Management Plan

Western Basin: Reach WB 08

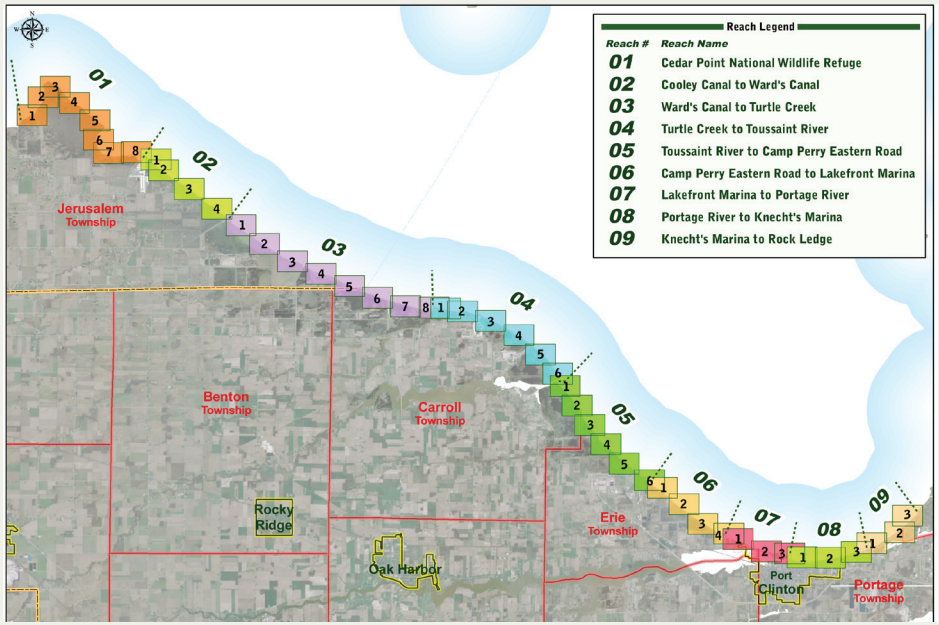
LESEMP

About the Program

In an on-going effort to assist property owners along Ohio's Lake Erie coast by providing free technical assistance, the *Lake Erie Shore Erosion Management Plan* (*LESEMP*) is being developed by the Ohio Department of Natural Resources through a partnership between the Office of Coastal Management, Division of Wildlife and Division of Geological Survey.

The *LESEMP* identifies the causes of erosion in specific areas called reaches which are stretches of shore with similar site conditions. The *LESEMP* then outlines the most likely means of successful erosion control based on reach-specific erosion issues, geology and habitat. The objective of the reach-based approach to erosion control is to simplify the decision process while enhancing the effectiveness of solutions to erosion related issues.

The *LESEMP* does not contain any regulatory oversight provisions.



The LESEMP is being developed by the project partners, Ohio Department of Natural Resources Office of Coastal Management, Division of Geological Survey and Division of Wildlife. Federal grant funding for this project is provided by the National Oceanic and Atmospheric Administration.

Description

Reach 8 of the Western Basin Region extends from the Portage River to east of Knecht's Marina. This reach contains approximately 12,000 feet of coast and includes residentially and commercially developed shore as well as Waterworks Park, Port Clinton Lakefront Preserve and the Port Clinton City Beach.

The shore in this reach is primarily oriented from west to east but begins to bend to the northeast at the east end of the reach. The shore is concave lakeward and has several irregularities, mostly attributed to man made structures. This reach is extensively developed.

At the west end of the reach is the east jetty at the mouth of the Portage River. Immediately east of the jetty, about 100 feet of shore is protected with armor stone and concrete blocks before giving way to approximately 4,500 feet of unarmored coast. This area includes the low embankment at the shore of Waterworks Park, Port Clinton Lakefront Preserve and the City Beach.

East of the City Beach, the next 700 feet of shore is comprised of commercial and residential development and is almost completely armored with shore structures. The stretch includes the Water's Edge Condominiums which are protected by an armor stone revetment fronted by a narrow beach. The 500 feet of commercial property to the east is protected by a concrete seawall. These revetment and seawall structures are set back from the shoreline, providing protection from flooding and severe storms with minimal interference to natural littoral processes.

