

NATURAL RESOURCES CONSERVATION SERVICE
VIRGINIA CONSERVATION PRACTICE STANDARD

STREAMBANK AND SHORELINE PROTECTION

(Ft.)

CODE 580

DEFINITION

Treatment(s) used to stabilize and protect banks of streams or constructed channels, and shorelines of lakes, reservoirs, or estuaries.

PURPOSE

To prevent the loss of land or damage to land uses, or facilities adjacent to the banks of streams or constructed channels, shoreline of lakes, reservoirs, or estuaries including the protection of known historical, archeological, and traditional cultural properties.

To maintain the flow capacity of streams or channels.

Reduce the offsite or downstream effects of sediment resulting from bank erosion.

To improve or enhance the stream corridor for fish and wildlife habitat, aesthetics, recreation.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to streambanks of natural or constructed channels and shorelines of lakes, reservoirs, or estuaries where they are susceptible to erosion. It does not apply to erosion problems on main ocean fronts, beaches or similar areas of complexity.

Sites with drainage areas that are 25 square miles or greater require approval from the State Conservation Engineer.

CRITERIA

General Criteria Applicable to All Purposes

Treatments shall be in accordance with all applicable local, state and federal laws and regulations.

Livestock exclusion is required for sites with vegetative measures. The Virginia Conservation Practice Standard *Fence (Code 382)* shall be used for all fences. Wildlife may need to be controlled during establishment of vegetative measures. Temporary and local population control methods should be used with caution and within state and local regulations. Vehicles and/or people shall be excluded during vegetative establishment, as appropriate.

Treatments applied shall seek to avoid adverse effects to endangered, threatened, and candidate species and their habitats, whenever possible.

Treatments applied shall seek to avoid adverse effects to archaeological, historic, structural, and traditional cultural properties, whenever possible.

An assessment of unstable streambank or shoreline sites shall be conducted in sufficient detail to identify the causes contributing to the instability (e.g. livestock access, watershed alterations resulting in significant modifications of discharge or sediment production, in-channel modifications such as gravel mining, head cutting, water level fluctuations, boat-generated waves, etc.).

Proposed protective treatments to be applied shall be compatible with improvements being planned or installed by others.

Protective treatments shall be compatible with the bank or shoreline materials, water chemistry, channel or lake hydraulics, and slope characteristics above and below the water line.

End sections of treatment areas shall be adequately anchored to existing treatments, terminate in stable areas, or be otherwise stabilized to prevent flanking of the treatment.

Protective treatments shall be installed that result in stable slopes. Design limitations of the bank or shoreline materials and type of measure installed shall determine steepest permissible slopes.

Designs will provide for protection of installed treatments from overbank flows resulting from upslope runoff and flood return flows.

Internal drainage for bank seepage shall be provided when needed. Geotextiles or properly designed filter bedding shall be incorporated with structural measures where there is the potential for migration of material from behind the measure.

Treatments shall be designed to account for any anticipated ice action, wave action, and fluctuating water levels.

All disturbed areas around protective treatments shall be protected from erosion. Disturbed areas that are not to be cultivated shall be protected as soon as practical after construction. The Virginia Conservation Practice Standard *Critical Area Planting (Code 342)* shall be used.

Additional Criteria for Streambanks

Stream segments to be protected shall be classified according to a system deemed appropriate by the state. Segments that are incised or that contain the 5-year, 24-hour return period (20 percent probability) or greater flows shall be evaluated for further degradation or aggradation.

A site assessment shall be performed to determine if the causes of instability are local (e.g. poor soils, high water table in banks, alignment, obstructions deflecting flows into bank, etc.) or systemic in nature (e.g. aggradation due to increased sediment from the watershed, increased runoff due to urban development in the watershed, degradation due to channel modifications, etc.). The assessment need only be of the extent and detail necessary

to provide a basis for design of the bank treatments and reasonable confidence that the treatments will perform adequately for the design life of the measure.

