SHORELINE STABILIZATION GUIDELINES

Example of a stable shoreline on a Reston lake created by soft engineering practices

Example of shoreline erosion and dilapidated bulkheading

Reston ASSOCIATION

Introduction

Each year requests are submitted to the Design Review Board for shoreline stabilization projects including installation of bulkhead and riprap. Over the years, Reston Association (RA) has received numerous calls for advice on shoreline stabilization. Many of these calls pertain to problems with existing bulkheads that have been improperly constructed and/or maintained or have simply deteriorated with age. RA also receives calls from property owners adjacent to bulkheading applications who have experienced accelerated erosion as a result of the wave energy traveling down the bulkhead and scouring the adjacent unprotected shoreline. In many cases, hard conventional stabilization applications such as bulkheading and riprap are unnecessary. Vegetative stabilization is more appropriate and beneficial.

RA is responsible for maintaining Reston's water resources and is concerned about the integrity and usefulness of stabilization methods being used, and their impact on the health and ecology of the lakes. Shoreline areas are important habitat for many organisms, ranging from invertebrates to young fish. These organisms are a critical part of the complex food chain in the lakes. If this habitat is destroyed it will impact the entire lake ecosystem and have a negative affect on the aesthetic and recreational use of the lakes, a loss that will not only affect lakeside residents, but also the Reston community as a whole. RA has modified the guidelines for shoreline stabilization practices to place a strong emphasis on the use of soft engineering and vegetative stabilization techniques.

Summary of Stabilization Techniques

Shoreline hardening practices such as bulkheading have several drawbacks. The structure may only assimilate 20 percent of the wave's energy, which means the majority of the energy is forced back out toward the lake and bottom, thus creating scour at the bottom of the structure, or creating accelerated erosion across from or adjacent to the structure. The chemicals used in pressure treated lumber are harmful to the aquatic life of our lakes. Sediment cores from Lake Anne, taken by the U.S. Geological Survey, have elevated levels of arsenic. Leaching of metals and other chemicals from pressure treated lumber is a major source of unwanted metals in our lakes. There are now more environmentally sensitive types of pressure treated timber available. RA recommends the use of recycled plastic lumber whenever possible. For taller bulkheads (>2½ feet high), using wood treated with one of the recent alternatives may be necessary. Another disadvantage of bulkheaded shorelines is the lack of habitat for fish, macroinvertebrates, or microorganisms, which fosters a sterile shoreline environment.

Riprap (rocks/stone), under most circumstances, adequately stabilizes shorelines and does not share all the negative characteristics of bulkheading, however, it does not provide optimal wildlife and water quality benefits as vegetated shorelines. It is important to always install filter fabric under riprap to prevent soil from washing out from underneath the rocks.

Vegetative and bioengineering solutions (biologs) stabilize the shoreline, provide aquatic wildlife habitat, and create beautiful landscapes of varied textures, colors, and flowers. Vegetated shorelines also filter lawn runoff and uptake nutrients prior to the runoff entering the lakes. This nutrient uptake will help to reduce algal growth evidenced in the lakes each summer.

RA's main concerns are the proper and appropriate application of stabilization practices including bioengineering, riprap, and bulkheading to arrest shoreline erosion, and the protection of aquatic habitat. Each of the three aforementioned methods provides similar stabilization results if installed properly. However, each method has a distinctly different effect on habitat and on the general ecological health of the lakes.

Guidelines for Shoreline Stabilization

Because of the benefits to the lakes' ecology, these guidelines place a strong emphasis on the use of vegetative or bioengineering stabilization techniques. RA encourages the use of these techniques when possible. RA's primary interest is protecting and improving the long-term health and usefulness of the lakes. Extensive vegetated shoreline buffers are essential to maintaining good aquatic habitat and fisheries.

Riprap will continue to be the preferred application in situations where "softer" solutions are not adequate. However, it is recommended that riprap should be used in combination with vegetation to improve the aesthetic appearance and habitat value.

For reasons previously mentioned, the use of bulkheads will be discouraged and will only be allowed in extreme situations where no other method will adequately stabilize the shoreline, or in short sections to accommodate high usage or access areas.

Bulkheading and riprap require Design Review Board (DRB) approval. The use of biologs does not require DRB approval. The DRB has approved the general use of biologs and plantings without any review or approval by staff or the DRB.

Please contact RA staff **prior** to installation to ensure the application is appropriate for the circumstances. Additionally, with **all** shoreline stabilization treatments, it is critical to verify property lines prior to installation. It is important that shoreline stabilization treatments are not installed on others or RA's property. Questions regarding DRB approval may be directed to (703) 435-9580. Infrastructure on RA property requires a licensing agreement. RA will require any unapproved infrastructure / application to be removed at the owner's expense.

