Lake Erie Shore Erosion Management Plan

Bratenahl to Grand River Region Introduction

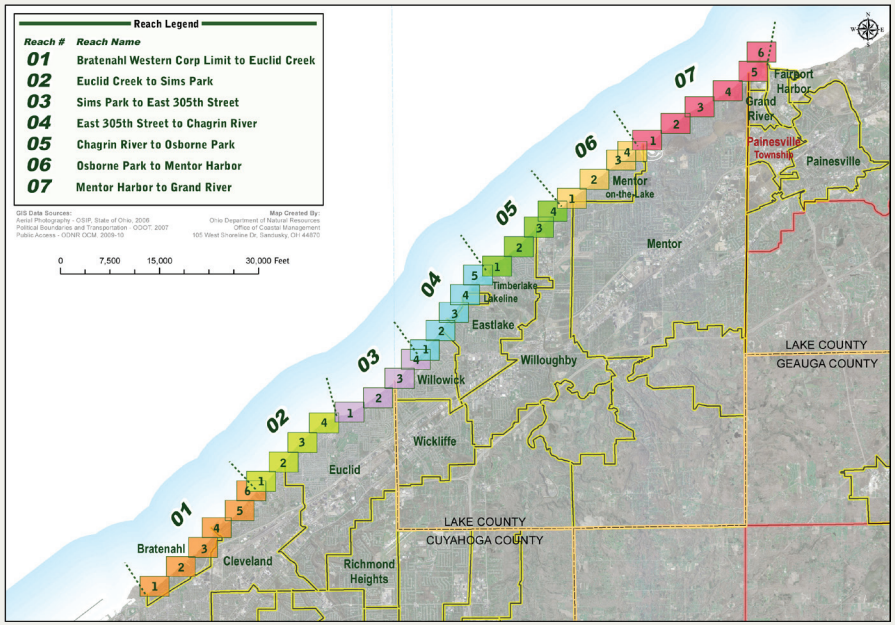
LESEMP

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.

Introduction

The Lake Erie Shore Erosion Management Plan (LESEMP) Bratenahl to Grand River Region includes the Lake Erie shoreline from immediately east of the Cleveland Lakefront Nature Preserve (formerly Dike 14) in Cleveland to the mouth of the Grand River. The river is the boundary between Painesville Township to the west and the city of Fairport Harbor to the east. The region spans the shore at the east end of Cuyahoga County and the western portion of Lake County.

The Bratenahl to Grand River Region includes approximately 25.2 miles of Lake Erie shore which totals about 8 percent of Ohio's 312-mile coast. This region includes (from west to east) the lakefront communities of the village of Bratenahl, the cities of Cleveland, Willowick and Eastlake, the villages of Lakeline and Timberlake, the cities of Willoughby, Mentor-on-the-Lake and Mentor and the west end of Painesville Township.

The shore from Bratenahl to the mouth of the Grand River is oriented from southwest to northeast along Lake Erie's Central Basin. On a large scale, the shore includes several natural and artificial headlands separated by broad embayments. The most notable headlands are the result of man-made structures such as the Easterly Wastewater Treatment Plant located on the northeast side of Cleveland, the Eastlake Power Plant, and the Fairport Harbor breakwaters at the east end of the reach. The largest natural headland is Moss Point near Sims Park in Euclid.

The shore is generally characterized by 20 to 50-foot high bluffs, primarily composed of till, clay and sand. Shale is also exposed at the toe of the bluff in the area of Moss Point which spans from Euclid Park to Sims Park in the city of Euclid. Bluff heights are fairly consistent throughout the reach with the exception of the floodplains for the Chagrin River, Marsh Creek (Mentor Harbor) and Grand River. The shore of this reach is also intersected by several small creeks (Green Creek, Dugway Brook, Ninemile Creek, Euclid Creek, and Two Town Ditch at the east end of Eastlake).