Changes in channel alignment shall not be made without an assessment of both upstream and downstream fluvial geomorphology that evaluates the affects of the proposed alignment.

The current and future discharge-sediment regime shall be based on an assessment of the watershed above the proposed channel alignment.

Bank protection treatment shall not be installed in channel systems undergoing rapid and extensive changes in bottom grade and/or alignment unless the treatments are designed to control or accommodate the changes.

Bank treatment shall be constructed to a depth at or below the anticipated lowest depth of streambed scour.

If the failure mechanism is a result of the degradation or removal of riparian vegetation, stream corridor restoration shall be implemented, where feasible, (see Additional Criteria for Stream Corridor Improvement) as well as treating the banks.

Toe erosion shall be stabilized by treatments that redirect the stream flow away from the toe or by structural treatments that armor the toe. Additional design guidance is found in National Engineering Handbook, Part 650, Chapter 16, Streambank and Shoreline Protection and National Engineering Handbook, Part 654, Stream Restoration Design.

Where toe protection alone is inadequate to stabilize the bank, the upper bank shall be shaped to a stable slope and vegetated, or shall be stabilized with structural or soil-bioengineering treatments.

Where rock riprap is used for bank or toe protection, undercutting by scour shall be prevented by one of the following methods of riprap placement:

- Key riprap into the bottom of the channel to a depth equal to the design riprap thickness or 2 feet (0.6m), whichever is greater, below the anticipated lowest scour line, or

- Place riprap as an apron with the design riprap thickness extending beyond the toe of the bank for a distance equal to at least five times the D_{50} size.

Riprap bank protection shall be keyed into the bank at both the upstream and downstream ends. The end keyway trenches shall extend from the toe keyway or end of the apron to the top of the protection. The end keyway trenches shall extend below the bottom of the riprap protection to a depth equal to the design riprap thickness or 2 feet (0.6m), whichever is greater.

When bank sloping is used, the banks must be stable against sliding after construction and flat enough to maintain vegetation. Side slopes shall be 2:1 or flatter unless a slope stability analysis is conducted to support using a steeper slope.

Channel clearing to remove stumps, fallen trees, debris, and sediment bars shall only be performed when they are causing or could cause unacceptable bank erosion, flow restriction, or damage to structures. Habitat forming elements that provide cover, food, pools, and water turbulence shall be retained or replaced to the extent possible. Virginia Conservation Practice Standard *Clearing and Snagging (Code 326)* shall be used.

Treatments shall be functional and stable for the design flow and sustainable for higher flow conditions.

Treatments shall not induce an increase in natural erosion.

Treatments shall not limit stream flow access to the floodplain.

Where flooding is a concern, the effects of protective treatments shall not increase flow levels above those that existed prior to installation.

Additional Criteria for Shorelines

All revetments, bulkheads or groins are to be no higher than 3 feet (1 meter) above mean high tide, or mean high water in non-tidal areas

Structural shoreline protective treatments shall be keyed to a depth to prevent scour during low water.

For the design of structural treatments, the site characteristics below the waterline shall be

evaluated for a minimum of 50 feet (15 meters) horizontal distance from the shoreline measured at the design water surface.

The height of the shoreline protection shall be designed according to TR-69: Riprap for Slope Protection Against Wave Action, TR-56: A Guide for Design and Layout of Vegetative Wave Protection for Earth Dam Embankments, or other acceptable engineering practices. As a minimum, the height of the protection shall be based on the design water surface plus the computed wave height and freeboard. The design water surface in tidal areas shall be mean high tide.

When vegetation is selected as the protective treatment, a temporary breakwater shall be used during establishment when wave run up would damage the vegetation.

Existing trees may need to be cut in order to reduce the threat of soil mass movement should the tree become uprooted. Trees should be selected for cutting based on need and in accordance with local regulations.

