

Western Basin: Reach WB 06



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.

Description

Reach 6 of the Western Basin Region extends from Camp Perry Eastern Road to Lakefront Marina just west of Port Clinton. This reach contains approximately 13,000 feet of shore including the Willow Beach residential community and the Darby Division of the Ottawa National Wildlife Refuge.

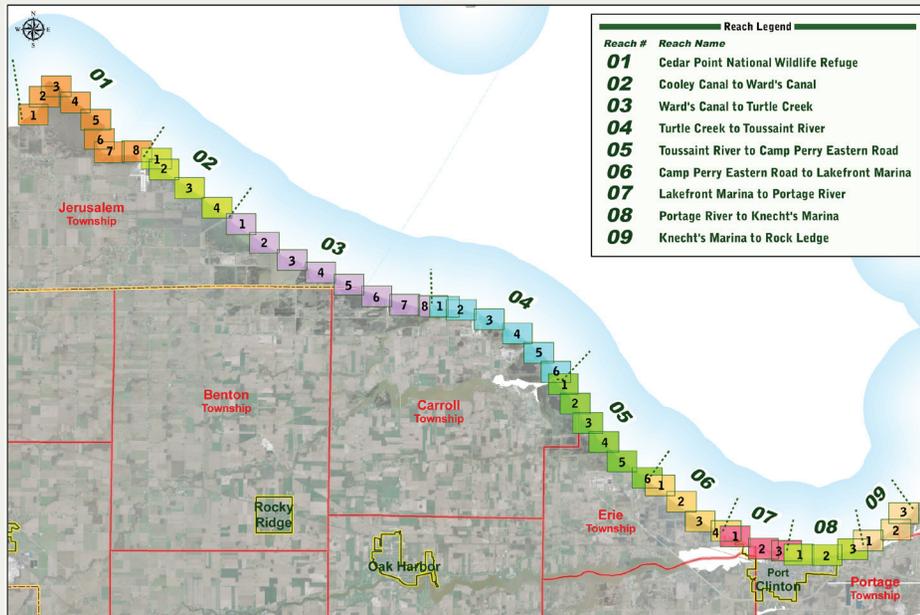
The coast in this reach is oriented in a northwest to southeast direction and is fairly uniform. At the west end of the reach is the Willow Beach residential community, just east of Camp Perry. The shore in this area is nearly completely armored with a variety of structures. Houses and other upland structures are placed very close to the lake and several homes appear to be constructed on land reclaimed from the lake with artificial fill. Most properties are protected with either a seawall or low revetment. Structures in this area are often discontinuous causing increased erosion in gaps between structures. Several properties also have small groins but sand accumulation is minimal.

The LaCarpe Creek enters Lake Erie approximately 4,000 feet east of Camp Perry Eastern Road. The mouth of the creek is stabilized with two rip-rap jetties. The west jetty has trapped a small fillet of sand in front of the Willow Beach mobile home community resulting in erosion at the Darby Division of the Ottawa National Wildlife Refuge east of the creek.

The next 8,200 feet of coast is protected with an earthen dike armored with rip-rap on the lakeward face. This dike protects the marshes at the Darby Division of the Ottawa National Wildlife Refuge. The dike has a maintenance access road at the crest and has several protrusions on the lakeward face for vehicle passing. Beaches lakeward of the dike are minimal until the eastern 2,000 feet where sand begins to accumulate updrift of the jetties at Lakefront Marina.

The eastern 1,000 feet of this reach is residential and includes the cottages on Swamp Road and the condominiums lakeward of West Yacht Port Beach Road. A narrow beach lakeward of a revetment and seawall protect the condominium facilities.

Nearshore slopes range from about 1 degree for the first 100 feet to about 0.4 degrees farther offshore. The net direction of the littoral current in this



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.

reach is from northwest to southeast. Nearshore sand deposits generally decrease from west to east and reduce to just 500 feet in width east of LaCarpe Creek. Lakeward of the sand deposits, glacial till and till lag deposits of muddy sand and gravel are exposed. A significant portion of the sand available in this reach is impounded up-drift of the jetties at LaCarpe Creek and Lakefront Marina. The lack of sand accumulation up-drift of smaller shore-perpendicular structures in the Willow Beach area is due to the limited sediment supply available in this reach.

