An Introduction to Erosion Control Methods

Today we know more about the potential impacts of development on environmental and water resources. We have learned that impact assessments of proposed shoreline erosion control installations should consider the combined effects that the project may have on a common shoreline, as well as the cause(s) of the erosion. This approach identifies and avoids incremental degradation of a shoreline when short-term solutions are used or when solutions on one property impact neighboring shorelines by displacing the erosion.

Choosing what erosion control method will work best for a particular segment of shoreline is the most difficult step in implementing a stabilization process. It requires an understanding of the causes of erosion and physical characteristics of the shoreline and adjacent land. Erosion is sometimes a problem because previous structures were sited inappropriately, without taking into consideration erosion processes. In order to successfully implement a stabilization method that will work effectively, while creating minimal impacts to adjacent properties and the environment, it is important to consider all available options.

These are methods used for providing shoreline erosion control in the Lake Champlain region:

1. **non-structural and preventative**
2. **structural**
3. **bioengineering**
4. **biotechnical**

Non-structural erosion stabilization options are often the simplest solution and generally work best where erosion is minor and where the land is mostly undisturbed by human activity. They may provide the best long-term benefit, as well as protecting natural habitat values.

Structural installations have traditionally been the first choice to provide shoreline protection, due in part to the greater familiarity of contractors and consultants with these methods. Hard physical structures to secure a shoreline are widely used and promoted throughout the United States. They have proven to be effective, but tend to be expensive, need replacement over time, and can have detrimental environmental impacts if not properly designed and installed.

Bioengineering uses vegetation plantings for shoreline stabilization. Vegetation provides resistance against light to moderate wave action. The plant roots break up the energy of the waves and hold the soil intact while acting as barriers to erosion and mass movement, and assisting in water drainage. The presence of plants on the shore also has multiple scenic and fish and wildlife habitat advantages.

Biotechnical methods of shoreline stabilization combine structural and bioengineering methods to stabilize shorelines. The structural and plant materials work together to provide an improved erosion control in areas of high wave energy or severe erosion, minimizing environmental impacts and providing stability within the system. A biotechnical approach is suitable for a wide range of erosion conditions and commonly used to prevent surface erosion and shallow mass-movement of soil.

All the methods presented help control or slow down a natural, ongoing occurrence; they do not prevent erosion.

Comparison of Stabilization Techniques

When choosing to apply any shoreline stabilization method, there is the chance of failure and of causing neighboring impacts. The charts on the following pages are provided to show a comparison of methods and the advantages and disadvantages for each. More in-depth information on each method is presented on the following pages. You should note that all cost figures are in 2003 US dollars, and should be adjusted in subsequent years for inflation.

	Erosion Control Method	Where It Works	Where It Doesn't Work	Neighboring Impacts	Labor/Preparation	Cost
NON-STRUCTURAL	**Re-Vegetation with Native Species** *page 19*	Along embankments, roadways, and steep slopes	Heavy wave action	None	Moderate	Low
	Relocation *page 20*	Where a structure is threatened by erosion along a shoreline and adequate room on site is available	Structures that cannot be moved due to structural integrity or inadequate space on site	None	High	High
	Drainage *page 20*	On banks that have become eroded from surface runoff Works well along roadways	Banks that are eroding due to other forces than runoff	Moderate to None	Moderate	Moderate
STRUCTURAL	**Stone Riprap Revetment** *page 21*	Embankments or shorelines where the underlying soil is stable	Steep slopes or embankments with significant amount of loose soil	Moderate to High	Moderate	Moderate to High
	Gabion Mattress *page 22*	Along embankments and roadways	Steep slopes Heavy wave action	Moderate to High	Moderate	High
	Concrete Wall *page 23*	Along moderate slopes which receive heavy action	Steep slopes Loose soil	Moderate to High	High	High
	Gabion Wall *page 23*	Along moderate slopes which receive heavy action	Steep slopes Loose soil	Moderate to High	High	High
	Bulkheads *page 24*	Unvegetated high banks with a lot of backfill and little wave action	Steep slopes Heavy wave action	Moderate to High	Moderate	Moderate to High
	Groins *page 25*	Long stretches of sandy beach	Rocky soils Heavy wave action	High	Moderate	Moderate
	Breakwaters *page 25*	Heavy wave action, >4 feet Harbors	Minimal wave action	High	High	High