To the east, a rip-rap revetment steps 250 feet lakeward and protects about 300 feet of commercial property. A surface water drainage ditch enters the lake just west of the nearly 500-foot armor stone revetment at the Shores Condominiums. The revetment at the Shores Condominiums is segmented by two 60-foot long pocket beaches created by sand trapped in 40-foot recesses.

The next 300 feet of shore is commercial property protected with a cast concrete seawall. Immediately east of the seawall begins an armor stone revetment set back approximately 60 feet landward. The revetment extends about 800 feet and protects Grande Lake Villa Condominiums. The

revetment is fronted by an approximately 60-foot wide beach supported with three armor stone groins.

East of the Grand Lake Villas, the shore is protected by a cast concrete seawall and armor stone revetment as it curves about 300 feet lakeward. An approximately 180-foot long beach is trapped between an armor stone groin and the breakwaters at the Docks at Captains Cove Marina. The Captains Cove Condominiums are landward of the trapped beach and a cast concrete seawall. The Docks at Captains Cove Marina is protected by two armor stone breakwaters extending about 600 feet into the lake with the west breakwater bending to the northeast to protect the marina entrance. East of Captains Cove is approximately 400 feet of beach held in place by the marina breakwaters.

To the east, a 100-foot long pocket beach is trapped lakeward of a cast concrete seawall. The next 200 feet of shore is protected by the 200-foot long cast concrete seawall and about 200 feet of armor stone revetment. East of the armor stone breakwaters protecting the entrance to the Vista Villa Marina, the shore consists of about 1,700 feet of beach. The beach is segmented by about 100 feet of armor stone revetment and a pair of breakwaters protecting a short channel cut from the lake inland about 500 feet. The east end of the reach includes the rip-rap breakwater protecting Knectht's Marina.

Nearshore slopes in this reach range from about 1 degree for the first 100 feet to about 0.3 degrees farther offshore. The net direction of littoral currents from the Sand Beach area to Port Clinton are from west to east while littoral currents from Port Clinton to Catawba Island are predominantly from east to west. This causes littoral currents to converge in the embayment at Port Clinton resulting in a gradual accumulation of littoral material and significant sand deposits in the nearshore zone. The nearshore zone includes four to six sand bars extending nearly the entire reach. While the sand bars are more defined near the eastern end of the reach, they are generally only broken by long, shore-perpendicular structures such as the breakwaters at Captains Cove. Nearshore sand deposits generally increase from east to west in this area due to the long-term trapping of sediment by the Portage River jetties. Lakeward of the sand deposits, glacial till and till lag deposits of muddy sand and gravel are exposed, although sand is present in much of the Port Clinton embayment.

Recession/Erosion

The ODNR Division of Geological Survey has evaluated the recession of Ohio's Lake Erie shore over three time periods: 1877 to 1973, 1973 to 1990 and 1990 to 2004. Changes in the rates measured during each of the time periods are generally attributed to development along the coast and natural factors such as lake level changes.

From 1877 to 1973 the coast in this reach experienced gradual accretion. Converging littoral currents have resulted in a steady accumulation of material in Port Clinton embayment. The Portage River jetties have further trapped material in this reach. The original jetties at the Portage River were constructed prior to 1877 and have gradually trapped sand resulting in

Looking west at the Port Clinton City Beach toward the city's Water Works Park on June 27, 2008. The northern reaches of the jetties along the Portage River are visible on the right side of the photo.

several hundred feet of accretion in the area of Waterworks Park.

From 1973 to 1990 average recession rates ranged from 0 feet per year to 10.1 feet per year. Recession was generally limited to unprotected beach areas and was greatest between Waterworks Park and the City Beach. The highly developed east end of the reach experienced low recession rates. Erosion was generally limited to areas where shore protection was set back from the lake or downdrift of large shore-perpendicular structures

From 1990 to 2004 average recession rates ranged from 0 to 0.4 feet per year. Recession was minimal over the entire reach. Many of the beach areas with recession from 1973 to 1990 experienced accretion from 1990 to 2004, particularly in the area immediately east of the Portage River jetties.