Because each shoreline situation is different, RA staff is available to perform site visits and to discuss various stabilization methods appropriate for the site and its intended use. Questions may be directed to RA's Central Services Facility at (703) 435-7658.

Important Questions to Ask When Evaluating Shoreline Stabilization Applications

1. What is the severity of the existing shoreline erosion?
2. What type of access to the lake is needed?
3. What kind of access is there to get to the shoreline?
4. What is the slope / depth of the existing shoreline/bottom?
5. What are the subsurface characteristics?
6. What is the sun exposure / orientation?
7. What are the aesthetic criteria?
8. What is the budget?
9. Is there a need to deter nuisance waterfowl?
10. Will the application impact the lake and/or neighboring properties?

Comparison Matrix for Shoreline Stabilization Methods

	BULKHEADS	RIP-RAP	VEGETATION	BIOLOGS w/ VEGETATION
ADVANTAGES	Reasonable longevity depending on construction quality Ease of recreational access Architecturally pleasing	Indefinite longevity Excellent energy dissipater Some use for wildlife Can be planted Various sizes, colors available Inexpensive Little maintenance required	Longevity/warm seasons only Dissipates energy Amenity for wildlife, fish Choice of flowering plants Inexpensive Aesthetically pleasing DRB approval not needed	Reasonable longevity, longer than vegetation alone Dissipates energy better than vegetation alone Amenity for wildlife, fish Choice of plants Enhances colonization of native plants Relatively inexpensive Aesthetically pleasing DRB approval not needed
DISADVANTAGES	Life expectancy 15-20 years Does not dissipate wave energy well Professional installation required Expensive Do not provide a benefit to wildlife, fish Chemical leaching Require maintenance Does not deter waterfowl Need DRB approval	Design must accommodate an area for recreational access Some consider aesthetically displeasing Can catch floating debris Expensive Access to site Need DRB Approval	May hinder some access May harbor wildlife Can collect floating debris Some species can overpopulate Need fencing first two growing seasons	May hinder some access May harbor wildlife Can collect floating debris Some species can over populate Need fencing first two growing seasons
COSTS	By contractor: $40-75/linear ft. not including backfill (for vertical sheeting wall)	By contractor: $35-75/linear ft. depending on grading & access By resident: $20-30/linear ft. Dependent of rock type	$10-15/linear ft. Depends on number, size, and types of plants	$15-20/linear ft. Depends on number, size, and types of plants

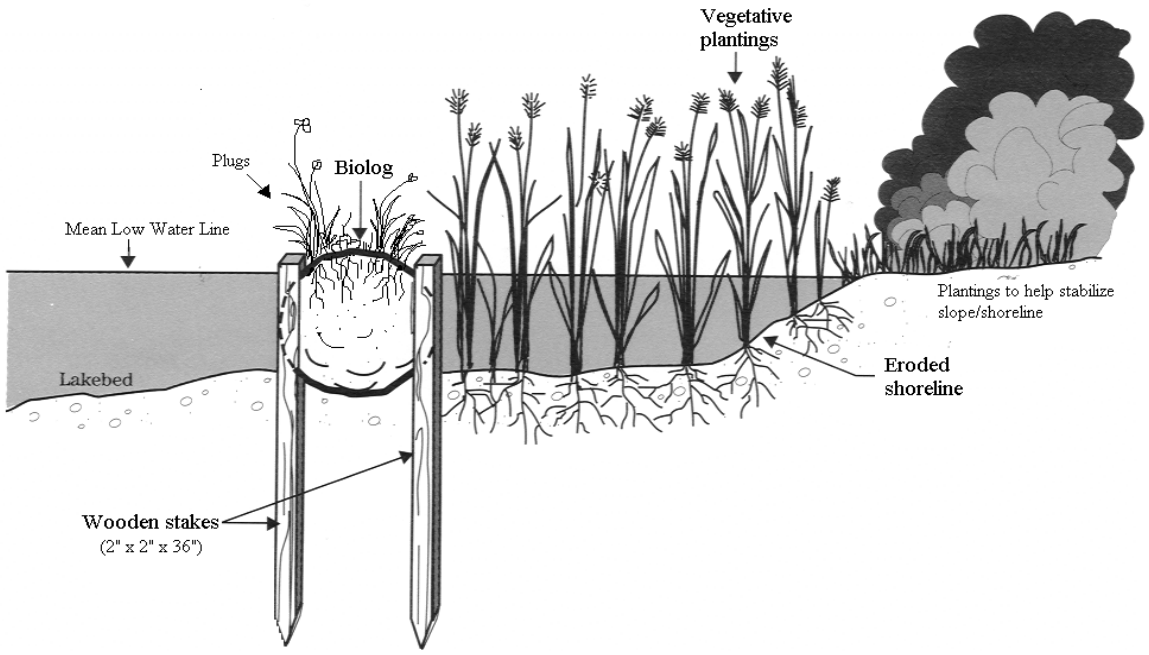
Note: 1. Some advantages and disadvantages listed for each type of measure are simply perceptions of different individuals, i.e. one resident may like the attractiveness of vegetation to wildlife, another may consider it a nuisance.
2. Costs are approximate and would vary based on exact materials chosen, access to the work area, and specific design considerations such as slope or depth to lake bottom.

