



United States Department of Agriculture

**Natural Resources Conservation Service**  
**CONSERVATION PRACTICE STANDARD**  
**RIPARIAN FOREST BUFFER**

**Code 391**

**(Ac)**

**DEFINITION**

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

**PURPOSES**

- 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 areas adjacent to permanent or intermittent streams, lakes, ponds, and wetlands. They are not applied to stabilize stream banks or shorelines.

**CRITERIA**

**General Criteria Applicable to All Purposes**

**For all purposes, the minimum width of a riparian forest buffer shall be at least 35 feet measured horizontally on a line perpendicular to the water body beginning at the normal water line, bank-full elevation, or the top of bank.**

The riparian forest buffer shall be positioned appropriately and designed to achieve sufficient width, length, vertical structure/density and connectivity to accomplish the intended purpose(s).

Dominant *climax* 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 to achieve the 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.

Overland flow through the riparian area will be maintained as sheet flow.

For sites to be regenerated or planted, excessive sheet-rill and concentrated-flow erosion will be controlled.

**NRCS, NHCP**  
**July 2010**

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service [State Office](#) or visit the [electronic Field Office Technical Guide](#).

**NRCS, WV**  
**May 2016**

Excessive sheet-rill and concentrated-flow erosion will be controlled in the areas immediately adjacent and up-gradient of the buffer site.

**Tree and Shrub List for West Virginia located in WV Field Office Technical Guide (FOTG), Section IV, Tools, lists some trees and shrubs associated with and suited for forested riparian areas. Review the key attributes for each species to assist in selection and the design process for establishing riparian forest buffers.**

**Recommended Trees/Shrub Species for Riparian Buffers can be found in the WV Field Office Technical Guide (FOTG), Section IV, Conservation Practices, Riparian Forest Buffer, 391.**

**Other species may also be suitable. Consult with West Virginia Division of Forestry personnel, NRCS staff forester and/or biologist concerning the suitability of other species.**

**When establishing a riparian forest buffer by planting, initial plant-to-plant densities for trees and shrubs will depend on their potential height at 20 years of age. Heights may be estimated based on: 1) performance of the individual species (or comparable species) in nearby areas on similar sites, or 2) predetermined and documented heights using the Tree and Shrub List for West Virginia located in WV Field Office Technical Guide (FOTG), Section IV, Tools.**

**Planting density recommendations for planting open areas are:**

<b>Plant Types/Heights</b>	<b>Plant-to-Plant Spacing in feet</b>
<b>Shrub less than 10 feet in height</b>	<b>3 to 6</b>
<b>Shrubs and trees from 10 to 25 feet in height (includes columnar trees)</b>	<b>5 to 8</b>
<b>Trees greater than 25 feet in height</b>	<b>12 to 25</b>

**NOTE: Interplanting between existing trees and or shrubs at spacings greater than those listed above is also acceptable.**

Use tree and shrub species that are native and non-invasive. Substitution with improved and locally accepted cultivars or purpose-specific species is allowed. For plantings and seeding, only viable, high-quality and adapted plant materials will be used.

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

**Plantings will consist of three (3) or more species with individual plants suited to the seasonal variation of soil moisture status of individual planting sites. Plant types and species shall be selected based on their compatibility in growth rates, flooding tolerance, ability to produce large debris, and shade and wildlife values. Limit evergreens and favor hardwoods where the site will allow. Fruit cultivars are limited to less than 30% of the planting stock.**

Necessary site preparation and planting shall be done at a time and manner to insure survival and growth of selected species for achieving the intended purpose(s).

**Refer to the practice standard Tree/Shrub Establishment, 612 for care, handling, and planting requirements of planting stock.**

***The method of planting for new buffers shall include hand or machine planting techniques and be suited to achieving proper depths and placement of planting stock roots.***

***An adequate nearby or adjacent seed source (within 250 feet) must be present when using natural regeneration to establish a riparian forest buffer. Mineral soil must also be exposed prior to seed fall in order to provide seed to soil contact. Refer to the practice standard Forest Site Preparation, 490.***

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.

***Harvesting operations in riparian forest buffers must adhere to current state and local regulations. Best Management Practices (BMPs) are outlined in the WV Field Office Technical Guide (FOTG), Section I, Laws - West Virginia Silvicultural Best Management Practices for Controlling Soil Erosion and Sedimentation from Logging Operations, 2014.***

<http://www.wvforestry.com/DOFbmpManual2014.pdf>

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

Harmful plant and animal pests present on the site will be controlled or eliminated as necessary to achieve and maintain the intended purpose. If pesticides are used, refer to the standard Pest Management, 595.

***Fenced water course crossings and livestock watering areas shall be located and sized to minimize impact to the riparian forest buffer vegetation and function.***

***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 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 width shall be at least 35 feet measured horizontally on a line perpendicular to the water body beginning at the normal water line, bank-full elevation, or at the top of the bank as determined locally.