The nearshore in this region is generally till, although shale is exposed in some areas near the center of the reach. Nearshore slopes are generally greatest within the first 100 feet from shore and gradually flatten farther

Beach widths are greatest updrift of the large shore perpendicular structures in this reach such as the wide beach that has accumulated updrift of the west breakwater at Fairport Harbor (top). Concrete rubble and fractured concrete are too light to withstand wave forces along the shore, are easily transported by littoral currents, provide little protection and can be a significant hazards (middle and bottom).

offshore. The net direction of littoral currents between Bratenahl and the Grand River is from west to east. Sand deposits are variable but generally increase from west to east. Beach widths are greatest up-drift (west) of the large shore-perpendicular structures at the Eastlake Power Plant and Fairport Harbor but narrow or transient beaches are common throughout the reach. The east end of the reach is fronted by several well-defined sand bars due to the large amount of sand updrift of the breakwaters at Fairport Harbor.

The region from Bratenahl to the Grand River includes some of the most altered shore along Lake Erie and is heavily armored with protective structures. In many lakefront communities the shore is divided into parcels as small as 50-feet wide. In most cases each property owner is responsible for his or her own shore protection. This has led to the construction of a mix of shore structures of varying designs. Revetments and seawalls are the most common shore structures in this region. Groins are also common, particularly in the eastern portions of the region as sand resources increase.

In many areas of this region concrete rubble has been dumped along the shore for the purpose of shore protection. Although easy to obtain, concrete rubble does not provide adequate protection from wave action. Concrete rubble is too light to withstand the wave forces along the shore and is easily displaced and transported by littoral currents. Individual pieces of broken concrete typically weigh less than a few hundred pounds as compared to the several ton armor stone used to construct a revetment. Concrete rubble also fractures more easily than solid stone armor units. Much of the concrete placed along the shore is in the form of slabs and broken pavement. These materials were intended to be evenly supported but randomly placed concrete rubble often has large voids. This causes the concrete to be unevenly supported and easily fractured. Concrete rubble dumped from the top of the bluff also increases erosion at the top of the bluff by adding weight to the bluff face and damaging beneficial vegetation along the bluff. Effective shore protection along Lake Erie is typically constructed with large limestone or sandstone armor units or engineered concrete forms.

Description

The Bratenahl to Grand River Region begins immediately east of the Cleveland Lakefront Nature Preserve which occupies the former Dike 14 confined disposal facility. The shore between the Cleveland Lakefront Nature Preserve and Euclid Creek generally consists of 30 to 40-foot high bluffs with residential development atop the bluff. The most prominent

feature in this area is the breakwater surrounding the Easterly Wastewater Treatment Plant. The breakwaters were originally constructed in 1915 and have accreted a wide beach along the updrift shore. The shore from Cleveland Lakefront Nature Preserve to Euclid Creek is heavily armored with protective structures. The only stretch of shore without structural protection is the wide beach updrift of the breakwaters at the wastewater treatment plant. Revetments are the most effective shore structure in this area. Continuous revetments effectively protect long stretches of shore, particularly in the area just east of the Cleveland Lakefront Nature Preserve.

Adjacent to the east of Euclid Creek breakwaters have been constructed to protect the marina and boat launch facilities at Wildwood Park. The structures were originally constructed in the late 1940s and have contributed to sand accumulation in the Euclid Beach and Villa Angela areas. The structures have also limited the amount of sand available to the area immediately east of Wildwood Park.

Much of the shore between Euclid Creek and the Chagrin River is protected by some form of shore structure. This area includes the east end of the cities of Cleveland, Euclid, Willowick and the west end of the City of Eastlake and the villages of Lakeline and Timberlake. The shore in this area is highly developed and is primarily residential. In most cases individual property owners constructed shore protection as area beaches eroded. This has led to a wide variety of shore structures ranging from well constructed seawalls and revetments to less effective measures such as concrete rubble dumped along the shore. Revetments are the most common and most effective shore protection structures in this area followed by concrete block seawalls.