BIOLOGS

Biologs are cylindrical rolls of packed coconut fiber bound together by twine also made from coconut. The logs usually come manufactured 12" in diameter and 20 feet long; however other sizes are available. Biologs protect shorelines by reducing wave energy and containing lakeshore substrate/soil behind them. Biologs are staked at the toe of the slope so that the approximately ½ to ¾ of the log is below normal lake elevation. The physical structure of the log functions as a "wave breaker" preserving easily eroded shorelines. In instances where the eroded shoreline is higher than the height of the log, multiple biologs can be stacked on top of each other. Biologs trap sediment and nutrients from land runoff, which helps decrease sedimentation and eutrophication (too many nutrients). Additionally, the coconut fiber provides a medium for the establishment of aquatic vegetation, which is continually enhanced by trapped sediment and nutrients. Many types of plants can be used in biologs, thereby creating an aesthetically pleasing shoreline stabilization application. Vegetated biologs benefit lake ecology by providing food, cover, and substrate for a variety of organisms. Biologs are an excellent alternative to conventional shoreline stabilization techniques that have minimal environmental benefits.

Because of the ecological benefits, RA encourages the use of biologs for lakeshore stabilization whenever possible. A recommended plant list and a list of nurseries are included in this document. In addition to their aesthetic and environmental value, biologs have additional benefits compared to bulkheading and riprap. Biologs tend to be less expensive and easier to install. Heavy equipment is not necessary for installation. The logs are flexible and can be molded to the curvature of the shoreline. Biologs are ideal for lakes where water levels and wave action fluctuate. Vegetation planted in and behind the logs is also adapted to fluctuating water levels and increases the level of stabilization and shoreline protection.

Cross sectional view of biolog installation



USDA Natural Resource Conservation Service. 1996. Streambank and Shoreline Protection (Chapter 16 – Engineering Field Handbook). 210-vi-EFH.

Biolog Installation instructions for lake shorelines

- Place biologs end to end along the shore so that the log is ½ to ¾ submerged. Key the ends of the logs into the shoreline. The logs may need to be trenched in. Slight grading may also be necessary. The area in between the biologs and shoreline can be filled with soil and planted with grass and/or native plants that live in moist soil. Another option is to not fill the area in between and plant it with emergent aquatic plants such as pickerelweed, duck potato, burreed, or arrow arum. A list of recommended plants is included in this packet.

- In order to keep the biologs in place, drive in wooden stakes along the length (in front and back) of the logs to secure them along the shoreline.

- Once the biologs are in place, it is time to plant them. Dig out or push out a small hole in the coconut fiber and plant "plugs" of desired appropriate, native plant species. The fiber should be snug around the plant just like planting any other plant. The top of the plug should be level with the surrounding biolog. Water should be splashed on the plug to give it a good wet start. The type of plant being used will dictate where it should planted on the biolog. Blue flag iris (Iris versicolor) and cardinal flower (Lobelia cardinalis) should be planted on top the biolog approximately 3-4" (1-2 mesh squares) apart. Plants like wool grass (Scirpus cypernius) should be planted on the lakeside of the log. .