In the Willow Beach residential area erosion will likely be limited to small unprotected pockets or gaps between structures. East of LaCarpe Creek the shore is well protected by the dikes at the National Wildlife Refuge and expected to be stable. The Swamp Road area is the largest stretch of unarmored shore in this reach. The sand beach in this area is stabilized by the jetties at Lakefront Marina but is still susceptible to erosion, especially during time of high water or severe storms. The eastern portion of this reach consists of residential development and is protected by a seawall and revetment.

Lakebed downcutting and erosion of the nearshore is also likely as nearly the entire reach is hardened with shore parallel structures

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.

During the time period from 1877 to 1973 this reach experienced slow to moderate recession, generally less than 2 to 3 feet per year. The stability of the lake plain area to the northwest of LaCarpe Creek increased

as residential development and construction of protective structures increased. The construction of the west jetty at LaCarpe Creek in 1934 caused significant sand accumulation up-drift of the structure. Construction of the jetty also caused increased erosion of the fragile barrier beach system fronting the Ottawa National Wildlife Refuge. The barrier beaches experienced significant recession and occasional breaches during this time period. The barrier beach system suffered the most considerable damage from 1968 to 1972 due to the high water and severe storm events, leading to the construction of the protective dikes.

From 1973 to 1990 average recession rates ranged from 0 feet per year to 5.6 feet per year. Recession was greatest just east of the end of the protective



From atop the watch tower at Camp Perry looking east, the above photo shows the coast along the residential Willow Beach area of Reach 06 on August 7, 2010. The west jetty at LaCarpe Creek is visible in the background.

dikes at the Ottawa National Wildlife Refuge. The dike fronting the wildlife refuge was effective in stabilizing the shore as the area experienced very little recession during this time period. Average recession rates in the Willow Beach residential area ranged from 0 feet per year to 1.1 feet per year as the shore in this area was already significantly armored.

In the period from 1990 to 2004 recession rates ranged from 0 feet per year to 0.3 feet per year. Recession was minimal over the entire reach due to the extensive armoring of the shore. Erosion in this area is generally limited to small gaps between structures and wear on the dikes at the wildlife refuge.

Flooding

The low-lying banks of this and the surrounding reaches are susceptible to flooding and erosion. Floods have usually been associated with gales from the northeast, such as may occur when tropical storms and the remnants of hurricanes migrate to the northeastern U.S. 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. The Willow Beach area is particularly vulnerable to such flooding as many residential structures are located immediately adjacent to the protective revetments and seawalls.

Due to this area's history as a part of the Great Black Swamp wetland, the widespread lacustrine clay soils are not conducive to drainage. Floodwaters may remain several feet deep for days after a storm.

Another storm-related hazard to homes and structures in this reach is ice.

The low-lying shore presents little barrier to ice rafted on lake waves and piled by northeast winds against the shore. Structures built along the shore are susceptible to damage.

Beaches/Sand Supply

The long term recession and breaching of the barrier beaches at the Darby Division of the Ottawa National Wildlife Refuge demonstrates the overall decrease in sand supply in this area. This is due in part to manmade structures in this reach. The construction of shore-perpendicular structures at LaCarpe Creek and Lakefront Marina impounded sand and removed it from the littoral system. This caused beaches to accumulate in the Willow Beach area and at the east end of the reach but increased erosion of the barrier beaches at the wildlife refuge. As a result, the shore of the wildlife refuge was armored with a rip-rap dike to protect the marshes. Hardening of the shore in this area caused lakebed downcutting and increased erosion of the nearshore, further limiting available sand resources. Similar scouring has occurred at the west end of the Willow Beach area where residential development close to the shoreline necessitated structural protection. This led to downcutting and erosion of sand from the nearshore. Several properties in this area have groin structures but there is minimal sand available for beach formation.

