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Educational Resources on Coastal Hazards

Great Lakes Water Level Dashboard

Interactive visualization of Great Lakes water level records to see historic highs & lows.
https://www.glerl.noaa.gov/data/dashboard/GLD_HTML5.html

Lake Level Viewer

Interactive map that visualizes the extent of rising and falling water levels along the shores of the Great Lakes from six feet above average lake levels to six feet below average lake levels.
coast.noaa.gov/llv/

REVIEWING YOUR OPTIONS

Many possible options exist to address coastal hazard issues. The appropriate actions for a particular property are often situational and site specific. The best option for a property experiencing coastal hazard issues can range from do-nothing, implementation of site management best practices, relocation of a house, and when absolutely necessary, construction of shore protection structures. The resources below offer some considerations when weighing these options.

Adapting to a Changing Coast – Options and

Stabilizing Coastal Slopes on the Great Lakes

Detailed fact sheet describing the coastal conditions and processes that can lead to bluff failure and some options for stabilizing the slope of a coastal bluff.
publications.aqua.wisc.edu/product/stabilizing-coastal-slopes-on-the-great-lakes/

IMPLEMENTING CONSTRUCTED MEASURES

If you decide that your best option is to proceed with constructed measures to protect your coastal property, then it's time to move forward and work with contractors, engineers, and potentially even your neighbors to consider, prioritize, and implement appropriate management actions.

Placing Erosion Control Structures on Great Lakes

Wisconsin Department of Natural Resources website with information on requirements and considerations for shore protection projects in Wisconsin
dnr.wi.gov/topic/Waterways/shoreline/GreatLakesErosionControl.html

Working with Engineers and Contractors on Shore Protection Projects

Fact sheet describing the process of finding and work-

Resources for Great Lakes Coastal Property Owners

Great Lakes Shore Protection Structures and Their Effects on Coastal Processes

Detailed fact sheet describing different types of shore protection structures and their potential impacts, both positive and negative, on the shoreline.
publications.aqua.wisc.edu/product/great-lakes-coastal-shore-protection-structures-and-their-effects-on-coastal-processes/

ects on Lakes Michigan or Superior. It is only a partial list and is in no way a list of "approved" or "recommended" firms.
seagrant.wisc.edu/our-work/focus-areas/coastal-processes-and-engineering/resources-for-property-owners/great-lakes-coastal-engineering-firms-and-contractors/

