

CITIZEN'S COASTAL EROSION MONITORING GUIDE

**LAKE COUNTY SOIL AND WATER
CONSERVATION DISTRICT**



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ACKNOWLEDGEMENT

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INTRODUCTION

The beauty of Lake Superior draws many people to make their homes along the North Shore. But water is a major driving force of change along our coastlines, and coastal erosion can lead to the loss of land and even threaten homes.

The goal of this guide is to empower citizens to document the process of coastal erosion along the North Shore. In this guide, you will find easy-to-follow, step-by-step directions to measure coastal erosion on your property. The materials you need are simple and affordable, and they are readily available at your local hardware store. By documenting erosion over time, you will gain valuable information that will allow you to mitigate the damage caused by erosion and increase the resiliency of your shoreline.

If you choose, you can participate in our citizen science coastal erosion monitoring program by uploading the data you collect to the Lake County SWCD website. By sharing your data, you will help to give us a better understanding of how coastal erosion is impacting our local communities.

This guide was put together by Lake County Soil & Water Conservation District, in cooperation with Cook County Soil & Water Conservation District, with funding from NOAA and the Lake Superior Coastal Program, administered by the MN Department of Natural Resources.

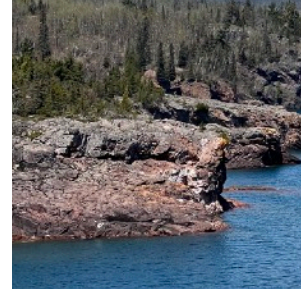
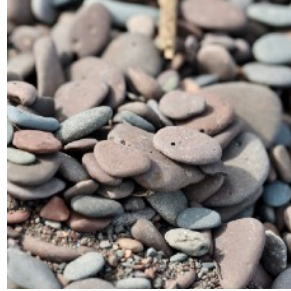
COASTAL EROSION

Coastal erosion is the loss of materials that make up the land along a coastline due to the movement of water and wind. Waves exert a force that repeatedly eats away at bluffs and shorelines. Wind creates waves and can also erode soil and sand on land that lacks vegetation. While coastal erosion is a natural process, it can threaten homes and infrastructure along the shore.

Lake Superior water levels play an important role in coastal erosion along the North Shore. The higher the water level, the more land is exposed to the force of water, the greater the erosion. In recent years, Lake Superior has seen record high water levels. Levels have come down from their peak, but the cycle between high and low water levels will continue

Coastal erosion can also be exacerbated by human activities. Surface water runoff from homes can add to erosion problems on a property, and the removal of vegetation from shorelines can make them much more vulnerable to erosion. Some erosion management techniques put into place along one stretch of shoreline can also impact the erosion that occurs on neighboring shorelines.





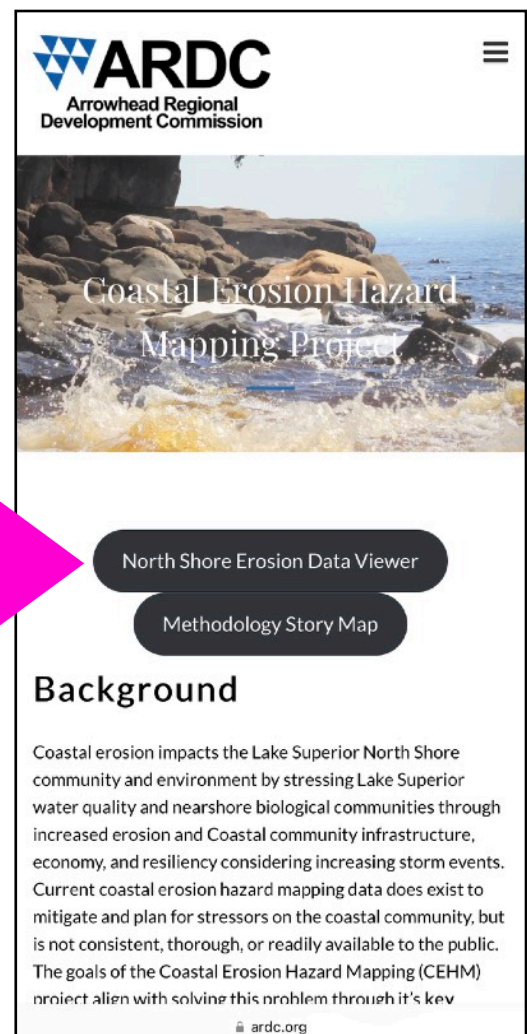
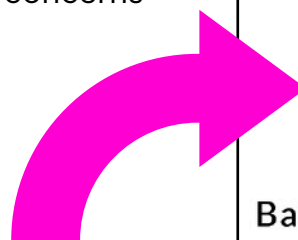
Many factors play a role in how vulnerable a particular stretch of coastline is to erosion. Soil type, bluff slope, the extent and condition of bedrock, vegetative cover, and stormwater management all affect a site's vulnerability to erosion. So, too, does a site's position relative to the prevailing winds that blow across the water and whether the site is protected by an island or in a bay.

