Lake Wise Info Sheet

Shoreland Best Management Practices for Lake-friendly Living.

Benefits

- Water Quality
- Wildlife Habitat
- Prevents Erosion
- Slow, Spread, Sink Stormwater
- Visual Appeal
- Low Cost
- Low Maintenance
- Small Spaces
- Protection & Resiliency

VT DEC recommended restoration practices

Related Info Sheets:

Lakeshore Buffers

Restore Natural Plant Communities

Beaches & Recreation Areas

BIOENGINEERING

Nature-based solutions for living shorelands

Description.

Bioengineering uses native plants, biodegradable products, and other natural materials to stabilize shorelands, prevent erosion, protect property, and support healthy lake ecosystems. It is often referred to as "soft-scape engineering," living shoreland restoration, or nature-based solutions. A suite of methods mimic naturally stable shorelines by creating vegetated lakeshore banks and a stabilized bank toe.

Applicability.

Bioengineering practices can be used in place of hardscaped lakeshore stabilization such as retaining walls and rip-rap. Hardscaping is typically much more expensive, requires more upkeep, and has harmful impacts to lake health and habitat. It creates a barrier for wildlife, causes scouring of the lake bed, and erosion along the shore.

Bioengineering can protect your property from waves, ice push, erosion, and provide the same stabilization benefits as hardscaping while also enhancing ecological benefits, such as wildlife habitat, stormwater filtration, lake resiliency, and aesthetics.

Cost comparison.

Cost	Stabilization method
$	Fiber coir roll Live stakes & fascines
$$	Slope regrading Stone toe
$$$	Encapsulated soil lifts Live crib wall
$$$$	Retaining walls & other hardscaping

The cost of bioengineering is site and project dependent, but typically much less than hardscaping in the short and long-term.

Bioengineering practices are solutions for the following shoreland conditions:

- Unstable or eroding shoreline
- Vegetation has been cleared
- Failing retaining wall or rip rap
- Areas of heavy use & soil compaction
- Upland erosion and runoff into lake

The practices range from very simple and inexpensive to complex and more costly. Many factors such as site conditions, space availability, location of structures, lake levels, lake shape, water depth, and erosive energy of waves need to be considered when selecting the proper practices.

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WATERSHED MANAGEMENT DIVISION

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Native planting on stabilized shoreland with biodegradable materials at Brighton State Park in Island Pond.

Types of bioengineering.

The establishment of a native plant community with a strong and diversified root structure is central to all bioengineering practices. All the biodegradable erosion control materials used in bioengineering methods, such as matting/blankets, fiber coir rolls, encapsulated soil lifts, and crib walls, are simply to provide structure and material for native plants to root into until they are established and can provide the structure and stability themselves. Properly sized and placed rock is used to protect the slope toe of a lakeshore bank, dissipating wave energy and preventing erosion of shoreland soils from fluctuating water levels, wind, wave action, and ice push. The following is an overview of the different types of bioengineering methods. For more information, see the **Vermont Bioengineering Manual**.

Materials.

- Native plants
- Erosion Control Blankets (ECB) with all-natural fibers
- Fiber Coir Rolls - all natural fibers
- Wood stakes & pins
- Encapsulated soil lift, Bio-D Blocks
- Screened topsoil, herbicide free & weed-free
- Natural fiber rope (coir, sisal, hemp)
- Untreated timber and rebar
- Washed stone and gravel
- Silt fence or turbidity curtain

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Vegetated buffer.

An undisturbed or restored natural area consisting of native vegetation and uncompacted soil that separates and buffers the lakeshore from developed land surfaces. Vegetated buffers are appropriate for all lakeshores whether erosion is occurring or not. Buffers should be as wide as possible, ideally 50 feet to 100 feet wide, but a minimum of 15 feet is required for adequate root structure to stabilize a lakeshore. For sloped banks, the buffer should extend at least 15 feet back from the top of the bank. Wider buffers increase water quality and wildlife habitat benefits. A 100 foot buffer is required under the **Shoreland Protection Act** for new development. See **Lakeshore Buffers** for more information.

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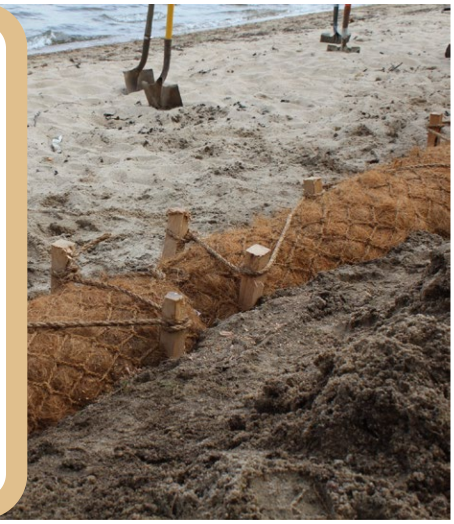
Slope regrading.