Sea Grant
University of Wisconsin

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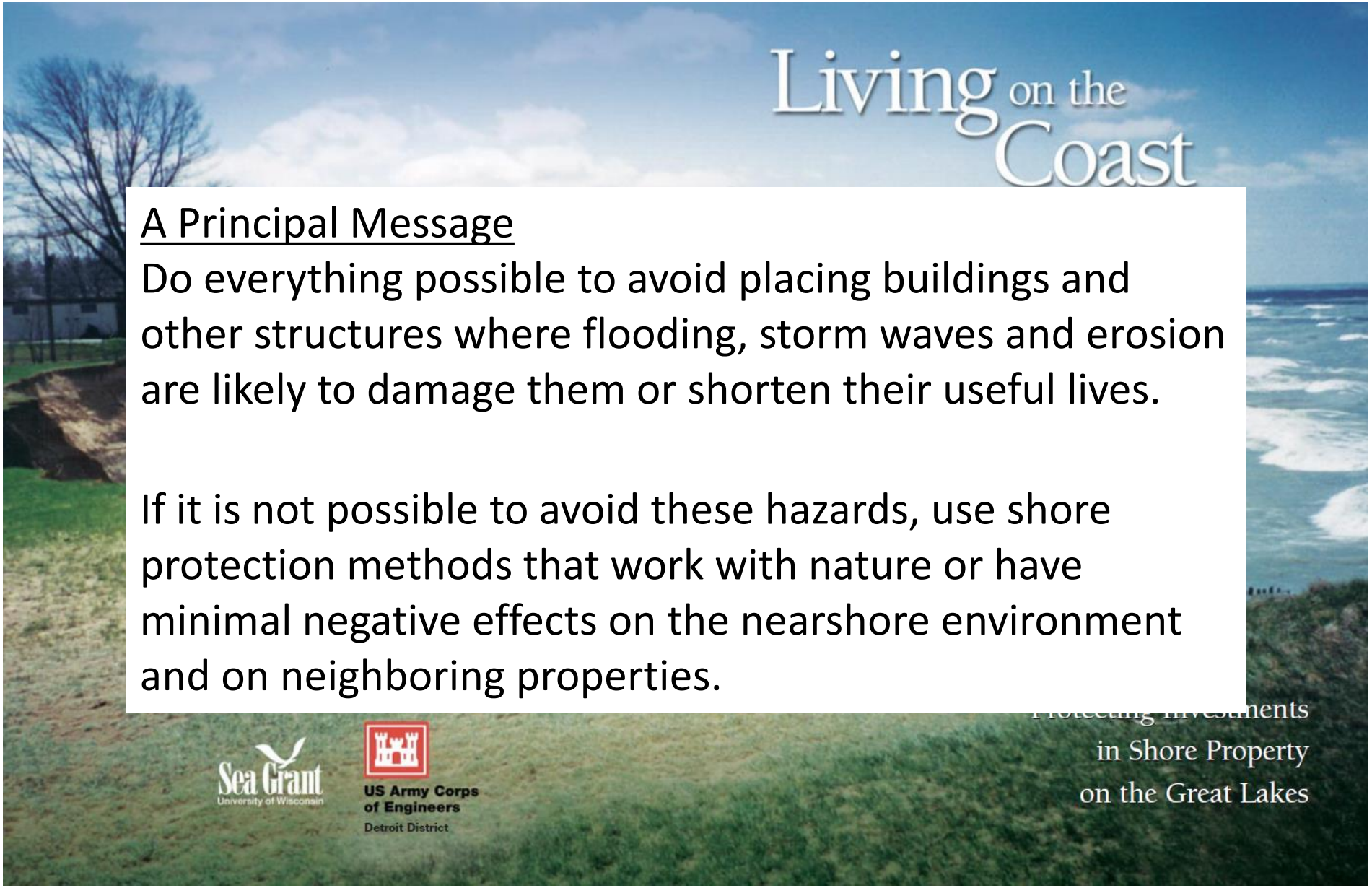
https://sewicoastalresilience.org/wp-content/uploads/2019/08/GLWaterLevelMtg_resources1_photo.pdf



