

**NATURAL RESOURCES CONSERVATION SERVICE**  
**CONSERVATION PRACTICE STANDARD**  
**RIPARIAN FOREST BUFFER**

(Ac.)

**CODE 391**

**DEFINITION**

An area predominantly trees and/or shrubs located adjacent to and up-gradient from watercourses or water bodies.

**PURPOSES**

This practice will develop native riparian vegetation to accomplish one or more of the following purposes:

- Reduce excess amounts of sediment, organic material, nutrients and pesticides in surface runoff.
- Reduce excess nutrients and other chemicals in shallow ground water flow.
- Create shade to lower or maintain water temperatures to improve habitat for aquatic organisms.
- Create or improve habitat for riparian dependent wildlife, and provide a source of detritus and large woody debris to the water body for aquatic organisms.
- Increase carbon storage in plant biomass and soils.
- Reduce risk of airborne pesticide drift entering the water body.

**CONDITIONS WHERE PRACTICE APPLIES**

Riparian forest buffers are applied on stable areas adjacent to permanent or intermittent streams, rivers, lakes, ponds, and wetlands that flood or pond.

**CRITERIA**

**General Criteria Applicable to All Purposes**

In all circumstances, the practice shall be at least 35 feet wide. The width is measured horizontally on a line perpendicular to the top of

the bank for streams and rivers, or the normal water line for other water bodies.

In all circumstances, the buffer shall consist of a Zone 1 and Zone 2 meeting or exceeding the following criteria:

ZONE 1	ZONE 2
- 15 ft., closest to water	- 20 ft., up-slope of Zone 1
- 2 species deciduous tree or shrub	- 1 specie of tree or shrub

The two vegetation zones are differentiated in order to reflect Zone 2's capability of supporting more intense management than Zone 1.

Zone 1 vegetation criteria may be specified for Zone 2, when that satisfies the landowner's objective.

Overland flow moving through the buffer shall be maintained as sheet (non-channelized) flow to the greatest extent possible. Unavoidable concentrated surface flows (for example ditches and streams) passing through the buffer shall be conveyed through stable (non-eroding) paths.

Erosion shall be controlled up-gradient of Zone 2, to the extent that sediment is not likely to damage the buffer's understory vegetation.

Trees and shrubs specified shall be native and adapted to the site conditions.

Trees and shrubs may be already established, naturally regenerated, planted, or seeded according to the NRCS-NC practice standard Tree/Shrub Establishment (612). An on-site technical determination is required to verify the seed source of desired trees is adequate for natural regeneration.

Site preparation shall be done according to NRCS-NC Tree/Shrub Site Preparation (490) practice standard.

Soil protecting cover shall be conserved or planted while the practice is being established.

Periodic removal of some forest products such as high value trees, medicinal herbs, nuts, and fruits is permitted provided the intended purpose is not compromised by the loss of vegetation or harvesting disturbance.

Livestock shall be controlled or excluded as necessary to achieve the intended purpose. Refer to the NC NRCS practice standards Prescribed Grazing, 528, and/or Access Control, 472.

This practice shall be installed, operated and maintained according to federal, state and local laws and regulations.

**Additional Criteria to Reduce Excess Amounts of Sediment, Organic Material, Nutrients and Pesticides in Surface Runoff**

Sediments contained in surface runoff are likely to have adsorbed nutrients (especially phosphorous) as well as pesticide particulates that are harmful to surface water quality. Research data shows that the most effective sediment trapping method is the use of grassy strips upslope from the tree portion of the buffer.

Overland flow passing through the buffer will be maintained as sheet (non-channelized) flow to the greatest extent possible in order to prolong the water's contact with the buffer.

Establish a Zone 3 (Filter Strip) up gradient of Zones 1 meeting or exceeding NRCS NC Filter Strip (393) practice standard and the following table:

<b>ZONE 1</b>	<b>ZONE 2</b>	<b>ZONE 3</b>
- 15 ft., closest to water	- 20 ft., up-slope of Zone 1	- 20 ft., up-slope of Zone 2
- 2 species deciduous tree or shrub	- 1 specie of tree or shrub	- 1 specie perennial grass

The Zone 3 criterion may be satisfied by specifying appropriate operation and maintenance of an existing strip of vegetation meeting or exceeding the requirements of NRCS NC Filter Strip (393) practice standard.