Flooding

The low-lying banks of this and the surrounding reaches are susceptible to flooding as well as erosion. Floods have usually been associated with gales from the northeast, such as may occur when tropical storms or the remnants of hurricanes migrate to the northeastern United States and southeastern Canada. The resulting winds, rotating counterclockwise around the storm center, may blow over many miles of open lake, piling water in the Western Basin and leading to overtopping or breaching of shore structures, flooding the upland behind them. If the storm coincides with a period of high water, the effect is intensified. One such storm in November 1973 caused $3 million of damage in Port Clinton. The ODNR Division of Geological Survey documented that during a storm on April 9-10, 1998 (with 40 to 50 knot winds for more than 16 hours), Perry Street and Lakeshore Drive in Port Clinton were impassible, blocked by more than 1-foot of water and debris washed inland by waves which included large stone blocks, gravel and sand. Although the area is extensively armored with protective structures, the residential and commercial development at the east end of the reach is often placed close to the shore, making the area especially vulnerable to flooding.

Beaches/Sand Supply

The long term accretion along the coast due to converging littoral currents and the Portage River jetties demonstrates the availability of sand in the littoral system. The presence of offshore sand bars is a result of considerable sand deposits in the nearshore. The accumulation of beach material up-drift of shore-perpendicular structures and in small embayments in structures also shows the availability of sand.

Use of Shore Structures

The eastern 7,500 feet of the reach from the Water's Edge Condominiums to Knecht's Marina is nearly completely armored with a variety of protective structures. Most properties are protected with seawalls or revetments. Several of the structures have been constructed on the upland to provide protection from severe storms or flooding while allowing a beach to form lakeward. A few structures, such as the revetment at Shores Condominiums, were constructed with recesses intended for beach creation. The east end of the reach has several breakwaters constructed to protect marinas and the mouths of small lake access channels.

A view of the City Beach from the water is shown in the right photo. East of the City Beach, the next 700 feet of shore is comprised of commercial and residential development and is almost completely armored with shore structures. Condos locally referred to as "the bird houses" are shown in the right photo.

GIS Data Sources:
Aerial Photography - OSIP, State of Ohio, 2006
Political Boundaries and Transportation - ODOT, 2007
Public Access - ODNR OCM, 2009-10

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Created By:
Ohio Department of Natural Resources
Office of Coastal Management
105 West Shoreline Dr, Sandusky, OH 44870

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Summary

The reach from the Portage River to Knecht's Marina is an area of converging littoral currents resulting in an overall accumulation of material and accretion along the shore. The accretion has been aided by the Portage River jetties trapping material in the Port Clinton embayment. The jetties have supported the unarmored beach area from Waterworks Park to the City Beach. The east end of the reach is highly developed and extensively armored with a variety of shore structures. Several properties have taken advantage of the availability of littoral material by constructing protective structures on the upland allowing beaches to form. As a result of the extensive structural protection and availability of sand in the littoral zone, future erosion will likely be limited to times of high water or frequent severe storms. With limited coastal erosion anticipated the greatest short-term threat is flooding.

Recommendations

The recommendations included below are options that may be applicable within this reach and should only be used for planning purposes. Based on the above physical characteristics, the following recommendations are suggested for the Portage River to Knecht's Marina reach. Each recommendation includes a brief overview of the solution prior to addressing areas within the reach where the recommendation is best suited. For more information on any of the items listed below, please refer to the LESEMP Glossary and Appendix: Erosion Control Solutions.

A view from City Beach looking east at small stand of trees in January.

In addition to the recommendations listed below a "do nothing" alternative should also be considered. This may be a viable, and even favorable, alternative for much of Ohio's Lake Erie shore. The Portage River to Knecht's Marina reach generally has a stable shore and has experienced steady, gradual accession. In areas where the shore is protected with effective structures additional protection might not be necessary. In the areas with effective structures, attention should be focused on monitoring and maintaining the structures. In other areas, particularly those with a natural shore and low erosion rates, the best option may be to hold development back from the shore and allow natural erosion/accretion processes to occur. This option should be considered in the unarmored beach area from Waterworks Park to the City Beach.

Sand Management:

*1. **Conserve Sand Resources**: Conserve sand resources within the shore and nearshore areas. Sand is a limited resource in constant fluctuation. Avoid removing sand from the system; sand moved or excavated during construction along the shore should be placed in the nearshore, not on the upland and should not be incorporated into the construction project.*

While there is sand available in the littoral system, this recommendation should be considered throughout this reach. Overall this reach has experienced steady sand accretion due to converging littoral currents and the Portage River jetties. Still, sand is a limited resource and must be conserved and managed sensibly.