Use of Shore Structures

Nearly the entire reach from Camp Perry Eastern Road to Lakefront Marina in Port Clinton is protected with shore structures. The Willow Beach residential area in the western portion of the reach is protected with



The Willow Beach residential area in the west portion of Reach 06 is adjacent to Camp Perry Military Reservation, which is shown at the right in the above picture.

a variety of seawalls and revetments. Most structures are continuous or directly adjacent to a structure on the neighbor's property. A few properties have unarmored areas or gaps between structures. Several structures also have groins lakeward of the seawalls and revetments but sand accumulation in this area is minimal. Sand has accumulated up-drift of the larger jetty structures at the mouth of LaCarpe Creek and the inlet for Lakefront Marina.

East of LaCarpe Creek, approximately 8,500 feet of shore at the Darby Division of the Ottawa National Wildlife Refuge is protected with an earthen dike armored with rip-rap. The dike is one continuous structure but has several passing areas protruding into the lake for maintenance vehicles. East of the Ottawa National Wildlife Refuge dike is the only span of unarmored shore in this reach. At the east end of the reach a seawall and revetment were constructed to protect the condominium communities at Lakefront Marina.

Summary

The shore from Camp Perry Eastern Road to Lakefront Marina in Port Clinton includes the Willow Beach residential area and the Darby Division of the Ottawa National Wildlife Refuge. The eastern end of the reach also includes a residential area adjacent to the Lakefront Marina developed with cottages and condominiums. Historically this area consisted of low lying lake plain and barrier beaches protecting marshes. The construction of

the west jetty at LaCarpe Creek and residential development in the Willow Beach area increased erosion in the area necessitating the protection of the marshes at the national wildlife refuge with an earth and rip-rap dike. The only portion of this reach not protected with shore structures is a small area between the Ottawa National Wildlife Refuge Dike and the condominiums at Lakefront Marina. Future erosion will likely be limited to this area and small gaps between structures in the Willow Beach area. Due to the extent of armoring in this reach recession rates have slowed considerably. With adequate maintenance of the protective structures this reach is expected to be remain stable.

This area has a history of flooding and is extremely vulnerable to strong northeast storms. The close proximity of residential structures to the lake in the Willow Beach area adds to this risk.

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 Reach CV 06: Camp Perry Eastern Road to Lakefront Marina. 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.