When drainage ditches bisect the buffer, determine if additional filter strips need to be installed beside the ditches to thoroughly

address pollutants in surface runoff that will not enter the riparian buffer.

**Additional Criteria to Reduce Excess Nutrients and Other Chemicals in Shallow Ground Water Flow**

Nitrates are recognized as the primary pollutant concern in shallow ground water flow in agricultural situations. In order for nitrates to be filtered before reaching surface water, the ground water must pass through a zone of high biological activity in the root zone of actively growing plants. Plant roots either take up nitrates for plant growth, or provide a catalyst for denitrification. Denitrification occurs almost exclusively in water-saturated zones with copious amounts of organic matter. So it is important to manage and maximize saturated conditions within the riparian zone.

If a drain tile or ditch passes through the buffer, at least one of the following measures shall be specified:

- Remove or plug drain tile or ditch.
- Install a regulating structure on drain tile or ditch to raise the water table into the buffer root zone. Specify appropriate operation and maintenance of the structure. Apply NC NRCS practice standards 587, Structure for Water Control, and 554, Drainage Water Management to satisfy this criterion.
- Restore the channel's natural geomorphology. Apply NRCS NC Open Channel (582) practice standard to satisfy this criterion.

Specifications for water table management in the buffer shall not impair the existing use or management of land outside the buffer, unless consistent with landowner's objective.

**Additional Criteria to Create Shade to Lower or Maintain Water Temperatures to Improve Habitat for Aquatic Organisms.**

Establish buffers on the side of the water body with greatest solar exposure, if feasible.

Buffers adjacent to a stream shall have a width equal to or greater than the stream channel's width.

Buffers adjacent to lakes, ponds and wetlands shall be at least 35 ft. wide.

Deciduous trees/shrubs shall be specified for at least 50% of the buffer width.

**Additional Criteria to Create or Improve Habitat for Riparian Dependent Wildlife and Provide a Source of Detritus and Large Woody Debris to the Water body for Aquatic Organisms.**

Riparian dependent wildlife are organisms that require a high water table or flooding to complete part of their life cycle. Examples of riparian wildlife include caddisfly, crayfish, frog, salamander, turtle, wood duck, mink, and river otter. Use the following vegetation and widths to meet the habitat requirements of riparian wildlife:

**Vegetation**

Deciduous trees/shrubs shall be specified for at least 50% of the Zone 2 area.

Deciduous trees and shrubs may be specified for all of Zone 2, when that meets habitat requirements for species of concern to the landowner.

Trees and shrubs shall be established in mixed stands, alternating rows of species, or small single species blocks to provide habitat diversity.

**Width**

In addition to the general width criteria (35 ft.), buffers designed for this purpose may extend outward from the water body, to a width based on client objectives and targeted wildlife needs.

Although not required, the buffer may extend to the toe of the terrace slope and include the entire flood prone area.

At locations where flooding rarely occurs outside of the channel, lake, pond or wetland, buffer widths exceeding 100 ft. are not essential for this purpose.

**Additional Criteria to Increase Carbon in Plant Biomass and Soils**

For optimal carbon sequestration, native plants (or mixtures of native plants) that grow rapidly shall be established at the full stocking rate specified in NRCS NC Tree/Shrub Establishment (612) practice standard.

Calculate predicted carbon sequestration rates using current, approved carbon sequestration modeling technology.

**Additional Criteria to Reduce Risk of Airborne Pesticide Drift Entering the Water Body**

Include this practice as a mitigating technique in a pest management plan.

Vegetation with fine or needle-like leaves will be planned as primary buffer plant varieties.

Vegetation selected for this purpose must be tolerant of chemical applied to adjacent cropland areas.

Primary buffer vegetation must be a minimum of twice the height of the typical adjacent crop.

Apply specific, chemical and crop specific management in conjunction with the riparian forest buffer.

The buffer width must be a minimum of 100' to reduce water quality risk.

**CONSIDERATIONS**

Consider extending the width of the buffer in high nutrient, sediment, and animal waste application areas, where the contributing area is not adequately treated or where an additional level of protection is needed.

Ecological functions of this practice will be maximized when it is used in combination with conservation practices that reduce non-point source pollution in the adjacent field or pasture draining into the buffer.