*2. **Beach Nourishment**: Supplement the current sand supply with beach nourishment, also known as beach fill or pre-fill. Beaches protected by groins and detached breakwaters will benefit from initial nourishment (pre-fill during or directly after construction) and periodic renourishment. The sand used in these projects should be acquired from an upland source.*

This recommendation is applicable for new construction projects intended to impede littoral currents and trap sand.

*3. **Sand Bypassing**: Move sand from areas of excess accretion, usually up-drift of a shore perpendicular structure, to areas downdrift. By redistributing sand within the nearshore system, the littoral drift in the area will be more evenly dispersed.*

Sand bypassing would be most beneficial updrit of marina and access channel breakwaters at the east end of the reach. For example, a considerable amount of sand has accumulated updrift of the breakwaters at the Vista

Villa Marina and the lake access channel about 1,000 feet east. The shore downdrift of these structures is more than 100 feet landward of the updrift shore. Sand bypassing would reduce the risk of erosion at these downdrift properties.

4. Dredging: Dredge marinas and harbors on as frequent a basis as possible to add sand into the littoral system. Dredging of navigation channels at harbors and marinas enhances navigation for boaters and provides sand for downdrift areas when placed along the shore. When dredged material is disposed of on the upland or in offshore areas, the material is no longer a benefit to the littoral system. In-lake placement is preferred as long as the sand meets the grain size and total organic carbon criteria. Uncontaminated dredge material that is composed of sand and gravel should be placed in the nearshore through sidecasting or placing downdrift. Placing sand in shallow water keeps the sand in the nearshore environment and the littoral system. Sand placed into deeper waters will likely be lost to the system and will not nourish downdrift beaches.

The availability of sand in the nearshore zone necessitates frequent dredging at the Portage River and several of the marina entrances in this reach. Should the dredged materials be suitable for the nearshore environment, nearshore placement would be beneficial to nourish the area downdrift of the marina jetties. Another beneficial use would be placement of suitable dredge material on the Port Clinton City Beach.

5. Vegetation: Encourage growth of native vegetation on the back beach. Beach vegetation encourages the formation of a dune system by holding sand in place and providing protection from wind. It is also possible to simply allow the natural succession of native plant species to grow along the beach.

Native vegetation in the unarmored beach area from Waterworks Park to the City Beach would be beneficial to help encourage dune formation and stabilize the shore. This recommendation also applies to the beaches between the Docks at Captain's Cove and the Knecht's Marina.

Toe Protection:

6. Detached Breakwaters: Detached breakwaters may be useful in areas where beaches are present or likely to form. As opposed to groins which trap sand moving along the shore, properly designed and constructed detached breakwaters will aid in retaining a beach by limiting the movement of sand offshore (perpendicular to shore) while still allowing for the alongshore movement of sand. An initial beach nourishment (pre-fill) and periodic renourishment will often be advantageous to creating and retaining the beach behind the breakwater while limiting impacts to neighboring shorelines. Some regulatory agencies may require pre-fill and periodic nourishment as one of the design components for a project that includes detached breakwaters.

Detached breakwaters would function well in the shallow water throughout the reach and would be beneficial for most of the reach. Many properties in this reach have revetments and seawalls placed landward of beaches to protect upland structures while preserving existing beaches. Detached

From atop a public transportation ferry heading north out of the Portage River channel, the shore is shown looking east along the shore of Water Works Park (left photo) and looking south at the east jetty and shore (right photo).

breakwaters are another alternative that provide erosion protection while preserving existing beach areas. Beach nourishment or sand pre-fill should be included in the design of a detached breakwater to prevent the structure from trapping littoral material and increasing the risk of erosion on adjacent properties.

*7. **Revetments**: Revetments along the toe of a bank will aid in protecting against wave-based erosion. In areas without beaches, a structural measure may be necessary to protect the toe of the bank. The low-relief banks within this reach have relatively gradual slopes, which are ideal for revetment development. In essence the revetments form a stable bank slope, providing protection to the soil underneath while breaking up wave attacks. Since material eroded off the bank is one source of beach-building sand, some regulatory agencies may require that one of the design components for a revetment be the inclusion of sand pre-filling in the amount equal to that which would have been added to the system over the life of the structure.*

Revetments are used extensively in this reach. A few revetments in the Shores Condominiums area and just west of the Vista Villa Marina were constructed along the shore. While these revetments have been effective at stabilizing the coast and protecting upland structures, most revetments in this reach are set back from the lake allowing beaches to exist lakeward. The availability of sand in the area helps increase the effectiveness of these revetments as waves will break on the beach in most conditions.