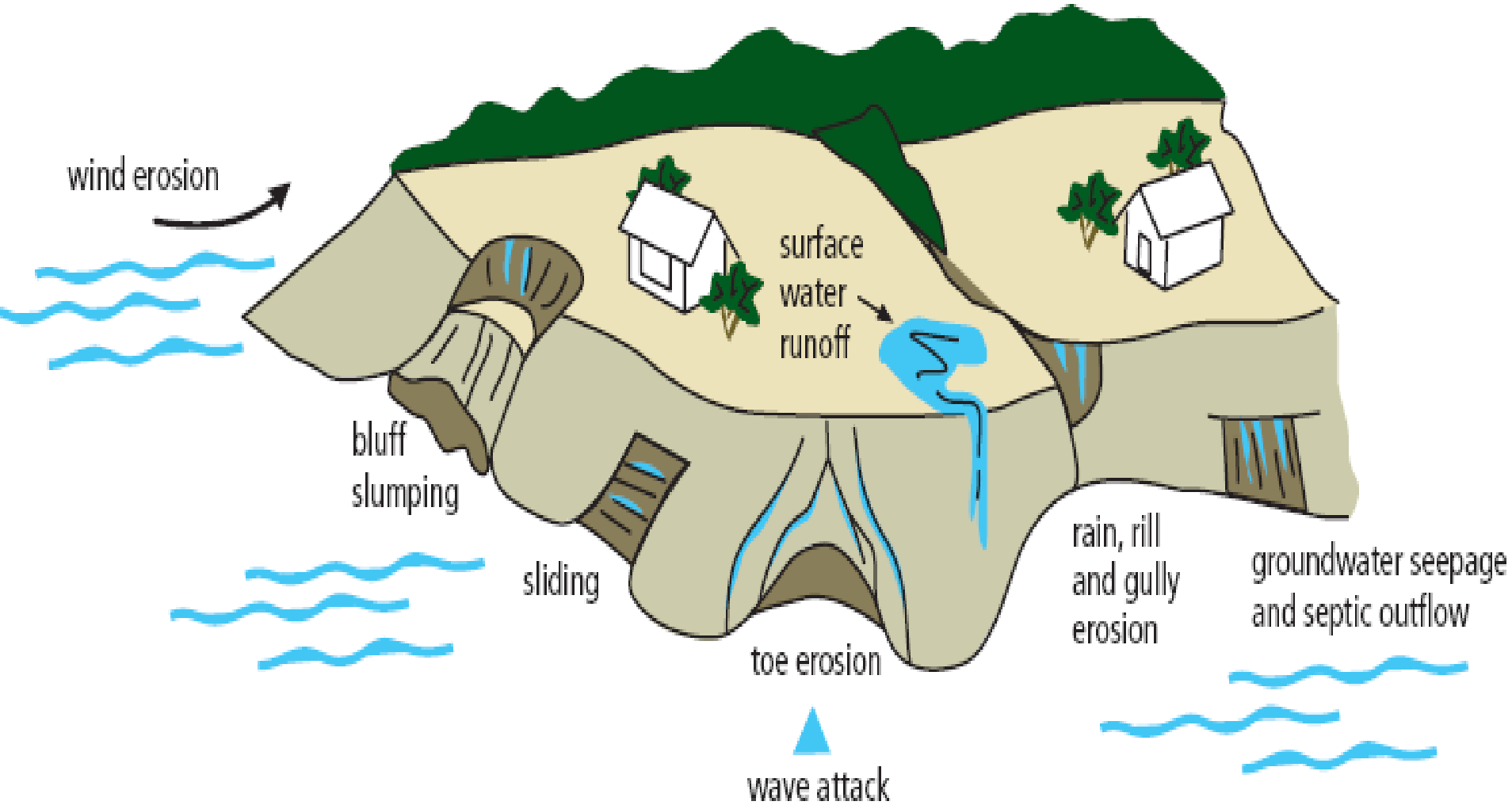
A Principal Message

Do everything possible to avoid placing buildings and other structures where flooding, storm waves and erosion are likely to damage them or shorten their useful lives.

If it is not possible to avoid these hazards, use shore protection methods that work with nature or have minimal negative effects on the nearshore environment and on neighboring properties.

http://publications.aqua.wisc.edu/product/living-on-the-coast-protecting-investments-in-shore-property-on-the-great-lakes/