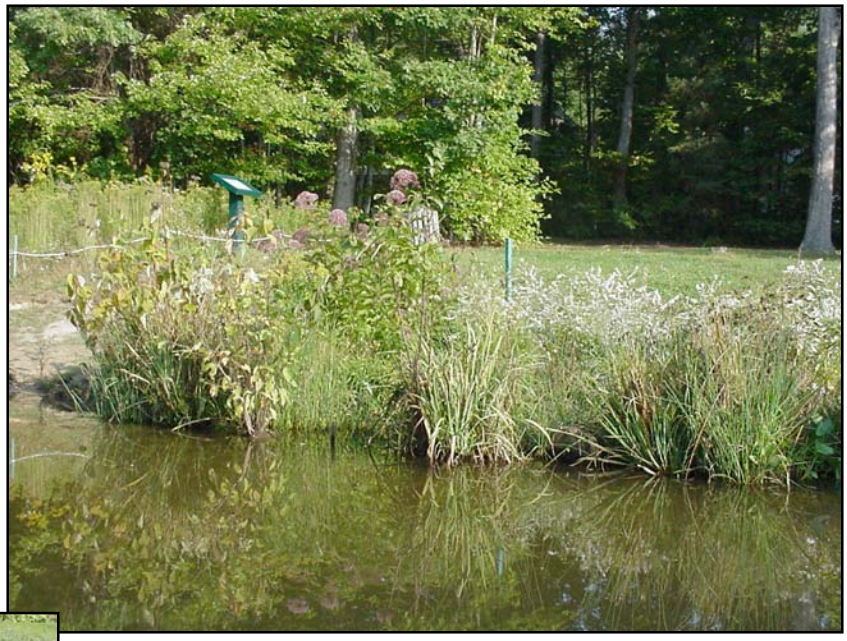
- If biologs are installed correctly, they should not need watering, except during extended droughts or when lake levels are drawn down for maintenance.

- Once the biologs have been planted, you have the option of fencing off the logs for 1-2 growing seasons to keep waterfowl away and allow the plants to get established. This is important since ducks and geese can pull-up, stomp on, and eat the plants growing on the biolog. If you choose to fence, drive metal stakes into the ground all the way around the biologs approximately 2-3' away, so waterfowl cannot reach the plants. Posts should be paced on either side of the biolog spaced evenly apart. Fencing should be attached to the posts with cable ties and should be flush with the ground and at least touches the water surface or is slightly submerged.

Newly nstalled biologs

ESTABLISHED BIOLOGS IN RESTON

Biologs at Lake Newport



Biologs at Lake Audubon

RECOMMENDED PLANTS FOR BIOLOGS

Cardinal Flower (Lobelia cardinalis) – Grows 2-4' in damp sites. It has clusters of deep red flowers; attract hummingbirds. Blooms July-September. Requires full sun.

Blue Flag Iris (Iris versicolor) – Grows to 4' in wetlands and along shorelines. The violet-blue flowers bloom in May-June. Tolerates partial shade as well as full sun.

Woolgrass (Scirpus cypernius) –Grows 3-5' in sedge meadows, marshes, and bogs. Slight triangular stem with branched flower head made up of clusters of spikelets that have a "wooly" appearance. Good for nesting and cover. Requires full sun.

Turtlehead (Chelone lyonii) - Grows 1-3' in wet thickets, stream banks, and low ground. The 1 ½" white tubular flowers resemble turtle heads and bloom July-September. Tolerates partial shade as well as full sun.

Monkey Flower (Mimulus ringens) – Perennial herb. Grows 30" in swamps, stream banks, and wet meadows. Attractive tubular blue-lavender flowers appear throughout the summer. Requires sun.

Soft Stem Bulrush (Scirpus validus) – Grows 3-10' along moist shorelines. Due to its soft stem, the plant is not able to withstand heavy wave action. Slightly triangular stems at base and rounded above. Requires full sun.

Fox Sedge (Carex vulpinoidea) – Slowing growing in freshwater marshes and wet meadows. Tolerates partial shade as well as full sun.

Swamp Milkweed (Asclepias incarnata) – Grows to 2-4' in swamps, marshes, and wet meadows. Lance-shaped leaves and pink flower clusters that bloom in late June through September. Excellent food source for monarchs and other butterflies. Requires full sun.

Lizard's Tail (Saururus cernuus) – Grows 1-5' in muddy shorelines, shallow swamps, marshes, and along lake fringes and streams. Fragrant plant with heart-shaped, lobed leaves and creamy-white flower spikes that appear June-September. Tolerates partial shade as well as full sun.

Tussock Sedge (Carex stricta) – Grass-like sedge found in swamps and marshes, forms hummocks. Extensive root system. Requires full sun.

Button Bush (Cephalanthus occidentalis) – Flowering medium-sized shrub found in wet soils in wetlands and along ponds and streams. Tolerant to flooding. Produces small white flowers clusters (buttons) that bloom in June and July. Flowers attract butterflies. Seeds eaten by waterfowl. Tolerates shade.

Marsh Hibiscus (Hibiscus moscheutos) – Perennial herb that can grow up to 7'. Produces attractive pink, red, or white flowers July through September that attract ruby-throated hummingbirds. Requires full sun.

RECOMMENDED EMERGENT PLANTS FOR SHORELINES AND/OR IN BETWEEN BIOLOG AND SHORELINE

Pickerelweed (Pontederia cordata) – Grows 3' in freshwater marshes and shallow waters. Plant has glossy lobed leaves and a spike of purple flowers that bloom in late summer and early fall. Can withstand considerable wave action. Tolerates partial shade as well as full sun. Spreads vigorously.