THE COASTAL EROSION HAZARD MAPPING PROJECT

The Coastal Erosion Hazard Mapping Project is a web-based mapping tool developed by the Arrowhead Regional Development Commission that is easily accessible to the public. It can be used to identify a site's vulnerability to erosion and its suitability for development. It can also be used to guide decisions related to conservation concerns and hazardous erosion areas.

You can visit the Arrowhead Regional Development Commission's website at: <https://ardc.org/cehm/>

There, you will find a link to the North Shore Erosion Data Viewer, as well as more information about the project.



MEASURING COASTAL EROSION

OVERVIEW

By measuring coastal erosion, you can get a better idea of the scale of changes occurring on your shoreline. Although erosion may happen in small increments over time, it may also happen all at once, for example during a storm. Long-term documentation of shoreline erosion can help you determine the specific causes erosion, allowing you to better address them.

If you have any questions on measuring coastal erosion after reading this guide, please get in touch with Lake County Soil & Water Conservation District and we can give you some additional tips.

SAFETY PRECAUTIONS

When measuring coastal erosion, it's important to keep safety in mind. Don't select a site that you can't safely measure. Take your measurements with at least one other person. Don't get too close to the edge of a steep bluff or cliff.



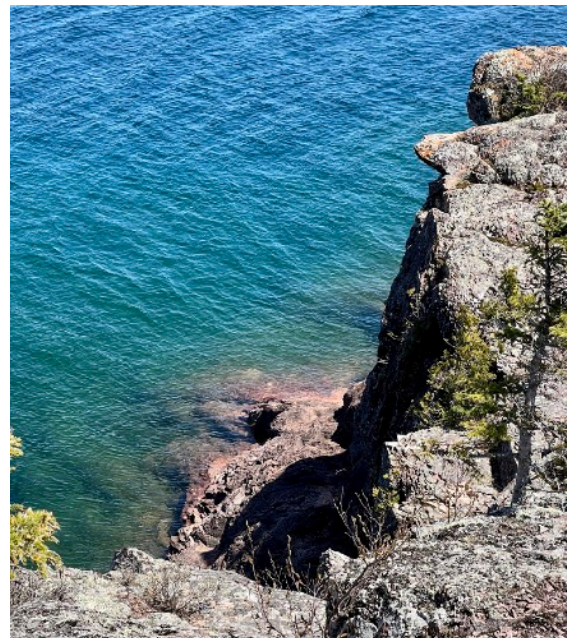
METHOD ONE: SIMPLE DISTANCE MEASUREMENT

Overview: The easiest way you can track shoreline erosion is by measuring the distance between a permanent location, such as a building corner, and a shoreline feature, such as the edge of a bluff or a vegetation line. This method is especially well-suited to sites situated near a steep bluff, where the second method would not be possible.