Recontouring and stabilizing a slope adjacent to a lakeshore to establish a more gentle, naturally sloped shoreland allows for increased soil permeability, improved sheet flow of stormwater runoff, and soil stability for native plantings. Biodegradable erosion control blankets composed of processed natural fibers are used to roll over, cover, and protect the newly graded area while plants establish. Slope regrading is appropriate for lakeshore locations where the land surface must be recontoured to improve vegetation growth and prevent further erosion. It is applicable to slopes greater than 2:1 (H:V). Slope regrading is often a required part of the installation of other bioengineering techniques, such as stone toes and vegetated buffers.

Fiber coir rolls.

Biodegradable fiber coir rolls are used to stabilize a bank and create a bank toe while plants establish. Fiber coir rolls are typically made from coconut coir or straw and encased in a fiber netting of jute, hemp, coconut coir, burlap, or sisal twine. They are typically 10 feet in length and 12-16 inches in diameter. It is important not to use fiber rolls with synthetic, nylon netting, even if it is photo-degradable because it is often buried and does not degrade and can then endanger wildlife. Fiber coir rolls are well suited for low to moderate energy sites where slope and toe stabilization is required in conjunction with other restoration practices, including slope regrading, live staking, and other plantings.



All photos by VT Lake Wise Program

Stone toe.

A band of layered stone installed at the toe of a shoreline (water's edge) or at the base of a bank to provide additional bank stability and protection. Stone toes are more effective when combined with native plantings to mimic how natural rocky lakeshores provide stability. They provide a solid foundation for other bioengineering techniques and are often combined with fiber coir rolls, slope regrading, encapsulated soil lifts, and live crib walls. Stone toes are well suited for moderate to high energy sites where hardened armoring is required to resist wave action and ice push. The size of the rock depends on the level of stability needed.

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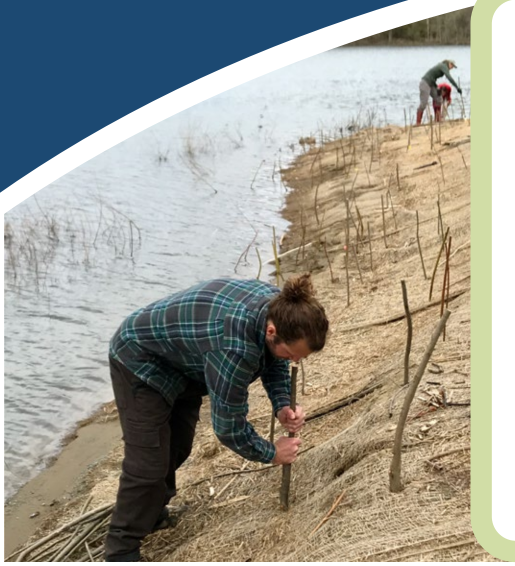
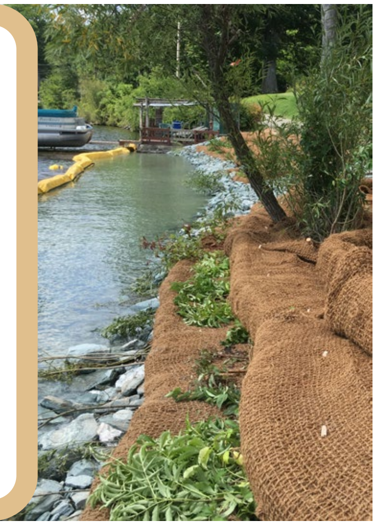


Live stakes & fascines.

Vegetative cuttings harvested and planted during dormancy, typically 1-2 inches in diameter and 1-3 feet tall and capable of quickly rooting into moist soils to provide slope stabilization. Cuttings of woody plants with adventitious roots spread vigorously and create a living root mat that stabilizes soil by reinforcing and binding soil particles together. Live stakes, which are driven into the soil individually, work well on eroding, steep, rocky slopes where disturbing the soil is difficult or not recommended due to risks of further erosion. Fascines, or bundles of live stakes, are generally installed horizontally along a bank slope in a shallow trench to provide stabilization. Live stakes and fascines are often used in conjunction with other bioengineering techniques, such as slope regrading, stone toes, and live crib walls.

Encapsulated soil lifts.

Terraces built with encased soil in erosion control blankets and fiber coir blocks on top of a stone toe to rebuild and restore a stable bank. Each terrace - or lift - is planted with woody shrubs and trees for long term stabilization. They are often used when sloping a bank back towards the shore for stabilization is not an option due to space constraints from roadways or other structures. Each lift is typically 12-16 inches tall with a maximum slope of 2:1. They are not appropriate for vertical drops more than 12-15 feet because they would encroach more than 30 feet into the lake, which is not permitted. Also, the increased weight and risk of weakening the soil layers when building more than five levels of lifts is too great. They typically require a lake encroachment permit to build.



Live crib wall.

A framed terraced retaining structure built with untreated timbers and filled with soil and live plantings. A live crib wall provides long term erosion control and slope reinforcement and is a lower cost sustainable alternative to a conventional retaining wall. They are most appropriate for lower banks that do not receive heavy wave action and for banks that require substantial filling for stabilization and revegetation. These walls are a good choice for higher foot traffic areas that need a combination of structural and vegetative support for optimal stabilization. The timber frames will eventually decay, years after the plants have firmly taken root, providing adequate stabilization for the bank, making the timber framework obsolete.

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