	Monitoring and Maintenance	Permitting	Can be Installed by	Advantages	Disadvantages	
	Moderate	Low to None	Skilled Individuals	• Low costs and labor • Aesthetically pleasing • Grows stronger with age • Provides wildlife habitat	• Limited time of year for installation of native species • High failure rate in first two years • Additional re-seeding may be necessary each year	NON-STRUCTURAL
	None	Moderate	Design– Engineer Install– Professional Contractor	• Removes future problems • No monitoring and maintenance	• Costs can be high • Improper setback distance may result in future problems • Requires heavy equipment • Requires significant land preparation	
	Moderate	Moderate to Intensive	Design– Engineer Install– Professional Contractor	• Re-directs water flow • Drainage structures are barely visible	• Can be expensive • May require significant land preparation • May create problem elsewhere	
	Moderate	Moderate	Design– Engineer Install– Professional Contractor	• Proven to be successful • Less expensive than other structural methods	• Not aesthetically pleasing • Costs can be high • Creates barrier for fish and wildlife habitat • Weakens with age	STRUCTURAL
	High	Moderate	Design– Engineer Install– Professional Contractor	• Can be built without heavy equipment • Supports vegetation	• Not aesthetically pleasing • Costs can be high • Creates barrier wildlife • High maintenance and repair • Weakens with age	
	Moderate	Intensive	Design– Engineer Install– Professional Contractor	• Strong, durable structure • Works well against heavy waves	• Expensive • Not aesthetically pleasing • Creates barrier for wildlife habitat • Does not support vegetation • Weakens with age	
	High	Moderate	Design– Engineer Install– Professional Contractor	• Resists heavy waves • Supports vegetation	• Expensive • Not aesthetically pleasing • Creates barrier for wildlife • Weakens with age	
	Moderate	Moderate	Design– Engineer Install– Professional Contractor	• Holds eroding soil in place • Can support some vegetation	• Expensive • Not aesthetically pleasing • Weakens with age • Labor intensive	
	Moderate	Not Permittable	Design– Engineer Install– Professional Contractor	• Essentially non-moving shoreline	• Not aesthetically pleasing • Need long reaches • Takes up a lot of space	
	Moderate	Intensive	Design– Engineer Install– Professional Contractor	• Reduces wave action	• Boat hazard • Environmental hazard	

	Erosion Control Method	Where It Works	Where It Doesn't Work	Neighboring Impacts	Labor/Preparation	Cost
BIO-ENGINEERING	**Live Staking** *page 26*	On slopes where erosion is minimal. Commonly used in conjunction with other methods	Badly eroded areas	Low	Low	Low
	Contour Wattling *page 27*	On slopes where erosion is minimal Top of a slope to provide a buffer zone	Badly eroded areas that receive heavy erosive action	Low	Low	Low
	Brush Layering *page 28*	On badly eroded slopes which need to be restored	Loose soils Heavy wave action	Low	Moderate	Low
	Brush Matting *page 29*	On badly eroded slopes which need to be restored	Loose soils Heavy wave action	Low	Moderate	Low
BIO-TECHNICAL	**Erosion Control Matting** *page 31*	Moderate to steep slopes along roadways or on slopes	Heavy wave action	Low	Moderate	Low
	Vegetated Riprap *page 31*	Waterways or inland lakes where the underlying soil is stable	Steep banks with loose soil	Moderate	High	Moderate to High
	Vegetated Gabion Wall *page 32*	Moderate slopes to resist wave action	Steep slopes Loose soil	Moderate	High	High
	Vegetated Gabion Mattress *page 33*	Moderate slopes to resist wave action, ice, and surface erosion	Steep slopes Loose soil	Moderate	High	High
	Vegetated Cribbing (Live Cribbing) *page 34*	Unvegetated slopes with a lot of backfill and little wave action	Steep slopes Heavy wave action	Moderate	Moderate	Moderate to High

Monitoring and Maintenance	Permitting	Can be Installed by	Advantages	Disadvantages	
Moderate	Low	Skilled Individuals	• Grows stronger with age • Provides habitat for wildlife • Low costs and labor • Natural appearance • Does not require skilled labor	• Limited time of year for installation • High failure rate in first two years	BIO-ENGINEERING
High	Low	Skilled Individuals	• Grows stronger with age • Provides habitat for wildlife • Low costs and labor • Natural appearance	• High monitoring and maintenance • Limited time of year for installation • Requires skilled individuals • High failure rate in first two years	
High	Low	Skilled Individuals	• Restores banks • Grows stronger with age • Provides habitat for wildlife • Natural appearance • Low costs	• More labor intensive • High monitoring and maintenance • Limited time of year for installation • Requires skilled individuals • High failure rate in first two years	
High	Low	Skilled Individuals	• Restores banks • Grows stronger with age • Provides habitat for wildlife • Natural appearance • Low costs	• More labor intensive • High monitoring and maintenance • Limited time of year for installation • Requires skilled individuals • High failure rate in first two years	
High	Low	Skilled Individual(s)	• Restores banks, slopes • Grows stronger with age • Provides wildlife habitat • Natural appearance	• High monitoring and maintenance • Limited time of year for installation	BIO-TECHNICAL
High	Moderate	Design– Engineer Install– Professional Contractor	• Increased stability with vegetation • More natural appearance • Provides some wildlife habitat	• Costs can be high • Labor intensive • High failure rate for vegetation in first two years • Increased monitoring and maintenance with vegetation added.	
High	Moderate	Design– Engineer Install– Professional Contractor	• Increased stability with vegetation • More natural appearance • Provides some wildlife habitat	• High costs • Labor intensive • High failure rate for vegetation in first two years • High monitoring and maintenance	
High	Moderate	Design– Engineer Install– Professional Contractor	• Increased stability with vegetation • More natural appearance • Provides some wildlife habitat	• High costs • Labor intensive • High failure rate for vegetation in first two years	
High	Moderate	Design– Engineer Install– Professional Contractor	• Use of timber creates nice, natural appearance • Provides wildlife habitat • Increased stability with vegetation • Holds eroding soil in place	• Expensive • Labor intensive • High failure rate for vegetation	