Just west of the Chagrin River, the water intake structures for the Eastlake Power Plant extend approximately 1,000 feet into the lake. The breakwaters at the power plant were originally constructed in the early 1950s and have gradually accreted a beach extending about 3,500 feet along the shore to the southwest. Due to the breakwaters at the Eastlake Power Plant, sand resources in the area just east of the Chagrin River are limited. The relief of the upland also decreases in the Chagrin River floodplain leaving this area susceptible to both flooding and erosion.

The shore between the Chagrin River and Mentor Harbor is highly armored with protective structures. Although ineffective, concrete rubble is commonly dumped along the shore in this area. In many cases the concrete rubble has been displaced by wave action and is dispersed throughout the nearshore. The placement of pre-cast concrete modules, particularly Great Lakes Erosion Control (GLEC) modules and Campbell modules, at the toe of the bluff or in the nearshore is also common. Revetments and seawalls have also been constructed along the toe of the bluff in many areas of this reach. As sand resources gradually increase near the east end of the Bratenahl to the Grand River Region, small shore-perpendicular structures such as groins become more effective at supporting beaches along the shore. Groins have

Large shore-perpendicular structures often disrupt the littoral transport of sand causing accumulation on updrift beaches such as the beach at the Villa Angela Area of Cleveland Lakefront State Park (CLSP) (left). At the same time, sediment supply to the shore downdrift of CLSP's Wildwood Area is limited (right).

been constructed in many areas along the shores of the cities of Mentor-on-the-Lake and Mentor.

The shore-perpendicular structures near the mouth of the Grand River have had a significant impact on the Lake Erie shore both to the east and west. The jetties at the mouth of the Grand River were originally constructed in 1827 and immediately began trapping sand updrift. The Fairport Harbor West Breakwater was constructed in 1908, increasing the impact to nearby beaches. The structures support a wide sand beach extending approximately 10,000 feet to the west. The structures have also prevented littoral transport of sand to the shore east of the Grand River, resulting in increased erosion to the east.

Surficial Geology

The shore from Bratenahl to the Grand River is generally fronted by 20 to 50-foot high bluffs. The bluffs throughout the region are primarily composed of till, however layers of laminated clay, sand and shale are also present. The nearshore is typically composed of either till or shale covered by a layer of sand. Sand resources are variable throughout the region due primarily to the presence of man-made structures along the shore.

The west end of the reach is fronted by 30 to 40-foot high bluffs comprised of glacial till covered with a layer of glaciolacustrine sand near the top of the bluff. The nearshore in this area is primarily till and till lag. Sand resources in the area are minimal due to the structures at and near Cleveland Harbor and the practice of dredging Cuyahoga River sediments and placing them in confined disposal facilities which are commonly called CDFs. Sand beaches are generally limited to areas where sand accumulation is supported by shore structures such as the Easterly Wastewater Treatment Plant and the detached breakwaters just west of Euclid Creek.

East of Euclid Creek the relief of the upland gradually decreases to 25 to 35 feet. The bluffs are primarily composed of till but shale is exposed at the toe of the bluff in the Moss Point area. The shale along the toe of the bluff extends from just east of Euclid Creek to just west of the Cuyahoga/Lake county line. The nearshore zone also transitions from till to shale in the area of Moss Point. Sand deposits in the area are minimal. This is due to both a lack of sand available along the shore to the west (to be transported to this area by littoral currents) and the overall hardening of the shoreline in this area. A wide sand beach is supported by the breakwaters at Sims Park. However, a large portion of the sand was added to the site as beach nourishment during the construction of the breakwaters.

From the Cuyahoga/Lake county line to the Chagrin River floodplain the shore is fronted by 40 to 50-foot high till bluffs. At the west end of Lake County there area several areas with laminated clay smears. A thin layer of laminated clay is also present at the top of the bluff just west of the Chagrin River. The nearshore in this area is composed of shale or till with a thin layer

The placement of pre-cast concrete modules along the shore is common between the Chagrin River and Mentor Harbor. Great Lakes Erosion Control modules at Willoughby's Osborne Park are shown (left). Fairport Harbor's west breakwater has caused a wide sand beach to accumulate along the updrift shore to the west (right).

of sand along the shore. Sand resources gradually increase to the east due to sand accumulation updrift of the Eastlake Power Plant. Sand bars are also common in the nearshore updrift of the power plant.