Arrow arum (Peltandra virginica) – Grows 2-3' in shallow fresh waters. Arrowhead shaped leaves. Produces fleshy seeds. Tolerates partial shade as well as full sun.

Duck Potato (Saggittaria latifolia) – Grows 1-3' along the shores of lakes, ponds, and sluggish streams. Arrow-shaped leaves and small white flowers that bloom June through August. Tolerates partial shade as well as full sun.

Giant Burreed (Sparganium eurycarpum) - Grows 2-4' in saturated soils along lakes and ponds. Produces prickly, golf ball sized clusters of seeds (seed head). Long, narrow lance-shaped leaves. Requires full sun.

Golden Club (Orontium aquaticum) – Grows 15" in shallow water. Low-lying velvety oblong leaves. Yellow club-like flowers bloom in early spring. Requires full sun.

Sweet Flag (Acorus calamus) – Perennial that grows 2-4' in marshy, muddy areas, along shorelines. Plant gives off sweet aromatic odor. Tolerates partial shade as well as full sun.

Soft Rush (Juncus effusus) – Grows 3’ in moist soils along lakes, ponds, and in wetlands. Steams are smooth, round and unbranched. Tiny flowers (in clusters) appear in early summer. Requires full sun.

River Bulrush (Scripus fluvuatilis) – Tall grass-like sedge that grows 3-5’ along lake and pond edges, streams, marshes, and sloughs. Thick triangular stems with brown spikelets. Excellent shoreline stabilizer; strong, dense rhizome network. Tolerates partial shade as well as full sun.

Plant Photos Courtesy of:
- University of Florida, Institute of Food and Agricultural Sciences, Center for Aquatic and Invasive Plants
- AltaVista© Images

Recommended Nurseries

- **Pinelands Nursery** (also supplies biologs and other erosion control materials)
  323 Island Road
  Columbus, NJ 08022
  (609) 291-9486
  fax: (609) 298-8939
  1-800-667-2729
  www.pinelandsnursery.com

- **Sylva Native Nursery & Seed**
  1683 Sieling Farm Road
  New Freedom, PA 17349
  (717) 227-0486
  fax (717) 227-0484
  www.sylvanative.com

- **Environmental Concern, Inc.**
  210 West Chew Avenue
  P.O. Box P
  St. Michaels, MD 21663
  (410) 745-9620
  fax: (410) 745-3517
  www.wetland.org/ecnursery.htm

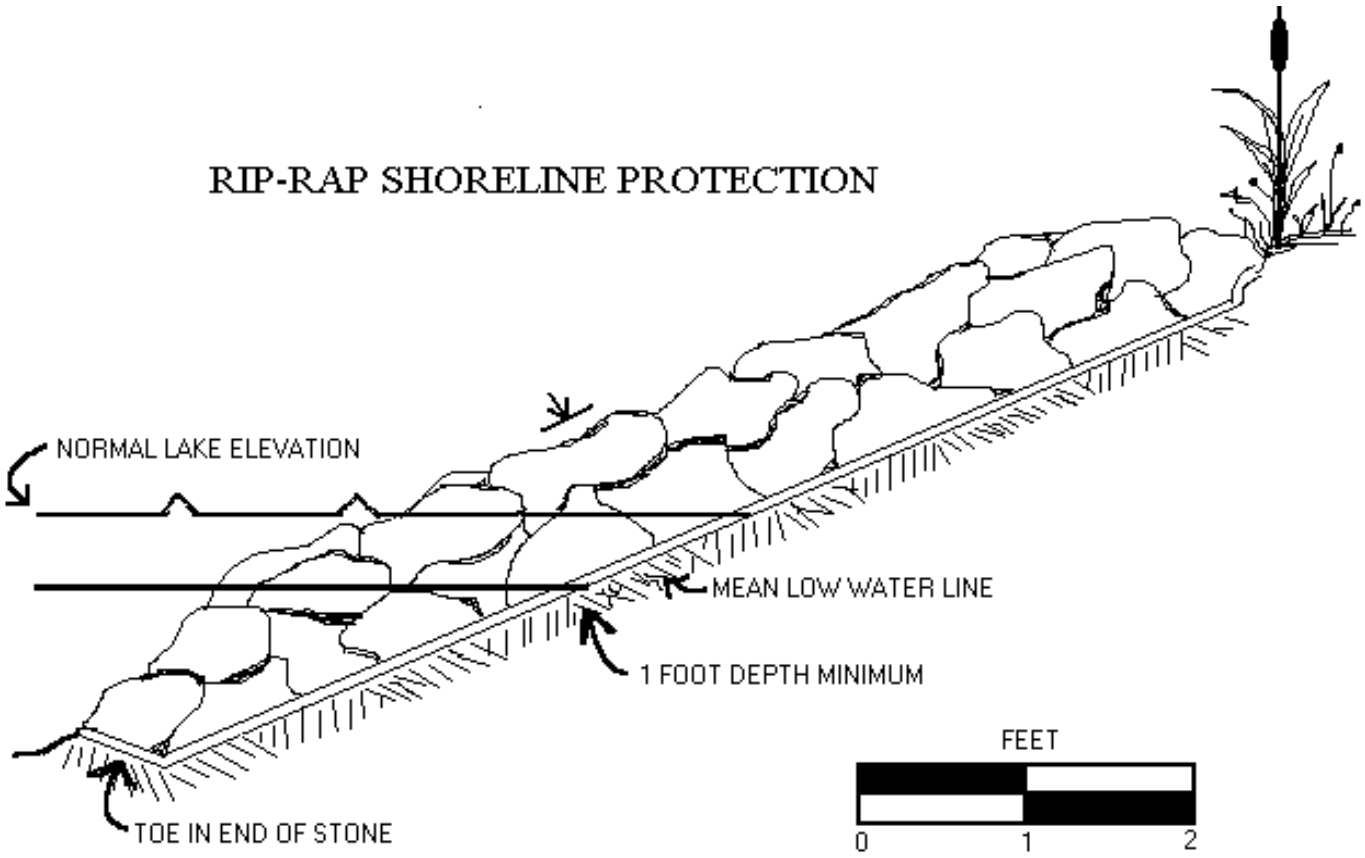
- **Springdale Aquatic Nursery and Supply**
  340 Old Quarry Lane
  P.O. Box 546
  Greenville, VA 24440-0546
  Orders: 1-800-987-5459
  Information: 1-800-337-1929
  www.springdalewatergardens.com