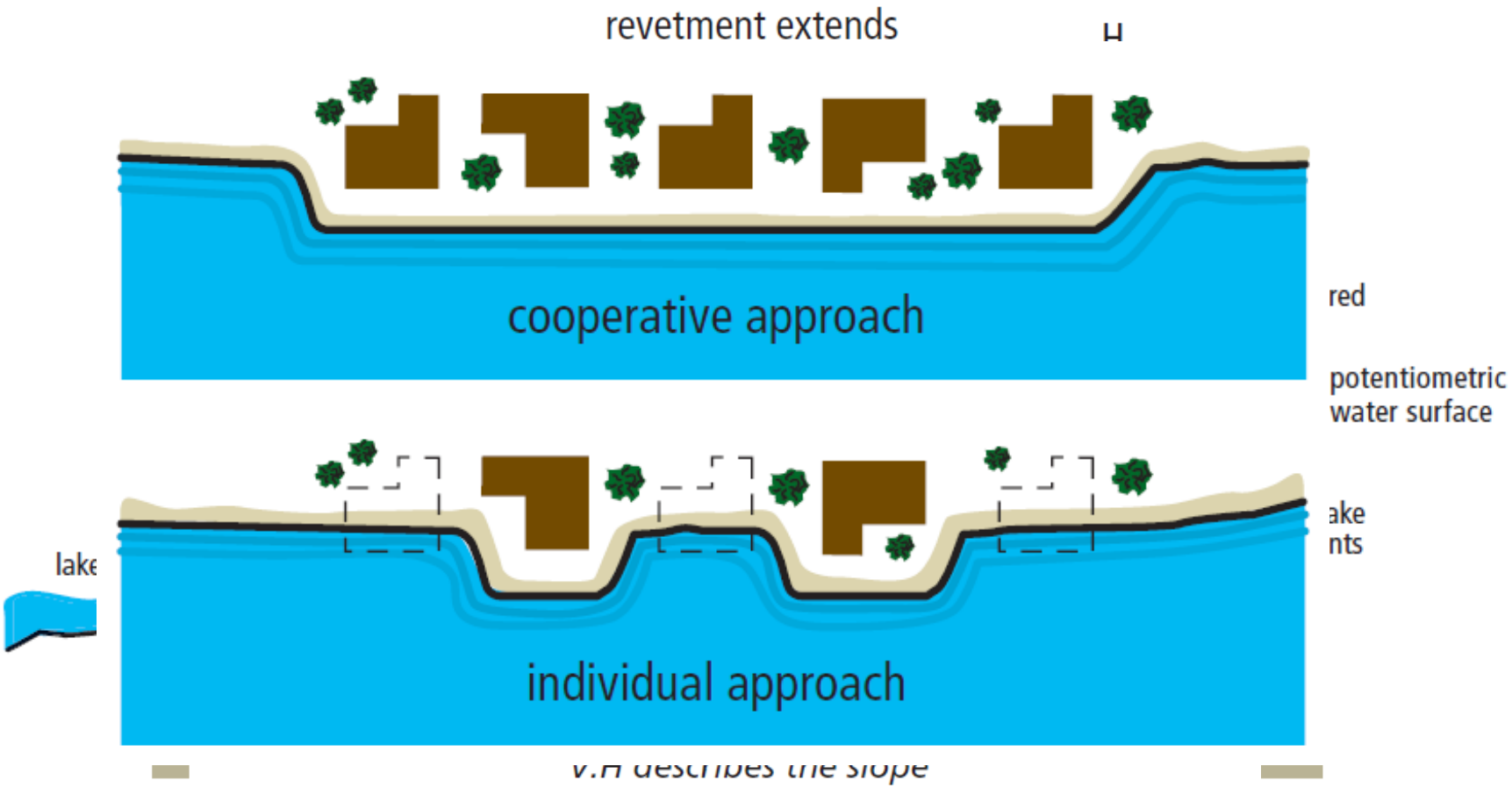
Natural Processes That Affect the Coast



[USACE/Wisconsin Sea Grant: Living on the Coast]