You Will Need

- Two people
- Compass
- Measuring tape
- Stakes and flags or ribbon
- Camera
- Data sheet (see page 19)
- Smartphone or GPS unit (optional)

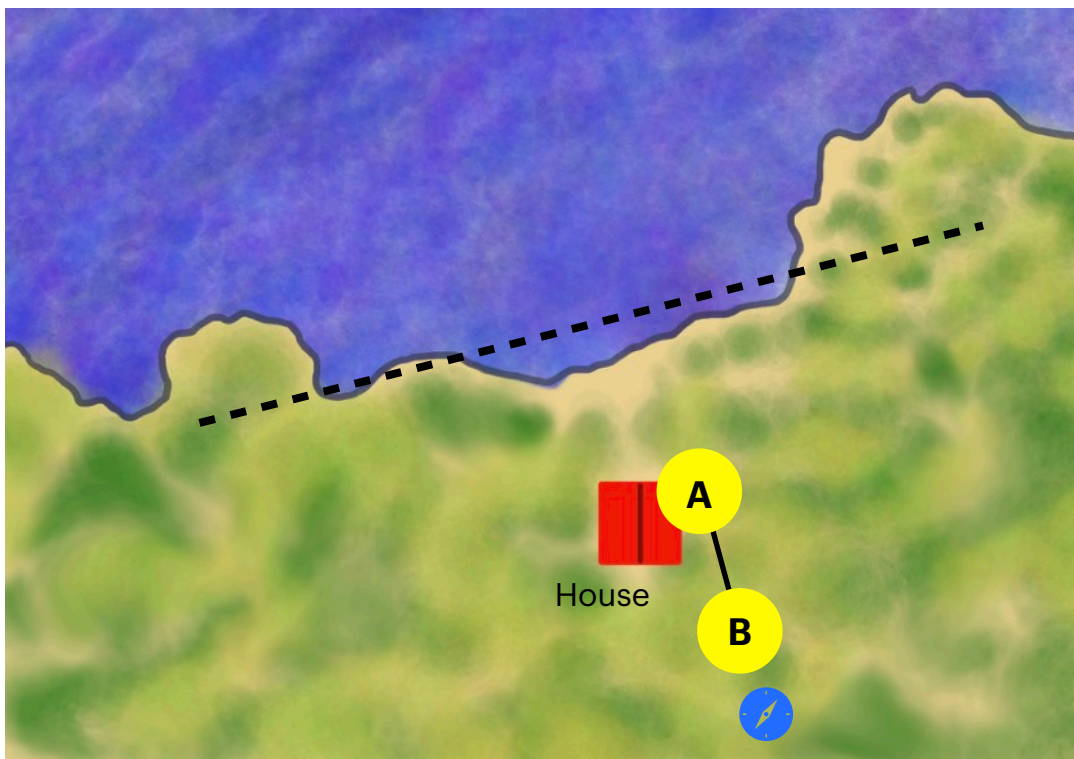


Step 1: Establish Two Reference Points

In order to measure erosion over the long-term, it's important to establish permanent reference points that can be used each time you take a measurement. You can use permanent features of the landscape, such as a building corner or tree, or you can pound a stake into the ground and use a small flag or ribbon to mark its location.