The width will be extended 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.

Existing, functional underground drains through the riparian area will pass pollutants directly to the outlet. To filter such pollutants, drains can be plugged, removed or replaced with perforated pipe/end plugs or water control structures (see 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.

***Additional herbaceous vegetation shall be added up-gradient to the riparian forest buffer when adjacent to cropland or other sparsely vegetated or highly erosive areas to filter sediment, address concentrated flow erosion, and maintain sheet flow. See the standards Filter Strip, 393, Riparian Herbaceous Cover, 390, and/or Critical Area Planting, 342, as applicable.***

***For areas with unstable banks refer to the practice standard Streambank and Shoreline Protection, 580.***

***The riparian forest buffer is a component of a planned land management system including nutrient, pesticide, runoff, sediment, and erosion control practices.***

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

The minimum width shall be at least 35 feet measured horizontally on a line perpendicular to the water body beginning at the normal water line, bank-full elevation, or at the top of the bank as determined locally.

The width will be extended to meet the minimum habitat requirements of the wildlife or aquatic species of concern.

Establish plant communities that address the target aquatic and terrestrial wildlife 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.

***Establish, favor, or manage species capable of producing stems and limbs of sufficient size to provide an eventual source of large woody debris (> 10 inches in diameter) for in stream habitat for fish and aquatic organisms.***

***Riparian corridors are appropriate places to establish pollinator habitats. Desirable species should be selected that encourage use by pollinators and bloom throughout as much of the season as possible. Since trees and shrubs typically are available prior to the bloom period of most herbaceous plants, they are often the most visited of plants by bees early in the season. Conversely, woody species stop blooming earlier in the growing season and the floral resources are not available throughout the growing season. Therefore, it is not advisable to depend solely upon woody species to provide pollinator resources. For this reason, it is acceptable when installing exclusively woody species enhancements to utilize bloom periods of very early, early and mid-season.***

***A woody pollinator mix must contain at least three species in each of the three blooming periods as discussed above (very early, early and mid). Trees and shrubs should be planted at a close spacing to aid in pollinator access but also allow for maximum crown development and bloom. Planting materials may be seedlings, containerized or balled and burlapped.***

***Installation of trees and shrubs should follow the practice Standard Tree/Shrub Establishment, 612 and Tree/Shrub Site Preparation, 490, as appropriate.***

***See the West Virginia Pollinator Handbook, West Virginia Field Office Technical Guide (FOTG), Section IV, Tools for a listing of trees and shrubs that benefit pollinators.***

**Additional Criteria to Create Shade to Lower or Maintain Water Temperatures**

***Buffers shall be maintained or established on the south and west sides of water bodies insofar as practical. The buffer canopy shall be established to achieve at least 50 percent crown cover with the average canopy heights equal to or greater than the width of the watercourse or 30 feet for water bodies.***

***Buffer species shall include native riparian species of sufficient height and crown density potential. Place drooping or wide-crowned trees and shrubs nearest the watercourse or body. Shoreline or channel relief (e.g. deeply incised channels) and topographic shading should be taken into consideration when selecting species.***

### **Additional Criteria for Increasing Carbon Storage in Biomass and Soils**

Maximize width and length of the riparian forest buffer.

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**

Tree and shrub species, which may be alternate hosts to undesirable pests, should be avoided. Species diversity should be considered to avoid loss of function due to species-specific pests.

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.

Allelopathic impacts of plants should be considered.

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.

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

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.

***Wide widths (75 feet or more) are preferred. They are more effective for the listed purposes and more feasible to manage. Narrower widths within this standard recognize the value of streamside land for farming and limited bottomland acreage in many locations.***

***The widths below are a guide for selected wildlife species. They include the sum of buffer widths on one or both sides of water courses or water bodies and may extend beyond riparian boundaries.***

<b><i>Species:</i></b>	<b><i>Desired Width in Feet</i></b>
<b><i>Bald eagle, wood ducks, heron rookery</i></b>	<b><i>600</i></b>
<b><i>Turkey, pileated woodpecker</i></b>	<b><i>450</i></b>
<b><i>Beaver, black duck, grouse, Trout</i></b>	<b><i>300</i></b>
<b><i>Deer</i></b>	<b><i>200</i></b>
<b><i>Songbirds, mallard</i></b>	<b><i>165</i></b>
<b><i>Bass, woodcock</i></b>	<b><i>100</i></b>

***The severity of bank erosion and its influence on existing or potential riparian trees and shrubs should be assessed. Watershed-level treatment or bank stability activities may be needed before establishing a riparian forest buffer.***

***When concentrated flow erosion and sedimentation cannot be controlled vegetatively, consider structural or mechanical treatments.***

***Where animal waste is a problem, management systems must be applied to the adjacent field. Forest buffers should not be planned as substitute practices.***