The Chagrin River floodplain extends east of the Chagrin River until just east of North Parkway Drive in Eastlake. The relief of the upland quickly increases to about 30 feet at North Parkway Drive. Bluff heights between the Chagrin River floodplain and the Marsh Creek floodplain (at Mentor Harbor) vary from 25 to 45 feet and generally decrease to the east. The bluff is composed of glacial till covered with layers of laminated clay and sand. The nearshore in this area transitions from shale to till covered with a thin layer of sand along the shore. Sand deposits in the area are variable but generally increase from west to east. Sand bars also form along the shore of Mentor-on-the-Lake updrift of Mentor Harbor.

East of Mentor Harbor the shore is generally fronted by 30 to 40-foot high bluffs but the relief of the upland declines near the Marsh Creek (Mentor Harbor) and Grand River floodplains. The bluffs are composed of glacial till covered with a layer of laminated clay. The layer of laminated clay is covered with a layer of sand just east of Mentor Harbor which transitions to till near the east end of the Mentor Lagoons Nature Preserve. The nearshore in this area is composed of till covered with a 3 to 10-foot thick layer of sand along the shore. Sand deposits in the area generally increase from west to east due to sand accumulation updrift of Fairport Harbor. Sand bars are present along the entire nearshore from Mentor Harbor to the Grand River but become more defined near the breakwaters at Fairport Harbor.

Habitat

Conservation of fish and wildlife habitat, particularly along the nearshore, is a critical component of the LESEMP. The Bratenahl to Grand River Region contains a variety of habitats such as nearshore, beaches, bluffs and coastal wetlands.

Prior to development, the shore of the Bratenahl to Grand River Region contained a variety of complex habitats. The region was fronted by a nearly continuous sand beach which provided habitat and feeding grounds for a variety of shore birds. Upland habitats gradually transitioned from mixed temperate forests to elm-ash swamp forests near Moss Point. Near the Cuyahoga/Lake county line the forests transitioned to beech forests which extended along the shore from the City of Willowick to the City of Mentor-on-the-Lake. The Marsh Creek area supported freshwater marshes and fens. The shore from Mentor Harbor to Fairport Harbor also included mixed oak

Layers of glacial till, laminated clay and sand are visible in the eroded bluff face at the Mentor Lagoons Nature Preserve (top). Sand beaches in the western portion of the region are generally limited to areas where sand accumulation is supported by shore structures like the detached breakwaters at Euclid Beach in Cleveland (bottom).

forests. As the area was developed the forests were cleared for agriculture and the shore eventually transitioned to residential development.

Today, habitats along the shore of the Bratenahl to Grand River Region can be characterized as nearshore, beaches, bluffs and coastal wetlands.

Nearshore

The nearshore habitat of the Bratenahl to Grand River Region is fairly consistent. The lake bottom typically consists of glacial till and shale bedrock, covered by variable sand deposits. These substrates provide important habitat for adult walleye, perch and smallmouth bass. The Grand River at the east end of the region also provides some of the best spawning habitat for walleye along Lake Erie's Central Basin.

Beaches

Beaches along the Bratenahl to Grand River Region provide important yet fragile habitat supporting both flora and fauna. Beaches wide enough to support vegetation are generally limited to areas where they are supported by shore structures. The Headlands Dunes State Nature Preserve updrift of the breakwaters at Fairport Harbor provides the most developed beach habitat along Ohio's 312-mile Lake Erie shore. The Headlands Dunes area provides a variety of habitats including sand beach, beach grass and vegetated dune. A variety of plants grow in the sand accumulated updrift of Fairport Harbor including beach grass, red osier, Canada wild-rye, cottonwood, sandbar willow and black oak.