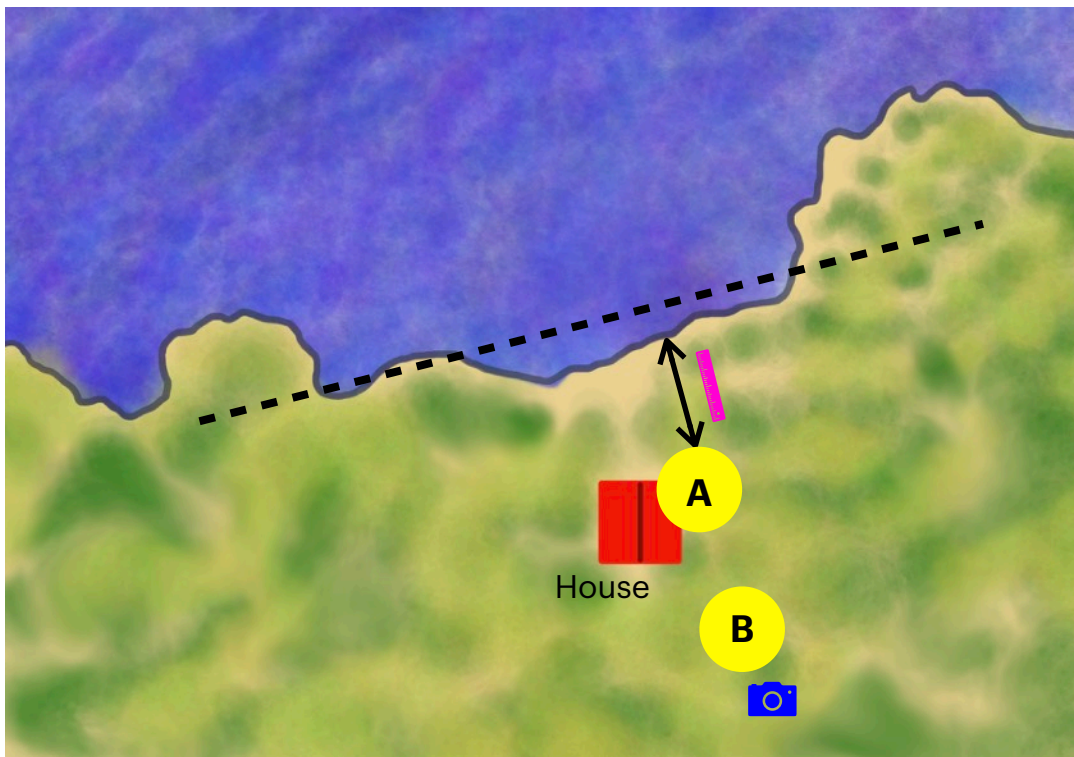
1. Establish your first reference point (Point A) 25-50 feet back from the eroding shoreline. Mark your reference point with a stake, and add ribbons or a flag to make it visible. Note down the location of your reference point on your data sheet.
2. Establish your second reference point (Point B) by moving 10-20 feet inland from Point A, keeping the imaginary line between points A and B perpendicular to the shoreline. Mark Point B as you did Point A.
3. If you have a smartphone or GPS unit available, document the GPS coordinates of Points A and B.
4. Using your compass, measure the bearing from Point B to Point A. Record the compass bearing on your data sheet.
5. Measure the distance between Points A and B with your measuring tape and note the distance on your data sheet.



Step 2: Measure the Distance to the Shoreline



1. Person #1 stands by Point B and uses a compass to get the correct transect bearing.
2. Person #2 moves along the shoreline until they are lined up with the transect bearing.
3. Person #2 measures the distance between the shoreline and Point A and records the number on the data sheet. Note: if you are near the edge of a cliff, stand at Point A and toss the end of your measuring tape over the edge of the cliff, then pull it back until just reaches the edge and then record the distance.
4. Make a note of any major weather events that have occurred or any other noteworthy changes that you see.
5. Take a photograph of your site from Point B along the transect between Points A and B towards the shoreline.



METHOD TWO: SHORELINE PROFILE

The second method you can use to track shoreline erosion is to take measurements and create a shoreline profile. This will give you more information than simply measuring the distance between a marker and the shoreline, and it will allow you to estimate the amount of sediment being eroded away.

You Will Need

- Three people (two can work in a pinch)
- Compass
- Stakes and flags or ribbon
- Data sheet (see page 20)
- Smartphone or GPS unit (optional)
- Camera
- Two 6-foot emery rods
 - Four yard sticks
 - Two six-foot strips of wood as wide as the yard sticks
 - Glue
 - Two levels
 - Four zip ties
 - Six feet of string or thin rope



Step 1: Assemble Your Emery Rods

1. Glue two yard sticks, end-to-end, onto the six-foot strip of wood and let them dry. Make sure both yard sticks are oriented the same direction. Repeat for the second emery rod.
2. Attach a level to each rod, halfway up the top yard stick, using two zip ties per rod.
3. Tie your six-foot string or thin rope around the middle of one of the rods. Then tie the other side of the string around the middle of your second rod, making sure there are exactly five feet of rope between the two rods. Trim off the excess.
4. If you wish, you can amend the markings on the top yard stick to continue counting on from 36 inches (e.g. use a sharpie to write "37" on the 1 inch marking, "38" on the 2 inch marking, etc.)