Bank Modifications:

*8. **Surface Water Management and Flood Protection**: Low lying areas should be protected from excess surface water and flooding from the lake and from upland runoff. In areas prone to flooding erosion protection should include surface water management design elements such as collection areas, retaining structures, and drainage ditches or culverts. Surface water should be routed away from the face of the bank. In areas where gullies or rills are forming, surface water is slowly eroding the face of the bank. Where possible, re-route water away from the bank toward a planned collection area and drainage system.*

This reach is comprised of highly developed, low lying lake plains. Much of this reach has been stabilized with seawalls and revetments to protect upland development very close to the shore. Surface water flows, including storm water outflows, can cause extreme localized erosion. Surface water collecting on roadways or parking lots near the shore should be routed away from the bank or beach whenever possible.

Looking east at the shore of the Port Clinton Lakefront Preserve during summer (bottom) and winter (middle) and look south from the water (top).

9. Vegetation: Encourage growth of vegetation along the bank slope. Where possible plant vegetation, preferably native species, along the bank to remove excess ground water while retaining soil strength. It is also possible to simply allow the natural succession of native plant species to grow along the bank.

Planting native vegetation on the upland above the revetments and seawalls in this reach would reduce excess surface water and help stabilize the low banks. Vegetation should be closely monitored on the actual structures. For example, vegetation growing on a rip-rap or armor stone revetment can damage the structure by causing stones to be broken or displaced.

Management and Monitoring:

10. Bank-Top Management: Keep heavy materials, equipment or structures well back from the edge of the bank-top. Any structure (concrete decks, stone walls) or heavy object (vehicles or construction equipment) placed near the bank edge will increase the stress within the soil and can lead to slope failure.

This recommendation applies to the low banks and structure crests throughout this reach. Several commercial and residential structures have been placed immediately landward of the seawalls and revetments in this reach. Further development near the crest of the structures could cause damage. Care should also be taken when maintaining shore structures or accessing the area with vehicles or other equipment to prevent damage.

11. Coordination of Projects: Continuation of similar erosion control measures along a stretch of shore will often yield more effective protection than the installation of multiple types of structures adjacent to one another. Most erosion control measures function better when utilized over large areas of the shore.

This recommendation is applicable throughout this reach but is particularly appropriate in the highly developed commercial and residential areas at the east end of the reach. This area could benefit from greater continuity along the shore. Development in this area has led to a highly variable shoreline with structures of varying designs, construction quality and condition. The interaction between these structures often limits their effectiveness and at times can increase erosion at the site or on adjacent properties. This is best avoided by coordinating projects over a length of shore.

When structures can not be continued across multiple properties, conditions at the ends of the structure should be carefully considered in the design. The structures should be designed to prevent intersections causing increased wave energy or gaps between structures where erosion is likely.

12. Shore Structure Management/Monitoring: Monitor and maintain shore structures. Routine monitoring of shore structures will allow for early detection of any potential failures. Smaller repairs performed more frequently will be less costly and can often increase how long the structure will be effective at controlling erosion. Should removal of an aged or deteriorating structure be necessary, consider the above recommended items as potential future solutions.

Many of the structures in this reach were constructed more than 30 years ago. The condition of the structures should be closely monitored and repairs should be made when necessary. If new erosion control measures are installed, the recommendations listed above should be considered. A combination of recommendations may be the most effective solution. For example, to further protect upland structures fronted by an existing beach a revetment landward of the beach or detached breakwaters with sand pre-fill may be considered.

References:

- Benson, D. Joe. Draft Open File Report 96-xxx (final publication number not assigned), Lake Erie Shore Erosion and Flooding, Ottawa County, Ohio. State of Ohio, Department of Natural Resources, Division of Geological Survey, Columbus, 1978.
- Ohio Department of Natural Resources, 1998 Final Coastal Erosion Area (CEA) Mapping.
- Ohio Department of Natural Resources, 2010 Final Coastal Erosion Area (CEA) Mapping.

Learn More:

LESEMP Webpages: ***ohiodnr.com/tabid/20501.default.aspx***

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