Contractors for Biolog Installation

- **Cardinal Landscaping**, Greg Lofton (703) 444-3311
- **Aquatic Solutions, Inc.**, David Cutlip (703) 451-1823, 1-800-944-2578

RIPRAP

Appropriate where long-term durability is needed. Should be used with soil bioengineering techniques and vegetative plantings. Filter fabric or some type of geo-textile should be placed under the rocks to prevent soil washout.



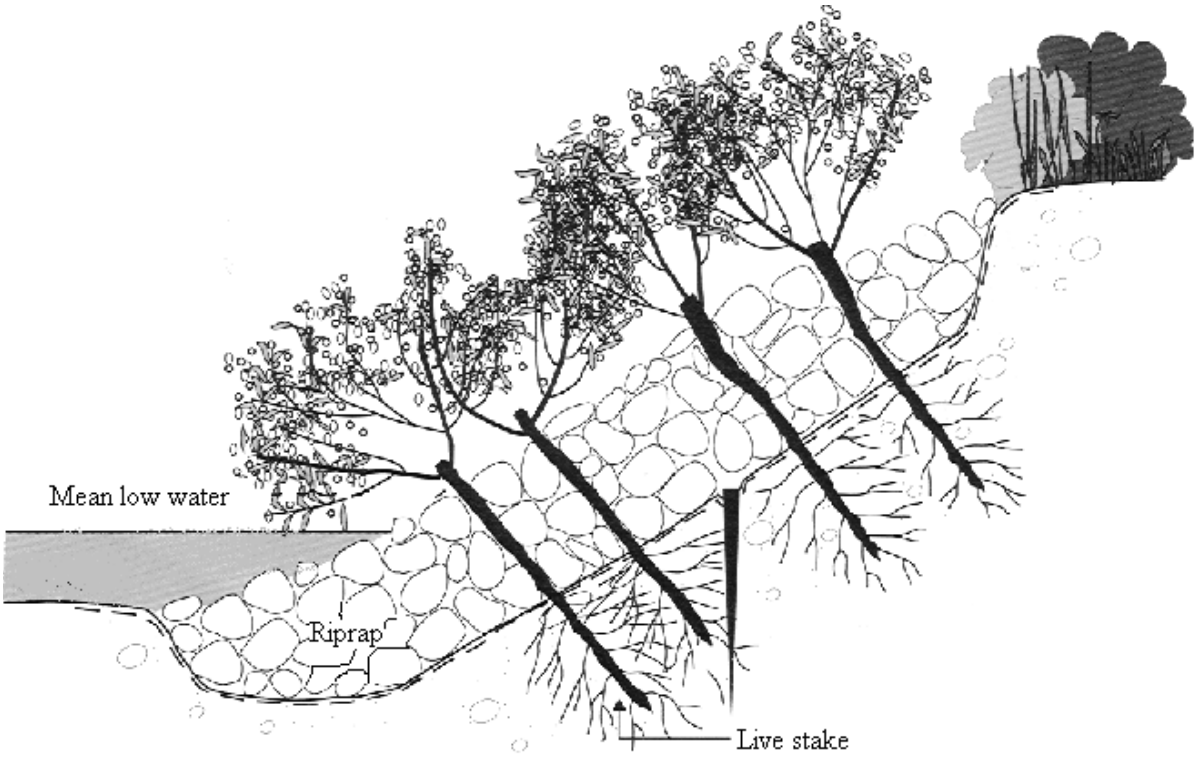
NOTES

- USE VDOT CLASS I RIP-RAP STONE OR EQUIVALENT (8”-1.5’)
- TOE IN BOTTOM (END OF STONE) IF SLOPE IS 4:1 OR STEEPER.
- STONE SHOULD EXTEND 1’ BELOW MEAN LOW (YEARLY) WATER LINE AND 1’ MINIMUM ABOVE NORMAL POOL ELEVATION.
- STONE DEPTH SHOULD BE 1’ MINIMUM.

RIPRAP WITH JOINT PLANTING

Joint planting, otherwise known as vegetated riprap, involves driving, or tamping, live plant stakes such as willows, dogwoods, or other species in the joints and spaces in between the rocks. This can be done with existing riprap structures or can be done as the rocks are being placed on the slope/shoreline. This is an excellent way to increase the aesthetic and wildlife habitat value of existing riprap. The roots of the plantings eventually form a living mat under the rocks that will reinforce the soil beneath and prevent washout of underlying sediments through open spaces. The roots further improve soil drainage.

The live stakes should be approximately 1.5" or larger in diameter and long enough to extend through the open spaces and into the soil below the riprap. The bark should be intact and side branches should be removed. The stakes should be randomly placed perpendicular to the slope of the riprap and with the growing tips protruding slightly above the top of the riprap. Before placing stakes, cut the rooting end (wider end).



USDA Natural Resource Conservation Service. 1996. Streambank and Shoreline Protection (Chapter 16 – Engineering Field Handbook). 210-vi-EFH.

