COLORADO STATE PARKS
STEWARDSHIP PRESCRIPTION

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Parks Affected: Reservoir Parks

Shoreline Erosion Monitoring

Stewardship Rx

Introduction to protocol

As shoreline and stream bank erosion continue to be a concern at certain Colorado State Parks, the following document is intended to outline an effective, easily followed, and consistent method to long term monitoring of shoreline erosion. If this method is to be implemented, more formal and specific guidelines may be developed in cooperation with park staff. This approach will provide a means for collecting quantifiable data that will be valuable in making long-term management decisions for a threatened resource.

Source: Stewardship Team, 2000

Purpose

Contributing factors to shoreline erosion may be large seasonal fluctuation in water levels, soils with low cohesive strength, poor vegetative protection and anchoring of shoreline, as well as wind and wave action. Until a semi-permanent or permanent solution can be made, shoreline loss should be monitored consistently. The purpose of such a monitoring program will be to assist in #1 illustrating more specifically, the magnitude of the shoreline loss, #2 identifying priority areas for stabilization, #3 achieving more predictable stabilization results, and #4 assisting in more successful and cost effective remedies. The data collected will be an integral component for analyzing erosion trends and rates, more effectively than simple observations and photo-documentation alone, by;

- Developing long term permanent GPS'd monitoring locations
- Quantifying soil loss over *time* (seasonal and annual intervals) and *area.*
- Providing insight into identifying levels of priority among different areas.
- Providing available data for analytical applications useful to contractors.
- Indicate more concretely, actual amounts of shoreline soil lost.

In addition, the data collected may be stored in an Arcview GIS project for park staff to access and evaluate trends at each monitoring location, identified by the associated GPS point.

Key considerations in the purpose and locations of the monitoring points will be the effects of water levels and adjacent shoreline characteristics including: visitor traffic, rip-rap in adjacent areas, type and amount of vegetation, corresponding lake levels, and if possible climatic influences.

The following pages outline and illustrate the approach to establishing the monitoring points, the methods and frequency for collecting the data with a basic approach that will determine shoreline loss values for width and length (X and Y-axis) or a more comprehensive approach that will help determine shoreline loss from changes in elevation (the Z-axis). Finally, recommendations on saving, applying, and graphing the data will be provided.

Establishing the monitoring points

The anticipated number of monitoring points will be from 5-7 points in order to pursue enough representative data without requiring an excessive time commitment. These points should be chosen with the following parameters in mind:

- Points that best represent the condition over a wide area
- Areas appearing to be particularly prone to high levels of shoreline loss
- Points that see high visitor traffic
- Areas where it is difficult to estimate past shoreline loss
- Locations adjacent to mechanically stabilized shoreline
- Points where park management deem useful for other reasons

Once the point locations have been established, these points will each be assigned a monitoring location ID, and staked at a specific height above the ground surface, with a post of rebar or another material (of which park management feels would be relatively unobtrusive, yet permanent). These points will be located a specific distance from the shoreline (see Figure #1). GPS points will be collected and entered into a GIS program for the park to access.

Methods for Collecting the Data

The methods for collecting the data will be the same at each monitoring location. The items required for each effort include:

For Basic Approach	For More Comprehensive Approach
Data sheets	Data sheets
Compass with sight mirror	Compass with sight mirror
50ft. Tape Measure	50ft. Tape Measure
Stadia rod	Hand sight level
	Stadia rod

Two people will be required to collect the data using the stadia rod, compass (with sight mirror) and tape measure. Diagram #2 illustrates the design at two (sample) monitoring points. Once the point has been established, a bearing perpendicular to the shoreline will be taken (for example, 80 degrees).

Note: It is critical to line the pupil of the eye, with sightline of the compass mirror, and the rod. All three must line up, in order to protect lateral accuracy for repeatable and consistent data collection.

The distance measured to the edge of the shoreline will be recorded on the data sheet provided (see figure #2). Subsequent measurements will be made at 10-degree intervals on both sides of that perpendicular bearing probably 3 to 4 measurements on each side of that perpendicular axis. All bearings will be permanently assigned to the data sheets. This will create approximately 3 to 4 foot intervals between measurements. The overall width of the shoreline at each monitoring point will be somewhere between 20 and 30 ft. If a longer representative section is preferred, simply set the fixed point farther away from the shoreline (40-50ft). This provides data on the rate of the shoreline receding over that distance of 20 to 30 ft. (or longer) In addition, the distance to the waters edge from the fixed monitoring point will also be recorded to compare erosion rates with corresponding lake levels or distance from waters edge to erosion line.

Implementing the third (Z) axis of monitoring (comprehensive approach) illustrated in diagram #2, will help indicate the difference in elevation using the fixed monitoring point as an elevation reference. Again, all measurements will be recorded in the appropriate data sheets for each point. An example of the data sheets is provided in Figure #1 and #2.

