

**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.

PURPOSE

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

CONDITIONS WHERE PRACTICE APPLIES

Riparian forest buffers are applied on stable areas adjacent to permanent or intermittent streams, lakes, ponds, wetlands, and areas with groundwater recharge that are capable of supporting woody vegetation.

CRITERIA

General Criteria Applicable to All Purposes

Position and design the riparian forest buffer to achieve sufficient width, length, vertical structure/density and connectivity to accomplish the intended purpose(s).

Dominant vegetation will consist of existing, naturally regenerated, or seeded/planted trees and shrubs suited to the soil and hydrology of the site and the intended purpose(s).

The vegetation will extend a minimum width of 35 feet for all purpose(s). Measurement shall begin at and perpendicular to the normal water line, bank-full elevation, or the top of the bank, as determined locally.

Maintain overland flow through the riparian area as sheet flow.

Control excessive sheet-rill and concentrated-flow erosion in the areas immediately adjacent to and up-gradient of the buffer site.

Use tree and shrub species that are native and non-invasive. A Tennessee Department of Agriculture, Division of Forestry forester or NRCS forester or biologist may approve substitution with improved and locally adapted cultivars or purpose-specific species. For plantings and seeding, use only viable, high-quality and adapted plant materials.

Favor tree and shrub species that have multiple values such as those suited for timber, nuts, fruit, florals, browse, nesting, and aesthetics.

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.

Complete necessary site preparation and planting at a time and manner to ensure survival and growth of selected species for achieving the intended purpose(s). Follow NRCS conservation practice (490) Tree and Shrub Site Preparation. Any whole fields or portions of fields that contain sod grasses (tall fescue, orchardgrass, bermudagrass, etc.) will be controlled with herbicide in their entirety over the area the sodgrasses are present before tree planting. Simply spraying the row areas where the trees or shrubs will be planted is insufficient.

Control or exclude livestock as necessary to achieve the intended purpose. Refer to the NRCS standards Prescribed Grazing, 528, and/or Access Control, 472, as applicable.

As necessary, control or eliminate harmful plant and animal pests present on the site to achieve and maintain the intended purpose. If pesticides are used, refer to the appropriate

NRCS standard Brush Management, 314, or Herbaceous Weed Control, 315.

Both zones 1 and 2 are required for all riparian buffers.

Zone 1 begins at the normal water line, or at the top of the bank, and extends a minimum distance of 15 feet, measured horizontally on a line perpendicular to the water body.

Zone 2 will begin at the edge and up-gradient of Zone 1 and extend a minimum distance of 20 feet, measured horizontally on a line perpendicular to the water body.

Three hard mast species must be included in Zone 1 and Zone 2 combined.

To achieve optimum interspersed, plant at least 2 species per row alternating species within the row.

Natural regeneration may be used to address small odd areas that are less than 1/2 acre in size that are inaccessible to spray equipment.

Comply with applicable federal, state and local laws and regulations during the installation, operation (including harvesting activities), and maintenance of this practice.

Additional Criteria to Stabilize Streambanks

Select or maintain species in Zone 1 that have medium/rapid growth characteristics.

Require high plant densities with 8 x 8 spacing or closer to increase root density and streambank stability.

Correct problems with severely leaning trees that might contribute to potential unstable banks. When correcting these problems, tree root wads should remain in the streambank if a leaning tree is removed.

Tree and shrub planting in the area next to a stream will help stabilize the streambank in the future. Treat the streambank if it is unstable using the NRCS standard Streambank and Shoreline Protection (580).

Additional Criteria to Reduce Excess Amounts of Sediment, Organic Material, Nutrients and Pesticides in Surface Runoff and Reduce Excess Nutrients and Other Chemicals in Shallow Ground Water Flow

The minimum combined width of Zones 1 and 2 will be 100 feet or 30 percent of the floodplain, whichever is less, but not less than 35 feet.