***Use of this practice without other nutrient, pesticide, sediment, and erosion control practices can result in adverse impacts on buffer vegetation and stream hydrology. The expected adverse impacts could be high maintenance costs, need for re-establishment of vegetation, and delivery of excess nutrients, sediment, and other potential pollutants through the buffer by concentrated flows.***

***Joining new buffers with existing buffers increases the continuity of cover and will further moderate water temperatures. A mix of species with growth forms that are tall and wide-crowned or drooping will increase moderation effects. For watercourses, buffers established on both sides will enhance riparian values.***

***Consider species that re-sprout when establishing the vegetation nearest the watercourses or bodies. For detritus and large woody debris, use species that meet the specific requirements of fish and other aquatic organisms for food, habitat, migration and spawning.***

***Consider species selection criteria to improve aesthetics include seasonal foliage color, showy flowers, foliage texture, form, and branching habit.***

***NOTE: The Stroud Water Research Center recommends 200 stems per acre as an acceptable or minimum target for riparian restoration.***

***Use recommendations from regional or other large-scale evaluations and plans when designing, locating, and connecting buffers for indicator and/or target species of wildlife, fish, and other aquatic organisms.***

***Consider the type of human use (rural, suburban or urban) and the aesthetic, social, and safety aspects of the area to determine the vegetation selection, arrangement, and management.***

***Complex ownership patterns of riparian areas may require group planning for proper buffer design, function, and management.***

***The layout and design should be appropriate for the setting as determined by adjacent land uses. A landscape analysis can help determine specific aesthetic requirements.***

***Where feasible, consider alternative water sources, such as tanks, ponds, wells, solar pumps, and ram pumps for livestock water supply needs.***

***Woody pollinator plantings greater than one-half acre (0.5 acres) in size are exponentially more beneficial.***

***Consider existing species within riparian areas when determining the need for pollinator plantings.***

## PLANS AND SPECIFICATIONS

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

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, or other acceptable documentation. ***Requirements for operation and maintenance of the practice shall be incorporated into site specifications.***

***At a minimum, the following will be identified in the conservation plan (as appropriate):***

- ***Purpose of riparian forest buffer***
- ***Size of riparian forest buffer***
  - ***minimum width of riparian forest buffer (ft.)***
  - ***length of riparian forest buffer (ft.)***
  - ***acres of riparian forest buffer (ac.)***
- ***Field location / Plan view***
- ***Site conditions prior to establishment of the riparian forest buffer***
- ***Site preparation methods (if used)***
- ***Plant species***
- ***Establishment method(s)***
- ***Cultural practices (i.e. pruning, forest stand improvement, etc.) (if any)***
- ***Access control methods (if needed)***
- ***Erosion control measures (if needed)***
- ***Any required permits, including but limited to, the CPA-052 or similar environmental documentation***
- ***Operation and Maintenance Plan***

## OPERATION AND MAINTENANCE

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

The riparian forest buffer will be inspected periodically and protected from adverse impacts such as excessive vehicular and pedestrian traffic, pest infestations, concentrated flows, pesticides, livestock or wildlife damage and fire.

***The buffer should be inspected at least annually and after heavy storm events. Check for areas where water is concentrated. Disperse concentrated flow by appropriate measures, including placement and repositioning debris.***

Replacement of dead trees or shrubs and control of undesirable vegetative competition will be continued until the buffer is, or will progress to, a fully functional condition.

***A 60% survival rate of planted materials after two years is considered satisfactory if trees/shrubs are well distributed over the planted area. The planted areas will be evaluated to determine whether to replant failed areas or if natural regeneration will meet the objectives of the landowner.***

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 practice standard Forest Stand Improvement, 666.

Control or exclusion of livestock and harmful wildlife shall continue. Refer to the standards Prescribed Grazing, 528, and/or access Control, 472, as applicable.

Fertilizers, pesticides and other chemicals used to maintain buffer function shall not impact water quality.

***Vehicular traffic or excessive animal traffic, and the removal or disturbance of vegetation and leaf litter must be avoided.***

***Where practical, management activities will be performed outside the primary nesting season (March 15 - July 15). An exception may be for mowing or cultivation to control vegetative competition.***

***As applicable, control of concentrated flow erosion and sediment deposition shall be controlled.***

***For the purpose of moderating water temperatures and providing detritus and large woody debris, riparian forest buffer management must maintain a minimum of 50 percent canopy cover.***

***For the purposes of reducing excess pollutants in surface runoff and shallow groundwater or providing habitat and corridors for wildlife, manage the canopy to maintain maximum vigor of the overstory and understory species.***

***Additional operation and maintenance requirements shall be developed on a site-specific basis to assure performance of the practice as intended.***

***NOTE: Bold Italic indicate information added to the national standard by West Virginia.***

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