Note: If you have difficulty sourcing materials or making your emery rods, contact Lake County Soil & Water Conservation District. We have a pair of rods that you may be able to borrow.



Step 1-1: Glue yard sticks onto 6-ft stick



Step 1-2: Use zip ties to attach levels



Step 2: Establish Two Reference Points

In order to measure erosion over the long-term, it's important to establish permanent reference points that can be used each time you take a measurement. You can use permanent features of the landscape, such as a building corner or tree, or you can pound a stake into the ground and use a small flag or ribbon to mark its location.

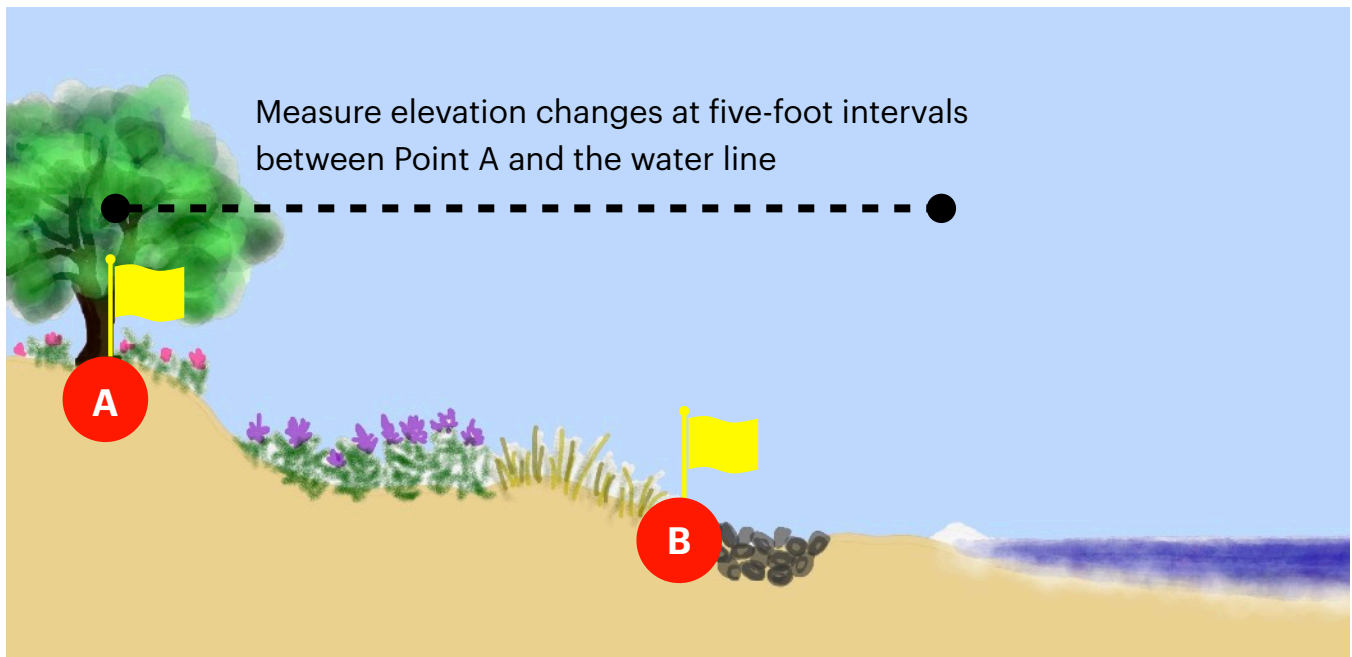
1. Establish your first reference point (Point A) at least 10 feet inland from the edge of an eroding feature. Mark the point with a stake and a flag or ribbon. Using a permanent feature of the landscape, such as a tree, will be helpful in making sure that you take your measurements at the same point each time.
2. Moving towards the water, establish your second reference point (Point B) along the shoreline on a contour, such as a vegetation line or erosion line. The imaginary line between Points A and B should be perpendicular to the shoreline.
3. If you have a smartphone or GPS unit available, document the GPS coordinates of Points A and B.
4. Using your compass, measure the bearing from Point B to Point A. Record the compass bearing on your data sheet.