Additional design guidance for shoreline protection can be found in the National Engineering Handbook Part 650, Chapter 16, Streambank and Shoreline Protection.

Additional Criteria for Stream Corridor Improvement

Stream corridor vegetative components shall be established as necessary for ecosystem functioning and stability. The appropriate composition of vegetative components is a key element in preventing excess long-term channel migration in re-established stream corridors. The establishment of vegetation on channel banks and associated areas shall also be in accordance with Virginia Conservation Practice Standard *Critical Area Planting (Code 342)*.

Treatments shall be designed to achieve habitat and population objectives for fish and wildlife species or communities of concern as determined by a site-specific assessment or management plan. Objectives shall be based on the survival and reproductive needs of populations and communities, which include habitat diversity, habitat linkages, daily and seasonal habitat ranges, limiting factors and native plant communities. The type, amount,

and distribution of vegetation shall be based on the requirements of the fish and wildlife species or communities of concern to the extent possible.

Treatments shall be designed to meet aesthetic objectives as determined by a site-specific assessment or management plan. Aesthetic objectives shall be based on human needs, including visual quality, noise control, and microclimate control. Construction materials, grading practices, and other site development elements shall be selected and designed to be compatible with adjacent land uses.

Treatments shall be designed to achieve recreation objectives as determined by a site-specific assessment or management plan. Safety requirements shall be based on type of human use and recreation objectives.

CONSIDERATIONS

When designing protective treatments, consideration should be given to the changes that may occur in the watershed hydrology and sedimentation over the design life of the treatments.

Consider utilizing debris removed from the channel or streambank into the treatment design to improve benefits for fish, wildlife and aquatic systems when it is compatible with the intended purpose.

Use construction materials, grading practices, vegetation, and other site development elements that minimize visual impacts and maintain or complement existing landscape uses such as pedestrian paths, climate controls, buffers, etc. Avoid excessive disturbance and compaction of the site during installation.

Consideration should be given to selecting vegetative species with the growth potential to quickly stabilize the site. The mature size of the vegetation and its potential for future problems should also be assessed.

Shrubs are encouraged over tree species. A zone of shrubs close to the bank with larger trees farther back from the bank is the preferred planting design.

Utilize vegetative species that are native and/or compatible with local ecosystems. Avoid introduced, invasive, noxious or exotic species that could become nuisances. Consider species

that have multiple values such as those suited for biomass, nuts, fruit, browse, nesting, aesthetics and tolerance to locally used herbicides. Avoid species that may be alternate hosts to disease or undesirable pests. Species diversity should be considered to avoid loss of function due to species-specific pests. Species on noxious plant lists should not be used.

Select plant materials that provide habitat requirements for desirable wildlife and pollinators. The addition of native forbs and legumes to grass mixes will increase the value of plantings for both wildlife and pollinators.

Treatments that promote beneficial sediment deposition and the filtering of sediment, sediment-attached, and dissolved substances should be considered.

Consider maintaining or improving the habitat value for fish and wildlife by including treatments that provide aquatic habitat in the treatment design and that may lower or moderate water temperature and improve water quality.

Consider the need to stabilize side channel inlets and outlets and outlets of tributary streams from erosion.

Consider aquatic habitat when selecting the type of toe stabilization.

Consider maximizing adjacent wetland functions and values with the project design and minimize adverse effects to existing wetland functions and values.

When appropriate, establish a buffer strip and/or diversion at the top of the bank or shoreline protection zone to help maintain and protect installed treatments, improve their function, filter out sediments, nutrients, and pollutants from runoff, and provide additional wildlife habitat.

Consider conservation and stabilization of archeological, historic, structural and traditional cultural properties when applicable.

Consider safety hazards to boaters, swimmers, or people using the shoreline or streambank when designing treatments.

Protective treatments should be self-sustaining or require minimum maintenance.