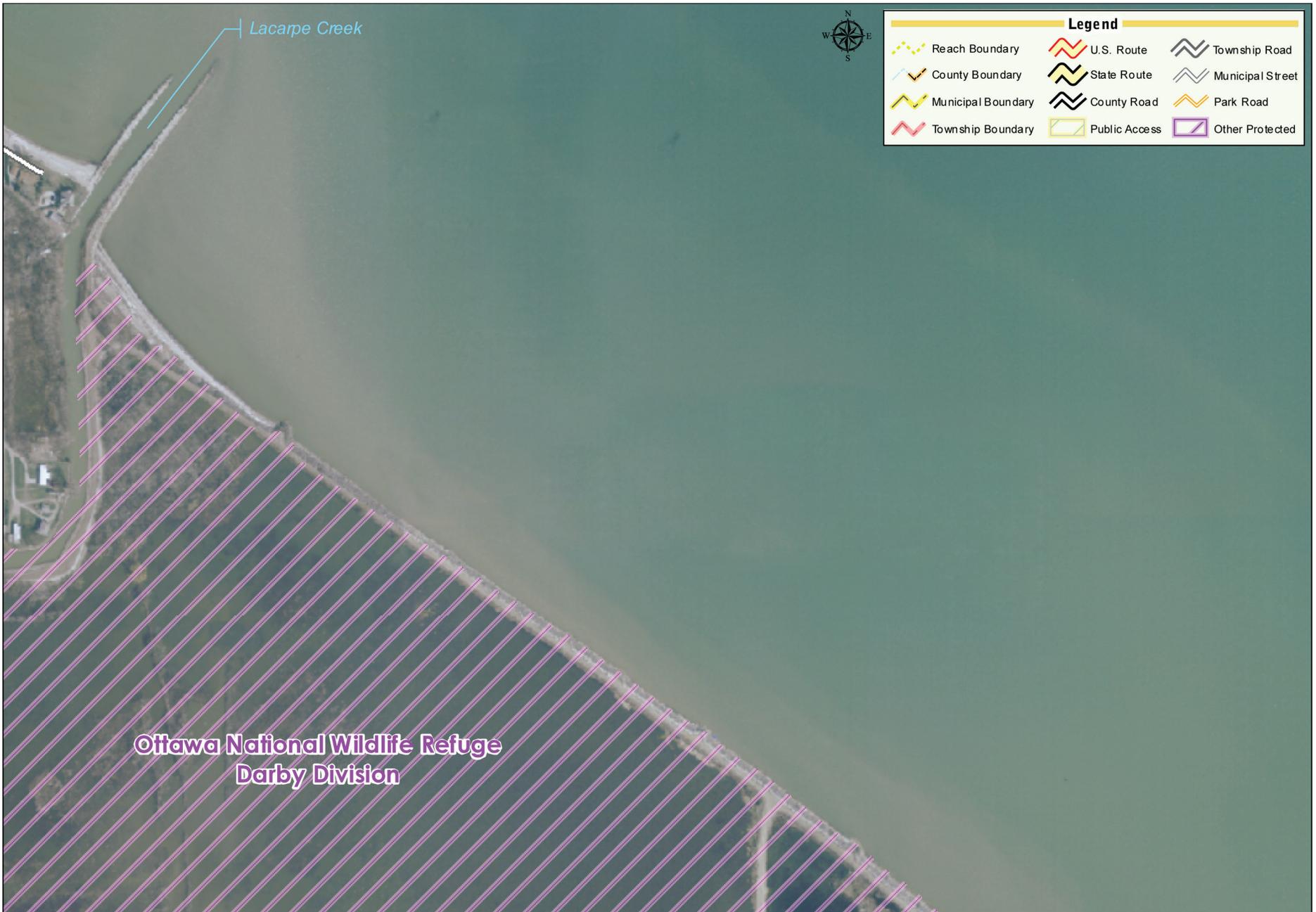
Nearly the entire reach from Camp Perry Eastern Road to Lakefront Marina in Port Clinton is protected with shore structures. The jetties at the mouth of LaCarpe Creek are visible at the left of the above photo.



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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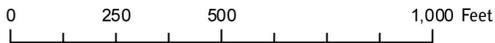
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 Office of Coastal Management
 105 West Shoreline Dr, Sandusky, OH 44870



Legend					
	Reach Boundary		U.S. Route		Township Road
	County Boundary		State Route		Municipal Street
	Municipal Boundary		County Road		Park Road
	Township Boundary		Public Access		Other Protected

Ottawa National Wildlife Refuge
Darby Division

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Aerial Photography - OSIP, State of Ohio, 2006
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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. Much of this reach has low erosion rates. In areas where the shore is already heavily armored additional protection might not be necessary. In these areas 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.

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.*

This recommendation applies to the entire reach. While sand has accumulated up-drift of large shore-perpendicular structures such as the jetties at LaCarpe Creek and Lakefront Marina, the lack of sand accumulation at smaller groin structures in the Willow Beach area demonstrates the overall lack of available sand in this reach. Hardening of the shore has also resulted in an overall decrease in sediment supply.

This recommendation is especially critical in the unarmored area just east of the Ottawa National Wildlife Refuge dike. The shore in this area consists of a narrow sand beach. The beach is held in place by the jetties at Lakefront Marina but a reduction in sand supply could lead to increased erosion in this area.

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 throughout the reach but would be most effective in the Willow Beach area. The addition of beach nourishment would be especially beneficial at sites with existing structures to stabilize it or as part of new construction for detached breakwaters.

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 beneficial at both LaCarpe Creek and Lakefront Marina. It may not be feasible to bypass current accumulation as up-drift areas have been developed but bypassing future accretion would substantially reduce erosion at downdrift properties.



The Willow Beach residential area in the western portion of Reach WB 06, shown above, is protected with a variety of seawalls and revetments. The sheet-pile seawall at the left of the above photo is also shown at the right of the photo on page 8.