Step 3: Measure Your Shoreline Profile

1. Person #1 stands an emery rod up at Point A, with the inch markings starting at 0 on the ground. Person #2 takes the second emery rod and stands it up five feet away from Point A towards the water. The string between the emery rods should be taught, and it should line up with the imaginary line between Points A and B. Person #3 can check that everything is lined up straight. Both emery rods should be level.
2. Person #1 stands comfortably behind their emery rod, facing the water, and finds where the lake horizon intersects with their rod. They call out the number on their emery rod and person #3 records it on the data sheet.
3. Without moving, person #1 looks ahead to the second emery rod held in place by person #2. Person #1 finds where the lake horizon intersects with the second emery rod, also making sure to line them up with where the horizon intersects with the first emery rod. Person #1 calls out to person #2 to move their hand until it matches the intersection with the horizon. Person #2 then calls out the number on their emery rod and person #3 records it.
4. Person #3 records on the data sheet whether the slope between person #1 and person #2 moves upward, downward, or is flat.
5. Person #1 then carries their emery rod to the point where person #2 is holding their emery rod, placing their rod in the same place that person #2's rod was positioned. Person #2 then advances with their rod five feet towards the water. Person #3 makes sure that both people are lined up with the imaginary line between Points A and B. Both emery rods should be level.
6. Repeat steps 2-5 until you reach the water.

Note: If there are any significant changes in the landscape that you would like to document at a finer scale than every five feet, you may place the emery rods closer together along your imaginary line. Just make sure to measure the distance between the emery rods and record it on the data sheet.



Step 4: Calculate the Elevation Changes on Your Shoreline

1. Looking at your data sheet, calculate the elevation changes between your first and second points for each segment you measured.
2. Fill in the calculations on your data sheet.
3. Use graph paper to draw a visual representation of your shoreline's profile.
4. Over time, as you record more shoreline profiles at the same spot, you will be able to see how your shoreline is changing and whether there is significant erosion.

SHORELINE PROFILE DATA WORKSHEET (METHOD TWO)