Research results have shown that nutrient cycling (removal of ammonia and nitrates) within small headwater streams is most effective when streams and stream bottoms have high organic carbon contents. Organic carbon promotes bacterial activity which leads to an increase in utilization and transformation of nitrogen in the stream.

When water table control is used in the buffer, a high water table in the riparian buffer may limit future land use and management.

Root damage to perforated tile or any low strength pipe left in the buffer area is likely to occur over time.

If beaver activity is observed in the buffer vicinity, specify reasonable protective measures for water table control structures.

Consider specified plant materials' tolerance to herbicides used in the adjacent field or pasture.

Discourage black walnut establishment close to the water's edge. Black walnut produces a chemical that suppresses growth of other vegetation.

Avoid specification of tree and shrub species that may be hosts to undesirable pests.

Switchgrass provides excellent filtering, bio-accumulation and wildlife habitat functions on moist to wet soil. Consider specifying Switchgrass (if adapted) as a Zone 3 planting on sites with full sun exposure.

Complimentary wildlife management actions in the buffer may include managing wildlife openings (in Zone 2), forest harvest strategies, creating snags, leaving large downed logs, constructing vernal pools, and managing native grasses (in Zone 3).

The buffer may be used to link habitats across the planning area or landscape.

Carbon accumulation occurs most rapidly in forests managed for rapid growth.

Consult a professional for current research on adapted plants that sequester carbon most efficiently.

Carbon sequestration benefits increase when trees are managed for durable, lumber products over a longer rotation.

## PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes, and narrative statements in the conservation plan (including references to plans prepared by other agencies or consultants), or other acceptable documentation.

Minimum documentation shall include:

A narrative or job sheet indicating:

- a. The practice's intended purpose.
- b. Buffer width including widths of each zone.
- c. Site preparation and planting method(s), and equipment to be used.
- d. Site specific needs for soil amendments, cultural, pest management or other practices.
- e. Plant material to be planted by zone.
- f. Plant spacing and arrangement.

- g. Required operation and maintenance instructions.
- h. Requirement to comply with all federal, state and local laws.

A map indicating location:

- a. Where riparian buffer will be established.
- b. Streams and water bodies buffered.
- c. Sensitive resource areas that need special care during site preparation activities.

## OPERATION AND MAINTENANCE

The following actions shall be carried out to ensure that this practice functions as intended. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance).

- Inspect the buffer for seedling mortality during the two years following planting. Replace dead seedlings to maintain at least 75% survival, and do not leave two adjacent dead seedlings.
- Protect the buffer from herbicide damage, especially from adjacent cropland. Use directed sprays and management strategies to control drift as specified in NRCS NC practice standard 595 Pest Management.
- Livestock access to the buffer shall be managed to ensure no damage to soil, water or plants occurs in the buffer.
- Inspect the riparian forest buffer periodically and repair damage from traffic, pest infestations and erosion.
- Any harvest or management of forest products must not compromise the buffer's ability to address the specified purpose(s). Utilize NRCS NC Forest Stand Improvement (666) practice standard, when trees in the buffer will be managed.

## REFERENCES

- Riparian Buffers and Controlled Drainage to Reduce Agricultural Nonpoint Source Pollution*, NC State University Technical Bulletin 318, September 2002.  
[http://www.soil.ncsu.edu/lockers/Osmond\\_D/web/RiparianBuffers.pdf](http://www.soil.ncsu.edu/lockers/Osmond_D/web/RiparianBuffers.pdf)
- Riparian Forest Buffer Design, Establishment and Maintenance (Fact Sheet 725)*, University of Maryland Cooperative Extension Service. 1999.

<http://www.agnr.umd.edu/MCE/Publications/Publication.cfm?ID=13>

*Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers*, U.S. Forest Service Northeastern Area, June 1998.

<http://www.chesapeakebay.net/pubs/subcommittee/nsc/forestry/handbook.htm>

*Control of Nitrogen Export from Watersheds by Headwater Streams*, Bruce J. Peterson, et al, Science Magazine Vol. 292, April 2001.

<http://www.sciencemag.org/cgi/content/full/292/5514/86>

*Field Office Technical Guide, NRCS North Carolina*. All supporting NRCS conservation practices cited in this standard.

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