4. **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 beach area to the east of the national wildlife refuge dike would be beneficial to help encourage dune formation and stabilize the unarmored shore in this area.

Toe Protection:

5. **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 could be used to restore the barrier beach that once fronted the marshes at the national wildlife refuge. Detached breakwaters would also

function well in the Willow Beach area and should be considered as older shore perpendicular structures are replaced. 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 causing increased erosion on adjacent properties.

6. **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.*

The lakeward face of the dikes fronting the Darby Division of the Ottawa National Wildlife Refuge are armored with rip-rap and form a low revetment along most of this reach. This structure has been effective in limiting coastal recession and protecting the wetlands of the national wildlife refuge.

Revetments have also been effective protection for residential structures in the Willow Beach area during most conditions. Care should be taken when applying this recommendation to ensure the structure crest is adequate



The area east of the Ottawa National Wildlife Refuge dike is the only span of unarmored shore in this reach.

to prevent overtopping and flooding of the residential area during storm conditions.

Bank Modifications:

7. *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.*

As this reach includes both highly developed low lying lake plains and protected wetland habitats this recommendation is of particular importance. Surface water flows, including storm water outflows, can cause extreme localized erosion. Surface water should be routed away from the bank or beach whenever possible.

The rip-rap dikes at the Darby Division of the Ottawa National Wildlife Refuge were installed to manage surface water at the shore. The marshes in the wildlife refuge include additional earthen dikes to control water levels and create suitable wetland habitat. Excess surface water is generally routed to the LaCarpe Creek or the Portage River.

8. *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.*

This reach contains a national wildlife refuge so vegetation is of particular importance. Planting native vegetation on the earthen portion of the dikes would reduce excess surface water and protect the dikes from wind. Native vegetation also provides habitat for shore birds and other wildlife. Vegetation should be closely monitored on the limestone portions to prevent tree roots from structurally undermining the dikes.

Management and Monitoring:

9. *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.*

While there are no high bluffs in this area, this recommendation does apply to the top of the dikes at the national wildlife refuge. It is unlikely that heavy structures or fill would be placed near the shore of the wildlife refuge but the dike does include a maintenance road. Care should be taken when accessing the area with vehicles or other equipment to prevent damage to the dikes.

Several properties in the Willow Beach area include residential structures



East of LaCarpe Creek, approximately 8,500 feet of shore at the Darby Division of the Ottawa National Wildlife Refuge is protected with an earthen dike armored with rip-rap. The dike is one continuous structure but has several passing areas protruding into the lake for maintenance vehicles.

placed on the crest of seawalls and revetments. Some properties appear to have also constructed residential structures on artificial fill. Care should also be taken when placing structures or equipment on the crests of shore protection to prevent structural failures.

10. *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 reach is nearly completely armored with a variety of shore protection. A large portion of the reach is protected with a single continuous dike at the national wildlife refuge. This structure has effectively prevented erosion and helped control water levels in the marshes at the wildlife refuge.

The Willow Beach area could benefit from greater continuity between structures. In many cases, structures were constructed directly adjacent to neighboring structures leading to the nearly continuously armored shore and resulting in the low recession rates in recent studies. Still, the areas experiencing the most erosion are small gaps between structures or discontinuities in the structure placement. As structures age and require maintenance or replacement, greater continuity of structures should be considered.

11. *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*



At the east end of Reach WB 06, a seawall and revetment were constructed to protect the condominium communities at Lakefront Marina, as shown above.

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.

The dikes at the national wildlife refuge are constructed with earth fill and armored with rip-rap on the lake facing side. These structures are particularly vulnerable to excessive water levels within the ponds at the refuge. Scouring from behind could undermine the levees. Routine monitoring of the dikes should include inspecting for surface water flows, displaced or fractured armor stones, or signs of water seepage through the dike.

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, in the Willow Beach area several neighbors with seawalls in need of maintenance may consider coordinating on a project to remove the existing structures and construct detached breakwaters with sand pre-fill.

References:

- Benson, D. Joe. Draft Open File Report 96-xxx, 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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