Date: **June 1, 2022**

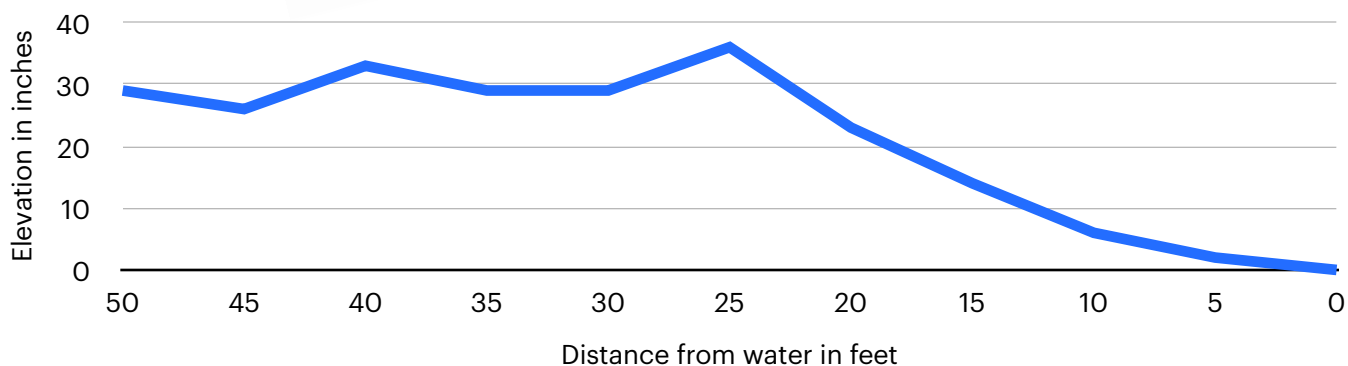
Location: **Agate Bay**

Point A GPS Coordinates (further from the shore): **47.0163014, -91.6664870**

Point B GPS Coordinates (closer to the shore): **47.0162440, -91.6665849**

Compass Bearing: **220 degrees SW**

Shoreline Profile Segment	Horizontal Distance (feet)	Slope Direction (up/down)	Landward Reading (inches)	Lakeward Reading (inches)	Change in Elevation (inches)	Notes
1	5	down	57	60	-3	
2	5	up	51	44	7	
3	5	down	55	59	-4	
4	5	level	53	53	0	
5	5	up	48	41	7	
6	5	down	58	71	-13	
7	5	down	57	66	-9	
8	5	down	63	71	-8	
9	5	down	65	69	-4	
10	5	down	64	66	-2	



SUBMIT YOUR DATA TO THE CITIZEN SCIENCE SHORELINE EROSION MONITORING PROGRAM

By submitting the data you collect on your property, you can help us learn more about how coastal erosion is affecting our coastal communities. To submit data, visit Lake County SWCD's website at www.lakecountyswcd.org and click on "Lake Superior Coastal Erosion." There, you will find links to submit your data. You can submit your data anonymously, but you will be asked to create a unique location name for your property so that we can file the data you submit all together.

The screenshot shows the website for the Lake County Soil and Water Conservation District. The browser address bar displays co.lake.mn.us. The navigation menu includes: HOME, DEPARTMENTS, COUNTY BOARD, CALENDAR, DOCUMENT CENTER, and SUPPORT GUIDE. A search bar is located in the top right corner. The main header features the Lake County logo and a large banner image of a road winding through a forest. Below the banner, the text "Lake County Soil and Water Conservation District" is displayed. The left sidebar menu lists: About Us, Document Center, Programs, Services, Watersheds, and Lake Superior Coastal Erosion. A red arrow points to the "Lake Superior Coastal Erosion" link. Below the menu, contact information for the Soil and Water Conservation District is provided, including a phone number (218) 408-6616. The main content area includes a "Welcome" message, a mission statement, and a link to register for a workshop. A photo of the Lake County SWCD main office in Two Harbors is also shown.

Lake County Soil and Water Conservation District

Welcome

Lake County Soil & Water Conservation District's mission is to support the people of Lake County in protecting and conserving the land and waters through professional consultation, education, and resources.

Register for the June 14th Aquatic Invasive Species Identification Workshop!

Lake County SWCD main office in Two Harbors

STABILIZING COASTAL EROSION

If you have identified erosion occurring on your property, there are a variety of land management practices you can put into place to mitigate the damage. The options available to you will depend on conditions specific to your site. Below we'll provide an overview of the different types of land management practices you may consider. We highly recommend that you seek professional help and assistance when altering or modifying your shoreline, as these projects can be highly complex, may require permitting, and can have a large impact on the environment and neighboring shorelines.

GREEN SHORELINES

By strategically planting native plants along your shoreline, you can help to reduce erosion. The roots of native plants can hold soil in place, and the plants create a buffer between the shoreline and upland areas. Native plantings can also be very attractive, improve water quality, and provide habitat and biodiversity. Native plantings are especially well-suited to low energy wave environments.



GREY INFRASTRUCTURE

Grey infrastructure refers to mitigation measures that involve harder features like rocks and concrete. Seawalls, rip rap revetments, and breakwaters are all examples of grey infrastructure, and they can help to stabilize shoreline, protect the toe of a bluff, or reduce the force of wave action on the shoreline. Grey infrastructure may be more appropriate for high energy wave environments. While grey infrastructure may do well at protecting the shoreline, it may lead to higher erosion at adjacent sites that are not reinforced.

HYBRID SHORELINES

Hybrid shorelines combine green shorelines with grey infrastructure. They are suitable for low to high energy wave environments. An example of a hybrid shoreline would be a small breakwater combined with vegetative stabilization. The breakwater would help to dissipate wave energy, while the vegetation would reduce erosion, provide wildlife habitat, and help the shoreline blend in with the natural environment.