Zone 2 will be expanded 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 desired.

Add the herbaceous Zone 3 to the riparian buffer to address concentrated flow erosion and maintain sheet flow. Use native grass-based options from NRCS standard Filter Strip, 393, to design Zone 3.

Existing, functional underground drains through the riparian area will pass pollutants directly to the outlet. To filter such pollutants, plug, remove, or replace drains with perforated pipe/end plugs or water control structures (see NRCS standard Structure for Water Control, 587) to allow passage and filtration of drain water through the riparian forest root zone. Caution is advised that saturated conditions in the riparian and adjacent areas may limit existing land use and management. If planting, species selection should be based on suitability to saturated conditions.

Additional Criteria to Create or Improve Riparian Habitat and Provide a Source of Detritus and Large Woody Debris.

Extend the buffer width to meet the minimum habitat requirements of the target wildlife or aquatic species.

Establish plant communities that address the target aquatic and terrestrial wildlife and pollinator needs and have multiple values such as habitat, nutrient uptake and shading. The establishment of diverse native woody and herbaceous species will enhance wildlife and pollinator values.

Additional Criteria for Increasing Carbon Storage in Biomass and Soils

Maximize width and length of the riparian forest buffer.

The species and plant communities that attain biomass more quickly will sequester carbon faster. The rate of carbon sequestration is enhanced as riparian plants mature and soil organic matter increases.

Select plants that have higher rates of carbon sequestration in soils and plant biomass and are

adapted to the site to assure strong health and vigor. Plant the appropriate stocking rate for the site.

CONSIDERATIONS

Assess the severity of bank erosion, concentrated flow erosion, or mass soil movement and its influence on existing or potential riparian trees and shrubs. Watershed level or contributing area treatment or bank stability activities may be needed before establishing a riparian forest buffer. Where concentrated flow erosion and sedimentation cannot be controlled with vegetation, consider structural or mechanical treatments.

In tree plantings, consider including one of the hard mast species from the red oak family and one from the white oak family.

Avoid tree and shrub species which may be alternate hosts to undesirable pests. Consider species diversity to avoid loss of function due to species-specific pests.

Consider marking the buffer boundary to prevent encroachment by cropping equipment.

Using seed and/or seedlings collected or propagated from multiple sources can increase genetic diversity.

Consider selecting species with tolerance to herbicide leakage from adjoining fields.

Consider matching tree species with site-specific conditions. See UT PB 1800, A Guide for Matching Oak Species with Sites during Restoration of Loess-influenced Bottomlands in the West Gulf Coastal Plain.

Before planting, consider the need to break compacted subsurface soil layers to aid in tree/shrub establishment.

Consider allelopathic impacts of plants.

The location, layout and density of the buffer should complement natural features and mimic natural riparian forests.

For sites where continued function of drains is desired, woody root penetration may eventually plug the underground structure. In these cases, a setback of woody vegetation planted over the drain maintained in herbaceous cover or using rigid, non-perforated pipe will minimize woody root penetration.

If detrimental wildlife activity (e.g. beaver dams or heavy deer browse) is observed in the buffer

vicinity, specify reasonable protective measures for trees/shrubs and for water table control structures.

Maximize widths, lengths, and connectivity of riparian forest buffers.

Plants that deplete ground water should be used with caution in water-deficit areas.

PLANS AND SPECIFICATIONS

Prepare and record specifications for applying this practice for each site using approved specification sheets, implementation requirements, technical notes, and narrative statements in the conservation plan, or other acceptable documentation.

Procedures, technical details, and other information listed below provide additional guidance.

BUFFER WIDTH GUIDE FOR SELECTED BENEFITS

Use the following chart in planning the minimum horizontal buffer width beginning from the water line.

Purpose	Minimum Buffer Width (Feet)
Sediment Filtering	35
Aquatic Habitat Protection	40
Soluble Nutrients Removal	50

The buffer widths listed below benefit the targeted wildlife, include the sum of the buffer on one or both sides of the water body, and may extend beyond the riparian boundary.