Protecting Your Coastal Investment

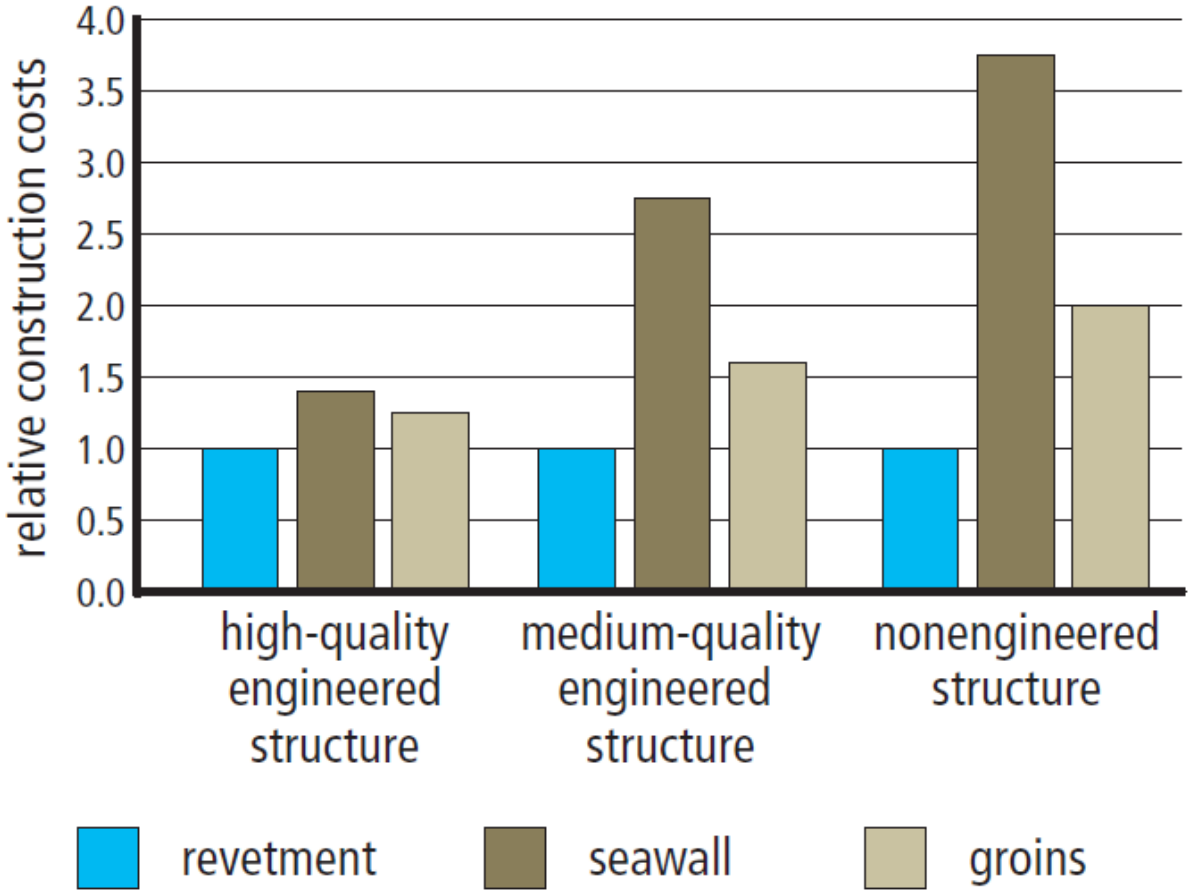
Environmental Impacts of Shore Protection Structures



Typical Revetment Profile

[USACE/Wisconsin Sea Grant: Living on the Coast]

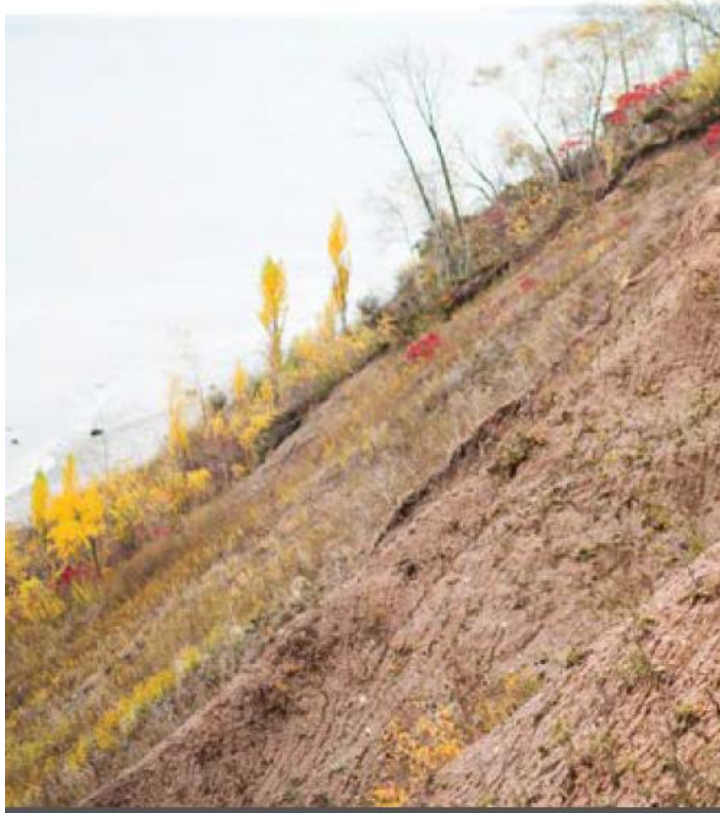
Economics of Protecting Your Coastal Investment