STORMWATER MANAGEMENT

Manage stormwater with green practices, such as rain gardens and permeable pavers. Directing water from your rooftop and driveway to a rain garden will decrease surface water runoff by increasing the infiltration of water into the ground. Rain gardens also filter pollutants carried in water from driveways, lawns, and rooftops, improving water quality.

Redirect stormwater away from your bluff or shoreline. Runoff directed towards the face of a bluff can erode surface material. Instead, direct the water near the front of your properties away from the shoreline or bluff.

Avoid removing vegetation, and don't mow near your shoreline. Try to leave native vegetation in place on at least half the length of your property to the lake. Native plant roots strengthen soil and remove water through root uptake and transpiration. They also slow runoff and trap sediment.

MORE INFORMATION

For more information on coastal erosion mitigation practices, visit Lake County SWCD's website and click on "Lake Superior Coastal Erosion."

RESOURCES FOR LANDOWNERS

SOIL & WATER CONSERVATION DISTRICTS

Lake County Soil & Water Conservation District
408 First Avenue, Two Harbors, MN 55616
(218) 834-8370
www.lakecountyswcd.org

Cook County Soil & Water Conservation District
411 West Second Street, Grand Marais, MN 55604
(218) 387-3647
www.cookswcd.org

COUNTY OFFICES

Lake County Planning and Zoning
601 Third Avenue, Two Harbors, MN 55616
(218) 834-8327
www.co.lake.mn.us/environmental-services/planning-and-zoning

Cook County Planning and Zoning
Cook County Courthouse, 411 West Second Street, Grand Marais, MN 55604
(218) 387-3630
www.co.cook.mn.us/government/departments/land_services/planning_and_zoning.php

SIMPLE DISTANCE MEASUREMENT DATA WORKSHEET
(METHOD ONE)

Location:
Point A GPS Coordinates (closer to the shore):
Point B GPS Coordinates (further from the shore):
Distance between Points A and B (feet):
Compass Bearing (degrees):

Date	Distance Between Point A and Edge of Eroding Feature (feet, inches)	Notes

SHORELINE PROFILE DATA WORKSHEET (METHOD TWO)

Date:

Location:

Point A GPS Coordinates (further from the shore):

Point B GPS Coordinates (closer to the shore):

Compass Bearing:

Shoreline Profile Segment	Horizontal Distance (feet)	Slope Direction (up/down)	Landward Reading (inches)	Lakeward Reading (inches)	Change in Elevation (inches)	Notes
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Horizontal Distance: The distance between your two emery rods. This will be 5 feet if you follow the directions for building your emery rods.

Slope Direction: Is the shoreline between your landward and lake ward points sloping up or down?

Landward Reading: The reading, in inches, where your emery rod intersects with the lake's horizon. Be sure to add the length, in inches, of your bottom yard stick if you're measuring off of the top yard stick.

Lakeward Reading: The reading, in inches, where the lake ward emery rod intersects with the lake's horizon and the landward reading (taken by the person standing at the landward emery rod).

Change in Elevation: The difference between your landward and lake ward readings. Subtract your lakeward reading from your landward reading. If the result is negative, the land will be sloping down towards the shore. If the result is positive, the land will be sloping upwards.

Notes: Make a note of anything you see that may be relevant to erosion.

SHORELINE PROFILE DATA WORKSHEET (METHOD TWO)

Date:

Location:

Point A GPS Coordinates (further from the shore):

Point B GPS Coordinates (closer to the shore):

Compass Bearing:

Shoreline Profile Segment	Horizontal Distance (feet)	Slope Direction (up/down)	Landward Reading (inches)	Lakeward Reading (inches)	Change in Elevation (inches)	Notes
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2						
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SHORELINE PROFILE DATA WORKSHEET (METHOD TWO)

Date:

Location:

Point A GPS Coordinates (further from the shore):

Point B GPS Coordinates (closer to the shore):

Compass Bearing:

Shoreline Profile Segment	Horizontal Distance (feet)	Slope Direction (up/down)	Landward Reading (inches)	Lakeward Reading (inches)	Change in Elevation (inches)	Notes
1						
2						
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