Diagram #1 Monitoring point measurement location

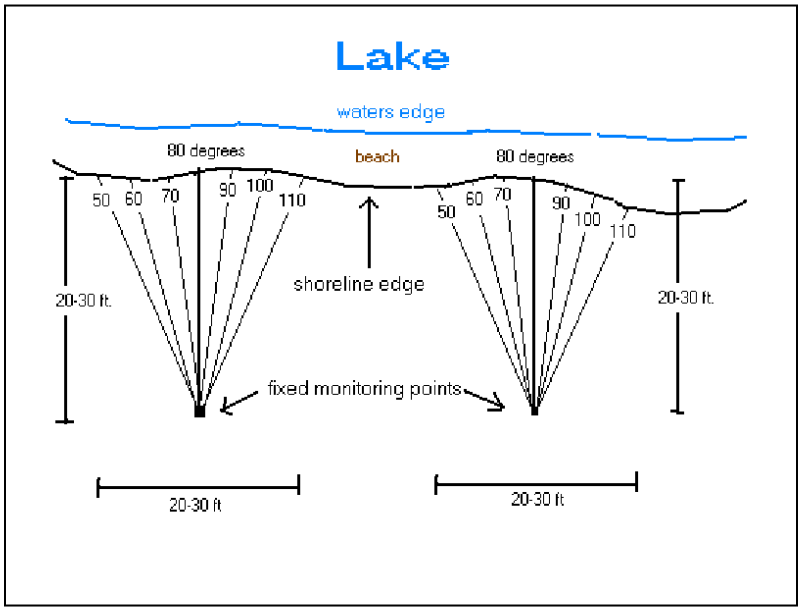

Diagram #2 illustrating height measurements

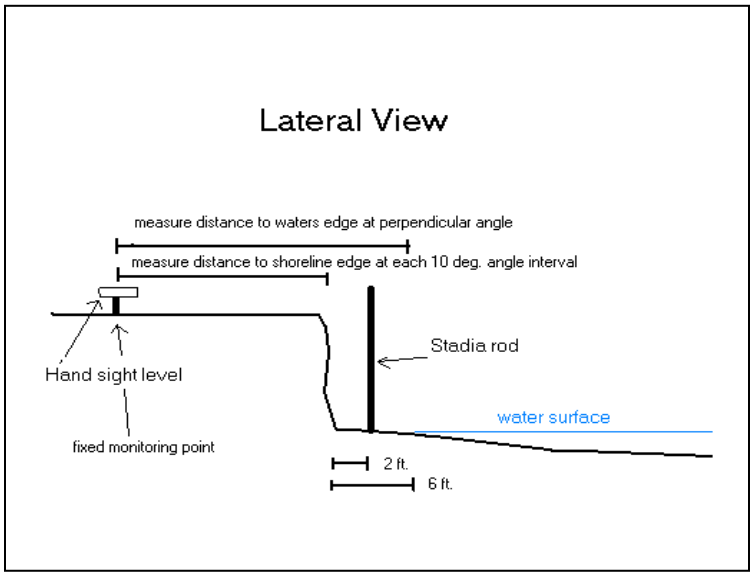

Figure 1: **Sample data sheets (Figures 1 and 2)– There should be one set of these data sheets for each monitoring point.**

Shoreline Monitoring Point A (one of several)

Example

Location: **Lakeside CG #14**

Recorded by:		Date:	
Distance from fixed point to waters edge	ft. in.	Camera and Photo #'s	

Measurement 1 (perpendicular to shore) Bearing = 60 degrees example	feet	inches
Measurement 2 Bearing = 70 degrees "		
Measurement 3 Bearing = 80 degrees "		
Measurement 4 Bearing = 90 degrees "		
Measurement 5 Bearing = 50 degrees "		
Measurement 6 Bearing = 40 degrees "		
Measurement 7 Bearing = 30 degrees "		

Observation Notes Today
Notes on Previous Month

Figure 2: **Sample Data Sheet**

Example **Monitoring Site A**

Date	Dist. To Water (from perpen.)	Meas. 1	Meas. 2	Meas. 3	Meas. 4	Meas. 5	Meas. 6	Meas. 7
Distance From Fixed point in Inches (convert feet and inches from data sheet 1, to inches)								
5/9/01	504	474	479	497	554	479	522	545
6/10/01								
7/11/01								
8/12/01								
9/13/01								
10/14/01								

In addition to the measurements taken, photo-documentation with a digital camera or a standard camera with film developed on a disc for computer downloading will complete each monitoring effort. Photo reference locations will be pre-determined and consistent. Ideally, two photos should be taken - one with the farthest right (angle measurement point) at the bottom of the view/photo
frame, and another with the farthest left (angle measurement point) at the bottom center of the photo.

Finally, any additional notes or observations made at time of data collection should also be recorded on the data sheets (i.e. recent obvious slump failures, evidence of human impact, etc).

The frequency and dates of data collection will be ultimately determined by park staff, however the recommended frequency is a minimum of twice a year with a maximum of six times a year. Park management will also determine individuals or parties responsible for the monitoring. Park management is free to make any changes or adaptations to the methodology provided here.

Saving and Using the Data

With the collected data analysis and tracking conditions over time can be performed using Microsoft Excel for data storage and graphing capabilities. Additionally, an Arcview GIS project should be created with linked data sets and photographs, to each monitoring point. The results for each monitoring effort should be recorded electronically, in a Data Results Spreadsheet for graphing and analysis purposes. Management or contractors may develop other applications for the data.

Conclusion

This monitoring method should provide useful and quantifiable data for short and longer-term time periods. It will provide information on shoreline lost over a given distance at pre-designated, GPS'd representative monitoring locations. The data results can be reviewed and analyzed using appropriate Arcview projects and Excel spreadsheets. Adapting the specific parameters for this monitoring protocol, and the frequency of data collection, will be a cooperative effort between each State Park management team and the State Parks Stewardship Team.

Source: Stewardship Team, 2001

CONTACTS

Army Corps of Engineers:
http://www.usace.army.mil/

U.S. Environmental Protection Agency:
http://www.epa.gov/OWOW/NPS/MMGI/Chapter6/ch6-4.html

For shoreline stabilization:
http://www.extension.umn.edu/distribution/naturalresources/components/DD6946g.html