Relative Construction Costs of Shore Protection Structures

[USACE/Wisconsin Sea Grant: Living on the Coast]

OPTIONS AND RESOURCES FOR
LAKE MICHIGAN PROPERTY OWNERS



Adapting to a Cha

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https://publications.aqua.wisc.edu/product/adapting-to-a-changing-coast-for-property-owners/

BUILDING RELOCATION

Who?
Homeowner

Purpose?
Move home to safe location without altering coastline

Challenges?
Relocation cost may exceed value of home

Cost?
$-$$$

Adding shore protection or re-grading a bluff can be extremely costly and requires appropriate techniques to be effective. Even when done properly, armoring the shore and altering the bluffs can have significant impacts on the coastal ecosystem and sediment budget within the lakes. In many cases, physically relocating an at-risk house away from the bluff top to a safe location can be a less expensive and more effective solution. For developers working in potentially high-risk coastal areas, consider using modular or mobile construction techniques and zoning practices that ease relocation.

Benefits	Challenges
Avoids damaging coastal ecosystem	Relocation cost can exceed value of home
Preserves sediment input to lake	Loss of homes could reduce tax base
Avoids impacts to neighbors from shore protection structures	Loss of homes could impact adjacent property values
Can be much less expensive than shore protection/bluff stabilization	
Can be most effective option for safeguarding homes	

Resources

"House Relocation-County Hwy LS-Sheboygan County" a summary of a relocation by a resident on the border of Sheboygan and Manitowoc counties by Alan Lulloff, Association of State Floodplain Managers (ASFPM).
uwmadison.box.com/v/lulloff-bluff-relocation

A news story about the relocation of musician Paul Simon's Hamptons Cottage in response to bluff erosion, featuring Gene Clark of Wisconsin Sea Grant.
realtor.com/news/celebrity-real-estate/paul-simon-hamptons-cottage-physically-moved/

"A Case Study on Adapting to Erosion and Sea Level Rise," a summary of the relocation of the town of Longboat Key in response to sea level rise in Florida by the Florida Sea Grant College Program.
flseagrant.org/wp-content/uploads/2011/08/Longboat-Key-Case-Study_web-version.pdf

"Move Back to Avoid the Hazard," an informational site from the Maine Sea Grant Program giving advice about relocation in the face of coastal hazards.
seagrant.umaine.edu/coastal-hazards-guide/beaches-and-dunes/move-back

"Relocation Engineering Principles and Practices," a factsheet produced by the Federal Emergency Management Agency (FEMA) for homeowners to help plan a relocation.
fema.gov/media-library-data/20130726-1506-20490-8344/fema259_ch5r.pdf

Related Option

Mobile Construction

Building relocation images: This Sheboygan, Wis., home had to relocate across the highway after a bluff collapse (left).

One strategy for living on a dynamic coastline is to use construction techniques that ease relocation, as is the case with this home (right).

Management Agency (FEMA) for homeowners to help plan a relocation.
fema.gov/media-library-data/20130726-1506-20490-8344/fema259_ch5r.pdf

Related Option

Mobile Construction

construction techniques that ease relocation, as is the case with this home (right).