Supplementing existing beach flora with additional native vegetation is recommended throughout this region both to improve habitat and for erosion management to help stabilize the beach.

Bluffs

Bluffs are present along most of the shore of the Bratenahl to Grand River Region. The bluffs support a variety of vegetation ranging from grasses and sedges to herbaceous shrubs and trees. The vegetation along the bluff face provides important habitat for both resident and migratory bird populations. Vegetation along the bluff face also provides several benefits for bluff stabilization and is recommended throughout the region.

Coastal Wetlands

The Bratenahl to Grand River Region contains coastal wetlands near the mouth of the Chagrin River and at Marsh Creek near Mentor Harbor. These areas provide a variety of habitats for both aquatic and terrestrial species including shallow waters, wooded wetlands, mixed oak swamp forest and beech-sugar maple forest. Coastal wetlands in this region provide habitat for hundreds of bird species. The Mentor Marsh State Nature Preserve near Marsh Creek has been identified as an Audubon Important Bird Area.

The nearshore, such as the area near the mouth of the Chagrin River (left photo), provides important habitat for adult walleye, perch and smallmouth bass. The Headlands Dunes State Nature Preserve (right photo) provides a variety of habitats including beach grass and vegetated dunes.

Coastal Erosion

The sand beaches and till bluffs in the Bratenahl to Grand River Region are susceptible to erosion due to a variety of factors. Wave action causes significant erosion along the shore of this region. On sandy shores waves cause both alongshore and cross-shore littoral currents responsible for the erosion and accretion of beach sand and fine materials. Waves reaching the glacial till bluffs have a scouring effect on the shore and can cause material to be washed into the lake. Sand and gravel suspended in waves can also abrade the till and clay at the toe of the bluff. The waves breaking on the shore release energy that dislodges material from the shore and forces water into existing voids, widening the voids and forcing materials apart. Surface water runoff and weathering, including wind and freeze-thaw processes, are important factors contributing to erosion of the bluffs in this region. Erosion at the toe of the bluff or between layers within the bluff can also result in mass wasting (slumping and collapsing). This is a major contributor to erosion on steep till bluffs in eastern Cuyahoga and western Lake counties.

Erosion and accretion along the shore of the Bratenahl to Grand River Region has been considerably impacted by the development of the region. The construction of large shore-perpendicular structures at and near Cleveland Harbor, the Easterly Wastewater Treatment Plant, Eastlake Power Plant, Mentor Harbor and Fairport Harbor has significantly impacted the area.

The original jetties at the mouth of the Grand River were the first large structures to be constructed in the Bratenahl to Grand River Region in 1827. The structures immediately began trapping sand on updrift beaches to the southwest. As the development of Fairport Harbor and sand accumulation on updrift beaches continued even longer structures were required. In 1908 the Fairport Harbor West Breakwater was constructed. The impounding of sand updrift of the structures has resulted in a wide beach extending approximately 10,000 feet to the southwest and a deficiency of sand resulting in increased erosion to the northeast.

Similar processes have occurred resulting in accretion of a wide beach updrift of the Eastlake Power Plant. The water intake breakwaters at the power plant were constructed in the early 1950s resulting in sand accumulation along the shore of the village of Timberlake and increased erosion near the mouth of the Chagrin River.

Erosion has also increased due to an overall reduction in material available to sustain beaches. Steady development along Lake Erie's shore has led

Allowing native vegetation to grow on the natural bluff face and on re-graded slopes above seawalls, revetments and other shore structures provides native shore habitat for resident and migratory birds and helps stabilize the bluff (top).

The shore-perpendicular structures at Fairport Harbor have caused a wide beach to accumulate along approximately 10,000 feet of shore to the southwest but have resulted in increased erosion to the northeast (bottom).