Targeted Species	Minimum Buffer Width (Feet)
Amphibians	100
Deer	200
Small Mammals	300
Cavity Nesting Ducks	600

PLANT LIST

Table 1 lists woody plant species commonly associated with riparian areas and suitable for establishment. Key attributes are listed for

each plant to assist in designing a buffer that can achieve the planned purposes and in selecting the proper species for the site. This list is not all inclusive; other species may be approved by a Tennessee Department of Agriculture, Division of Forestry forester or NRCS forester or biologist.

PLANTING DENSITIES

Initial spacing between plants will depend on the primary benefits the planting is designed to achieve. Table 1 lists the recommended seedling plant spacing for the commonly desired buffer benefits. Tree rows should parallel the stream or water body and on the contour as nearly as possible.

CARE, HANDLING, SIZE, AND PLANTING REQUIREMENTS FOR WOODY PLANTING STOCK

Follow the NRCS standard Tree and Shrub Establishment, 612, when using woody planting stock.

SITE PREPARATION

Follow the NRCS standard Tree and Shrub Site Preparation, 490, for proper site preparation methods.

OPERATION AND MAINTENANCE

Inspect the riparian forest buffer periodically and protect from adverse impacts such as excessive

vehicular and pedestrian traffic, pest infestations, concentrated flows, pesticides, livestock or wildlife damage and fire.

Inspect the buffer for seedling mortality during the two years following planting. Replace dead seedlings to maintain at least 60% survival, and do not leave two adjacent dead seedlings.

Any manipulation of species composition, stand structure and stocking by cutting or killing selected trees and understory vegetation shall sustain the intended purpose(s). Refer to the standard Forest Stand Improvement, 666.

Any use of fertilizers, pesticides, and other chemicals shall not compromise the intended purpose.

REFERENCES

Bentrup, Gary. 2008. [Conservation buffers: design guidelines for buffers, corridors, and greenways.](#) Gen. Tech. Rep. SRS-109. Asheville, NC: Department of Agriculture, Forest Service, Southern Research Station.

Merker, David and Don Tyler. A Guide for Matching Oak Species with Sites during Restoration of Loess-influenced Bottomlands in the West Gulf Coastal Plain. University of Tennessee Extension Publication 1800. <http://utextension.tennessee.edu/>