Contractors

- **K & K Excavation**
  (703) 327-4470
  Contact: Keith Sayne (Owner)
  Pager (703) 423-6447

- **J D Roy Excavating Inc**.
  (703) 791-2504
  Manassas, VA
  Contact: Joe Roy

- **Brickman Group Ltd.**
  (703) 444-1700
  Sterling, VA
  Contact: Steve Cook

- **Sycamore Valley Landscaping**
  (703) 444-3969
  www.sycamorevalley.com
  Contact: David Maguire

***Additionally, many small excavation, construction, and landscape firms conduct shoreline stabilization (riprap) work.**

BULKHEADS

After consulting with several experts, both from the design and construction phases of the process, there appears to be three universally accepted methods of constructing bulkheads that will last. The first, which is generally cost prohibitive to most residents, is using driven steel H-piles with landscape timbers placed between them. The obvious drawback to this method is the need for large equipment to drive the piles.

The second method is vertically driven vinyl coated corrugated steel sheets. These last a long time, come in different colors and corrugation patterns (Z-pattern is typical) and provide a strong, but somewhat flexible barrier to help dissipate some non-direct wave energy. The cost for the materials is higher than that for timbers, resulting in a project cost that can be 25% higher than timber applications.

The third, and most widely used method on lakes, rivers, and bays, is driven vertical tongue and grooved sheeting, tied back to the land by a wale system. The important distinction between the above system and the typical method is the ability to get part (~1/2) of the structure under the mud line, thus preventing the structure from being undermined and adding considerably to its strength. Also, this method can be installed with the lake at normal pool elevation.