Cleveland Lakefront Nature Preserve, formerly known as Dike 14, is a confined disposal facility in Cleveland that marks the western extent of the Bratenahl to Grand River Region (top and middle). The bottom photo shows erosion along the unarmored beach at the west end of the Mentor Lagoons Nature Preserve.

to considerable shoreline armoring for structural protection and erosion prevention. The widespread prevention of erosion, however, reduces the amount of sand that enters the littoral system through mass wasting. Transport of eroded soils into the lake from upland by rivers and streams is a second significant source of sand. This source, however, has been reduced due to dredging for the maintenance of navigation. For this reason, sandy dredge material should be placed in the littoral system when possible. Unfortunately, contamination from industrial and agricultural sources often requires dredge material to be placed offshore or in confined disposal facilities, permanently removing it from the littoral system.

The interaction of natural lake processes and gradual development of the shore has resulted in areas of consistent erosion and accretion throughout the Bratenahl to Grand River Region. These processes are most visible in the vicinity of the large shore-perpendicular structures (such as the Easterly Wastewater Treatment Plant, Eastlake Power Plant and Fairport Harbor) but can be seen on a more local scale adjacent to smaller structures and headlands throughout the region.

From 1876 to 1973 average recession rates in this region typically ranged from 0 to 3 feet per year in the western portions of the region (from Bratenahl to the Chagrin River) to 3 to 5 feet per year east of the Chagrin River. The area immediately downdrift of Mentor Harbor experienced the greatest recession during this time period with average recession rates reaching 7 to 9 feet per year. Overall, average recession rates decreased during this time period as the shore was progressively developed and protected with shore structures.

From 1973 to 1990 average recession rates ranged from 0 to 9.6 feet per year, although average recession rates were typically less than 3 feet per year throughout the region. Recession was greatest along the shore of Osborne Park (prior to the installation of shore protection at the park). Average recession rates also reached 8.9 feet per year near the west end of the barrier beach fronting Marsh Creek and 7.2 feet per year near the west end of the beach updrift of Fairport Harbor, near the terminus of Willowbrook Drive in Mentor.

As the shore continued to be armored, average recession rates gradually decreased from 1990 to 2004. Average recession rates during this time period ranged from 0 to 5.2 feet per year throughout the region. Recession was greatest along the barrier beach fronting Marsh Creek. Average recession rates also reached 4 feet per year along the shore of Overlook Beach Park in the Mentor-on-the-Lake. Overall, recession rates were

typically less than 2 feet per year throughout the region.

While viewing shoreline recession on a large scale, the greatest recession rates in the Bratenahl to Grand River Region generally occurred on unprotected beaches or downdrift of large shore-perpendicular structures. On a more localized scale, reviewing recent recession rates reveals a distinct correlation between areas in this region experiencing higher recession rates and areas relying on concrete rubble for shore protection. For example, from 1990 to 2004 recession in the western portion of the region was greatest along the shore near the east end of Gordon Park and near the end of Canterbury Drive at the east end of Cleveland. These areas both rely on ineffective concrete rubble for shore protection. The shore between East 325th Street and East 330th Street in Willowick is another example. Shoreham Drive previously extended along the shore in this area but was lost as the shore receded. This demonstrates the ineffectiveness of concrete rubble for shore protection.

In addition to the gradual recession due to erosion, the threat of lake-based flooding is a concern along the low-lying areas near the mouths of Euclid Creek, the Chagrin River and Marsh Creek. Development in these areas may also be susceptible to damage due to flooding of the river or creeks. Flooding due to surface water run-off on the bluff face may also be a concern when residential structures are constructed at or near the toe of the bluff. This is a concern along some properties in the Mentor Headlands area.

Future erosion along the Bratenahl to Grand River Region will likely be most severe in small unprotected gaps between structures or in area relying on concrete rubble for shore protection. Much of the shore from Bratenahl to the mouth of the Grand River is protected with effective shore structures. With adequate maintenance of the existing shore structures, future recession rates should be low.

Needs Assessment – Bratenahl to Grand River Region

A needs assessment was performed in 2006 and 2007 to gather information from coastal property owners and local officials about their knowledge and perceptions of Lake Erie coastal erosion. The needs assessment included mail/internet surveys and focus groups.