When protecting shorelines from erosion, consider "Living Shoreline" techniques. The technique consists of placing plants, stone, sand

fill land plants and grasses, shrubs, and trees at various points along the water line.

PLANS AND SPECIFICATIONS

Plans and specifications for streambank and shoreline protection shall be prepared for specific field sites and based on this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

Plans shall include treatments to minimize erosion and sediment production during construction and provisions necessary to comply with conditions of any environmental agreements, biological opinions or other terms of applicable permits.

Record all required information in an engineer field book, on a plan sheet or design computation sheet, or in another appropriate location.

DESIGN DATA

1. Completed Environmental Evaluation and subsequent requirements.
2. Site investigation report with supporting data including flow information, channel materials, source of streambank or shoreline instability (if known), land use upstream and downstream, activities in the watershed impacting the stream, etc. Include photographs.
3. Soils investigation.
4. Survey and plot data: profile, cross-sections, topography, as needed.
5. Design computations, including purpose of practice and references used.
6. Plan view of site with existing features; location of treatment(s), including planting areas; location of borrow area(s) if on site; location of disposal area (s) if on site; and apparent property lines and owners.
7. Planned cross sections.
8. For streambanks, include velocities, water surface profiles, and other geomorphic parameters as required for permit(s).
9. For shoreline, include fetch and wave height.
10. Standard Cover Sheet (VA-SO-100A).
11. Materials and quantities needed. Identify borrow material and/or spoil area, as needed.
12. Vegetation and/or ground cover requirements.
13. Identification of needed Erosion & Sediment Control measures.
14. Supplemental practices required.
15. Virginia Conservation Practice Specifications (700 Series).
16. Operation and Maintenance Plan.

CHECK DATA

1. As-built survey.
2. As-built plans including dimensions, types and quantities of materials installed, and variations from design. Include justification for variations.
3. Locations of appurtenant practices.
4. Adequacy of vegetation and/or ground cover.
5. Complete as-built section of Cover Sheet.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be prepared for use by the owner or others responsible for operating and maintaining the system. The plan shall provide specific instructions for operating and maintaining the system to ensure that it functions properly. It shall also provide for periodic inspections and prompt repair or replacement of damaged components or erosion.

REFERENCES

NEH Part 650, Chapter 16, Streambank and Shoreline Protection.

USDA-Natural Resources Conservation Service. National Engineering Handbook, Part 653. Stream Corridor Restoration: Principles, Processes, and Practices. October 1998.

USDA-Natural Resources Conservation Service. Electronic Field Office Technical Guide

(eFOTG), Section IV [Online]. Available at <http://www.nrcs.usda.gov/technical/eFOTG>.

USDA-Natural Resources Conservation Service. National Engineering Handbook, Part 650. Chapter 16, Streambank and Shoreline Protection, December 1996.

USDA-Natural Resources Conservation Service. *Plant Establishment Guide for Virginia*. October 2001.

USDA-Natural Resources Conservation Service. Technical Release 69: *Riprap for Slope Protection Against Wave Action*. May 1983.

USDA-Natural Resources Conservation Service. Technical Release 56: *A Guide for Design and Layout of Vegetative Wave Protection for Earth Dam Embankments*. December 1974.

USDA-Natural Resources Conservation Service. Virginia 700 Series Construction Specifications. [On-line]. Available at <http://www.nrcs.usda.gov/technical/eFOTG>.

USDA-Natural Resources Conservation Service. National Engineering Manual, Part 501, Subpart E, Assistance on Shoreline Erosion Control, Section 501.51 Scope.

Virginia Department of Environmental Quality Office of Wetlands and Water Protection. Joint Permit Application. [Online]. Available at <http://www.deq.state.va.us/wetlands/>

College of William and Mary, Virginia Institute of Marine Science, Center for Coastal Resources Management, Living Shorelines [Online]. Available at <http://ccrm.vims.edu/livingshorelines/index.html>

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