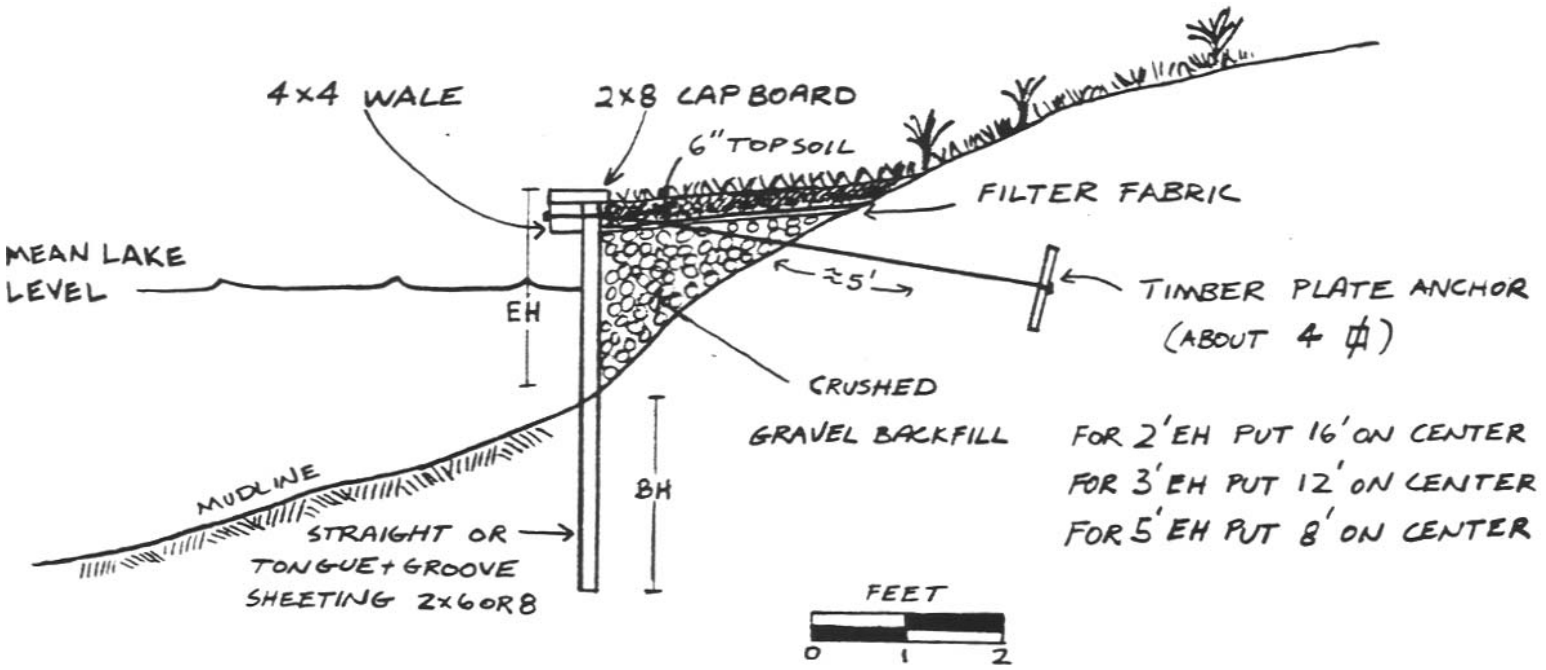
Guideline drawings for a typical timber vertical sheeting bulkhead are enclosed in this packet. Obviously, the height varies with the adjacent slope of the land and how steeply the bottom falls away. The depth to point of refusal is simply the extent to which the machine can drive the sheet, given the existing substrate material. Although this type of wall is more expensive than poorly constructed horizontal member varieties, the expected life is considerably longer, making them cost-effective over the long run. The structural integrity also minimizes maintenance required to keep the structure sound, safe, and aesthetically appealing.

Another important consideration, regardless of the type of bulkhead being considered, is the quality of the pressure treated lumber used given the constant contact with water (esp. the piles). It is important to choose lumber with an appropriate rating. The rating reveals the degree of pressure treatment and gives an indication of its longevity under certain conditions. RA encourages the use of low toxic pressure treated lumber such as ACQ, CBA or other alternatives to arsenic treated lumber (CCA).

A recent alternative to bulkheading is the use of masonry block walls, such as Keystone© or similar products. These have not been widely used, but may be applicable in certain situations. Please contact RA's watershed manager for more information.

Bulkheading, in all cases, requires Design Review Board approval and verification of property lines.

(VERTICAL SHEETING BULKHEAD
(GENERAL GUIDELINES)



NOTES

- EXPOSED HEIGHT (EH) ≤ BURIED HEIGHT (BH)
- ACQ lumber grade (.40) for Fresh Water Contact
  Hot dipped or stainless steel fasteners MUST be used with ACQ
- VERTICAL SHEETING DRIVEN UNTIL EH = BH; ABSOLUTE MINIMUM = 1 FOOT
- EACH SHEET NAILED TO WALE WITH TWO 16D GALVANIZED NAILS
- ANCHOR CABLE IS 3/8" GALVANIZED STRAND
- CAP BOARD NAILED TO WALE / WALL WITH 16D MINIMUM GALVANIZED NAILS ON 18" CENTERS
- WALE JOINTS SCABBED OR SHIP LAPPED
- FILTER FABRIC PLACED BETWEEN STONE FILL AND TOPSOIL AND ON LANDSIDE OF ANGLES IN WALL

Contractors

- CJS Enterprises, Corky Sautkulis, (703) 221-2123
- Geoscape, Ken Duffy (ASLA), (703) 716-5660