Written surveys were sent to both public officials and lakefront property owners. Statewide 243 property owners and 140 public officials responded to the survey. Survey respondents were asked to provide their zip code to help identify the erosion characteristics and needs of their community. Twenty one public officials and 35 property owners responded from the zip codes included in the Bratenahl to Grand River Region (44108, 44110, 44119, 44123, 44132, 44095, 44097, 44094 and 44060).

Three focus groups were held in Bay Village, Painesville and Port Clinton. Based on meeting proximity, it is expected that property owners or officials from the Bratenahl to Grand River Region participated in the Painesville meeting. Overall, the meeting participants understood the effects of erosion and were in favor of technical assistance or written best management practices to better inform those affected.

To supplement information gained from the initial LESEMP needs assessment several meetings were held in the Bratenahl to Grand River Region. Public officials from Cuyahoga County, Lake County, the cities of Cleveland, Euclid, Willowick, Eastlake, Willoughby, Mentor-on-the-Lake and Mentor, and the villages of Bratenahl, Lakeline and Timberlake were invited to participate. Meetings were also scheduled for the general public at the Mentor Public Library and Eastlake Public Library. All lakefront property owners within the region's boundaries were invited to attend.

Top Priorities for Shoreline Property Owners

According to property owners in the Bratenahl to Grand River Region, the following are their top priorities with regard to erosion issues and control measures:

1. Providing information on a variety of erosion control methods. Property owners requested that several potential options be provided for erosion management to give shoreline property owners the information necessary to select measures appropriate for their property and budget.
2. Providing more information to assist property owners' efforts to increase vegetation along the bluff. Many property owners were interested to hear the benefits of vegetation in managing shore erosion and requested more detailed information.
3. Providing an explanation of all of the potential causes of erosion in the area. Most property owners were well aware of erosion due to wave action along the shore but many property owners requested additional information about erosion due to surface and ground water. These issues are of particular importance to this area due to the predominantly till and clay bluffs along the shore.

Top Priorities of Local Public Officials

Overall public officials in the Bratenahl to Grand River Region were receptive of the LESEMP and interested in assisting property owners with erosion concerns. The most notable concerns from public officials in the Bratenahl to Grand River Region include:

1. Communicating to the public that the Lake Erie Shore Erosion Management Plan is intended to assist property owners with erosion issues. Concerns were related to the impression that ODNR is a regulatory agency and the ability to represent the LESEMP as technical assistance separate from ODNR regulatory authorities
2. Providing a variety of options for erosion management with alternatives that are practical for most lakefront property owners
3. Involving local officials in the development and review of the LESEMP recommendations. Public officials at the meeting were interested in the LESEMP and encouraged greater coordination with local efforts.

A range of erosion management alternatives are presented for each reach. Recommendations such as planting vegetation are practical for property owners to do themselves. Other recommendations, such as constructing detached breakwaters require the help of design and construction professionals.

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Recommendations

To provide better recommendations for the various coastal conditions within the Bratenahl to Grand River Region, the region has been segmented into seven reaches. Each reach contains introductory material on the coastal setting of the reach, followed by a set of recommendations specific to the reach. For more information on the recommendations, please refer to the Erosion Control Methods Appendix.

The reaches for the Bratenahl to Grand River Region are:

- Reach 01: Bratenahl (east end of Cleveland Lakefront Nature Preserve/Dike 14) to Euclid Creek
- Reach 02: Euclid Creek to Sims Park
- Reach 03: Sims Park to East 305th Street (Willowick Lakefront Park)
- Reach 04: East 305th Street (Willowick Lakefront Park) to Chagrin River
- Reach 05: Chagrin River to Osborne Park
- Reach 06: Osborne Park to Mentor Harbor
- Reach 07: Mentor Harbor to Grand River

The sections for each reach are designed so that they can be read individually or as part of this chapter. Additionally, the reaches do not have to be read in any order as they do not reference information from other reaches.

Learn More:

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

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