TABLE 1 - WOODY PLANTS FOR RIPARIAN AREAS

PLANT COMMON/SCIENTIFIC NAME	ATTRIBUTES		PLANTS/ACRE (SPACING-Feet)	
	FLOOD TOLERANCE	BENEFITS	MINIMUM	MAXIMUM
EVERGREEN TREES				
Loblolly Pine - <i>Pinus taeda</i>	M	A T	436 (10x10)	681 (8x8)
Shortleaf Pine - <i>Pinus echinata</i>	M	A T	436 (10x10)	681 (8x8)
Virginia Pine - <i>Pinus virginiana</i>	M	A T	436 (10x10)	681 (8x8)
White Pine - <i>Pinus strobus</i>	M	A T	436 (10x10)	681 (8x8)
Eastern Hemlock - <i>Tsuga canadensis</i>	M	A T	436 (10x10)	681 (8x8)
DECIDUOUS TREES				
Baldcypress - <i>Taxodium distichum</i>	VH	A T	436 (10x10)	681 (8x8)
Black Willow - <i>Salix nigra</i>	VH	A	436 (10x10)	681 (8x8)
Swamp White Oak - <i>Quercus bicolor</i>	VH	A T W	302 (12x12)	436 (10x10)
Water Tupelo - <i>Nyssa aquatica</i>	VH	A T W	302 (12x12)	436 (10x10)
Blackgum - <i>Nyssa sylvatica</i>	H	A T W	302 (12x12)	436 (10x10)
Cherrybark Oak - <i>Quercus falcata</i> v. pag.	H	A T W	302 (12x12)	436 (10x10)
Nuttall Oak - <i>Quercus nutallii</i>	H	A T W	302 (12x12)	436 (10x10)
Persimmon - <i>Diospyros virginiana</i>	H	T W	302 (12x12)	436 (10x10)
Pin Oak - <i>Quercus palustris</i>	H	A W T	302 (12x12)	436 (10x10)
River Birch - <i>Betula nigra</i>	H	A	436 (10x10)	681 (8x8)
Swamp Chestnut Oak - <i>Quercus michauxii</i>	H	A T W	302 (12x12)	436 (10x10)
Water Oak - <i>Quercus nigra</i>	H	A T W	302 (12x12)	436 (10x10)
White Ash - <i>Fraxinus americana</i>	H	A T W	302 (12x12)	436 (10x10)
Willow Oak - <i>Quercus phellos</i>	H	A T W	302 (12x12)	436 (10x10)
Hickory - <i>Carya spp.</i>	M	T W	302 (12x12)	436 (10x10)
Northern Red Oak - <i>Quercus rubra</i>	M	A T W	302 (12x12)	436 (10x10)
Shumard Oak - <i>Quercus shumardii</i>	M	A T W	302 (12x12)	436 (10x10)
Southern Red Oak - <i>Quercus falcata</i>	M	A T W	302 (12x12)	436 (10x10)
Yellow Poplar - <i>Liriodendron tulipifera</i>	M	T W	302 (12x12)	436 (10x10)
SHRUBS				
Buttonbush	VH	A W	1,210 (6x6)	2,722 (4x4)
Smooth Alder - <i>Alnus serrulata</i>	H	A W	681 (8x8)	1,210 (6x6)
Black Alder - <i>Alnus glutinosa</i>	H	A W	681 (8x8)	1,210 (6x6)
Silky Dogwood - <i>Cornus amomum</i>	H	A W	1,210 (6x6)	2,722 (4x4)
Crabapple - <i>Malus angustifolia</i>	M	B W	681 (8x8)	1,210 (6x6)
Wild Apple - <i>Malus coronaria</i>	M	B W	681 (8x8)	1,210 (6x6)
Hawthorn - <i>Crataegus spp.</i>	M	B W	681 (8x8)	1,210 (6x6)
Chickasaw Plum - <i>Prunus angustifolia</i>	M	B W	681 (8x8)	1,210 (6x6)
Wild Plum - <i>Prunus americana</i>	M	B W	681 (8x8)	1,210 (6x6)
Indigobush - <i>Amorpha fruticosa</i>	M	B W	1,210 (6x6)	2,722 (4x4)
Flowering Dogwood - <i>Cornus florida</i>	M	B W	681 (8x8)	1,210 (6x6)
Gray Dogwood - <i>Cornus racemosa</i>	M	A B W	681 (8x8)	1,210 (6x6)
Roughleaf Dogwood - <i>Cornus drummondii</i>	M	A B W	681 (8x8)	1,210 (6x6)
Am. Beautyberry - <i>Callicarpa Americana</i>	M	A B W	1,210 (6x6)	2,722 (4x4)
Viburnum - <i>Viburnum spp.</i>	M	A B W	681 (8x8)	1,210 (6x6)
Wild Hydrangia - <i>Hydrangia arborescens</i>	M	A B W	1,210 (6x6)	2,722 (4x4)
Strawberry-bush - <i>Euonymus americana</i>	M	A B W	1,210 (6x6)	2,722 (4x4)

FLOOD TOLERANCE:

VH = VERY HIGH
H = HIGH
M = MODERATE

BENEFITS:

A = AQUATIC
T = TIMBER
W = WILDLIFE

Species not listed in Table 1 must be approved by a Tennessee Department of Agriculture, Division of Forestry forester or NRCS forester or biologist.

NRCS, TN
December 2013