LOW-IMPACT PRACTICES BUILDING RELOCATION 3

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Stabilizing Coastal S

Living With a Legacy

The Great Lakes Basin has a long histo
line and adjacent bluff changes with n
lion years of glacial advance and retre
cient river valleys. When the glaciers re
10,000 years ago, mixtures of clay, sil
rocks were left behind as layers of "
exposed in eroding bluffs and lakebe
the till are layers of sand and gravel d
beaches and stream deltas at the borde
and lake. There are also layers of sand,
deposited on the lake bottom when lake
much higher than they are today.

This geological legacy is important pa
soil types have different properties and di
tance to erosion. Clay can stand as very
when dry only to fail as large landslide
or severely undercut. Sand is easily erode
a more gentle slope and rarely fails catas
Exposed bedrock is more resistant than
to erosion, but it eventually succumbs to
freezing and expanding of water within c
and porous layers, and the relentless atta
The geological legacy is also important
the presence or absence of natural defe
breaking storm waves. Some properties
natural defenses in the form of broad, sta
or bedrock outcrops along the shore a

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Figure 1: An example of a Great Lakes revetme

Great Lakes Coastal
and Their Effects on

Introduction

Many Great Lakes private and public
ports, harbors and marinas are prot
damage by storms, waves, ice and high
els by a variety of engineered coastal a
shore protection structures. Just as ther
types of Great Lakes shorelines and coa
there are many shore protection altern
the effects of those structures both on
diate site as well as farther away along
line can vary. Each location/structure c
could have both positive and negative
pending upon conditions. Therefore, it i
important to understand Great Lakes c
cesses and how coastal structures can af
processes when choosing an engineered

Great Lakes Coastal Processe

Changes along the shoreline are influen
eral things—the marine climate, the geo
area, the weather and human-induce

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Working With Engineers and Contractors on Shore Protection Projects

Great Lakes shorelines continue to evolve, and many of them have been retreating for thousands of years. As the shoreline has retreated, there has been a corresponding erosion (or down-cutting) of the lake bed in many places. Stopping these natural processes is complex because of the consequences to other sections of the shoreline, the variability in shoreline soils and geometry, and the complexity of the processes that erode the shoreline. Natural processes (including the freezing and thawing of water) impact the function of shore protection structures.

Shore protection as a do-it-yourself project is often a series of short-term experiments in a vain and costly search for a long-term solution.

Experienced coastal engineering professionals have the expertise necessary to influence the success of a shoreline project, including the permitting process, public and neighbors' responses to the planned project, construction and maintenance costs, management and the performance and life of the project. They can monitor the project following completion and plan any modifications or repairs needed after major storms. An investment in the services of experienced professionals is the best way to ensure the long-term success of a coastal protection project and minimize costs during the period of ownership.

The steps of typical shore protection projects that go beyond surface water control and revegetation of slopes are shown in the box to the right.

Issues

- Eliminating shoreline retreat
- Protecting the shore from the damaging action of waves and ice
- Stabilizing coastal slopes
- Developing recreational amenities, such as beaches and beach access
- Minimizing damage and protecting or enhancing environmental habitat

Typical Steps of a Shore Protection Project

- Selecting technical advisors or consultants
- Identifying the property owner's needs and expectations
- Conducting field investigations
- Analyzing and designing by consultants
- Preparing and submitting permit applications to regulatory agencies
- Modifying the designs (if needed) and securing permit approvals
- Soliciting bids and selecting a contractor
- Observing construction
- Monitoring the shore protection at least annually and after major storms
- Repairing and replacing the shore protection as needed

For shoreline projects, we recommend retaining a professional with experience undertaking similar projects. A professional experienced in coastal slope stability and erosion control may be registered as a geologist, geoscientist or engineer. A professional experienced in the design of coastal shore protection structures is likely to be a coastal engineer registered as a professional engineer (P.E.). Request and contact references provided by prospective consultants of clients for whom similar work was done.

Benefits of a Professional

Professionals can describe how the shoreline has been naturally changing, including the rate of shoreline retreat and the presence (or absence) and significance of lakebed erosion. They can describe the long-term and short-term consequences of halting that retreat at particular locations. They can also estimate wave conditions approaching the shore, predicted variations in water levels, discuss