

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

RIPARIAN FOREST BUFFER

(Acre)
CODE 391

DEFINITION

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

PURPOSES

- Create shade to lower 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

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

Where subsurface drains (tile lines) cross a tree/shrub planting, and where these drains will remain functional:

- (1) Install sealed conduit through the planting and extend a minimum for 100 feet from rows of large trees (capable of reaching heights greater than 60 feet) and 50 feet from all other trees and shrubs.
- (2) Avoid planting trees and shrubs within 50 feet of either side of functional subsurface drains.

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

Maintain overland flow through the riparian area as sheet flow.

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

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). Limit natural regeneration to sites not suited to any kind of tree planting. The tree planting plan developed for establishing the buffer will include justification for use of natural regeneration. See Conservation Practice Standard TREE/SHRUB ESTABLISHMENT (Practice Code – 612) for additional criteria and specifications for natural regeneration and tree planting.

Conduct necessary site preparation and planting at a time and manner to insure survival and growth of selected species for achieving the intended purpose(s). See Conservation Practice Standards TREE/SHRUB SITE PREPERATION (Practice Code – 490) and TREE/SHRUB ESTABLISHMENT (Practice Code – 612) for additional criteria and specifications.

Use tree and shrub species that are native and non-invasive. For plantings and seeding, only use viable, high-quality and adapted plant materials. Select

species from Table 1, Plant List for Riparian Forest Buffers, or from Conservation Tree/Shrub Suitability Groups located in Section II of the Illinois Field Office Technical Guide. Improved and locally accepted cultivars or purpose-specific species may be substituted in place of the listed plantings.

No single species will make up more than 50% of the total number of species planted.

Favor tree and shrub species that have multiple values such as those suited for timber, nuts, fruit, florals, browse, nesting, and aesthetics. When adapted to conditions, use heavy-seeded species marked with an asterisk in Table 1.

Control or exclude livestock as necessary to achieve the intended purpose. Use the criteria in Conservation Practice Standards PRESCRIBED GRAZING (Practice Code – 528) and/or ACCESS CONTROL (Practice Code – 472), as applicable.

Livestock control must include a grazing prescription that addresses duration, intensity, season/frequency of use, and alternative water sources. Where planned riparian buffer function will be impaired by livestock overuse (trampling, compaction, over utilization of woody cover, etc.) livestock must be immediately removed from the riparian area. Evaluate and reduce or eliminate livestock access to keep the riparian area fully functional.

Control or eliminate harmful plant and animal pests present on the site as necessary to achieve and maintain the intended purpose. If pesticides are used, use the criteria in Conservation Practice Standard PEST MANAGEMENT (Practice Code – 595).

Extend the vegetation a minimum width to achieve the purpose(s). Begin measurement at and perpendicular to the normal water line, bank-full elevation, or the top of the bank as determined locally. (see Figure 1) The forested buffer will consist of a minimum of two zones as established in the table below.

Minimum Zone Widths

Stream Order	Zone 1	Zone 2	Total
1 st & 2 nd	25 feet	25 feet	50 feet
3 rd & Larger	25 feet	75 feet	100 feet

Stream order can be determined using a USGS 7.5 minute quad map: first order streams are those which have no tributaries and are at the uppermost level of a watershed. Two first order streams join to form a

second order stream, two second order streams join to form a third order stream, etc.

Zone 2, for any stream order classification, may be increased to include areas of overland out-of-bank flow and/or scour erosion, up to the width of the 100-year floodplain. Document evidence of scour erosion, debris deposits or sediment deposition by observation during a site visit or by evaluation of aerial photography.

Maximum combined width of zones 1 and 2 is defined by the 100-year floodplain (see Figure 2). The 100-year floodplain can be determined from Federal Emergency Management Agency (FEMA) maps or other documented materials. Additional assistance may be obtained from the Illinois Water Survey in determining the 100-year floodplain. On small streams with floodplains less than 50 feet wide the maximum combined width of zones 1 and 2 is 50 feet.

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.

Trees to be harvested should be marked by a forester to avoid “highgrading” the stand. Direct felling and skidding of trees away from the water course or water body. Conduct skidding in a manner to prevent creation of ephemeral channels perpendicular to the stream.

Control concentrated flow erosion, excessive sheet and rill erosion or mass soil movement in the up-gradient area immediately adjacent to zone 2 prior to establishment of the riparian forest buffer.

Figure 1 Minimum Widths for Riparian Buffers

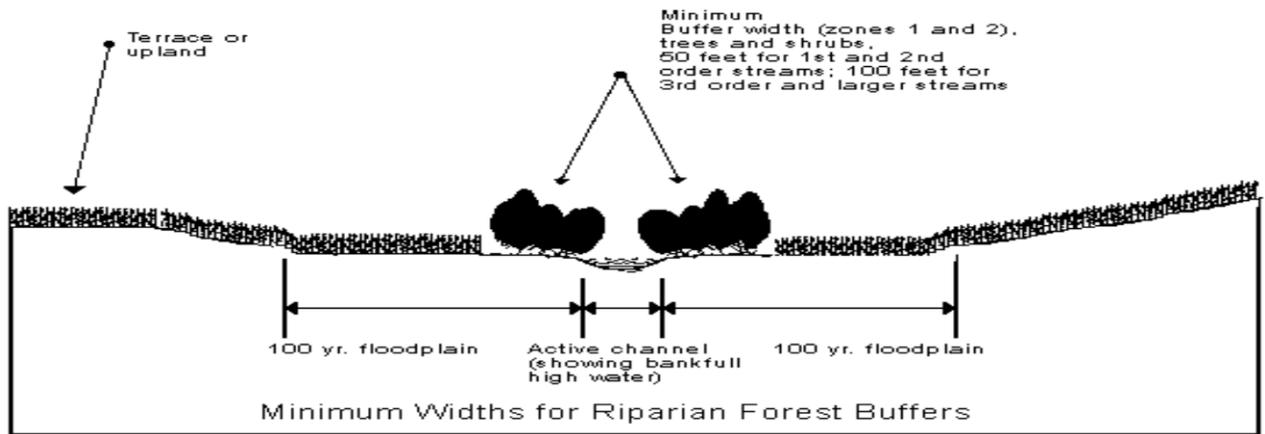
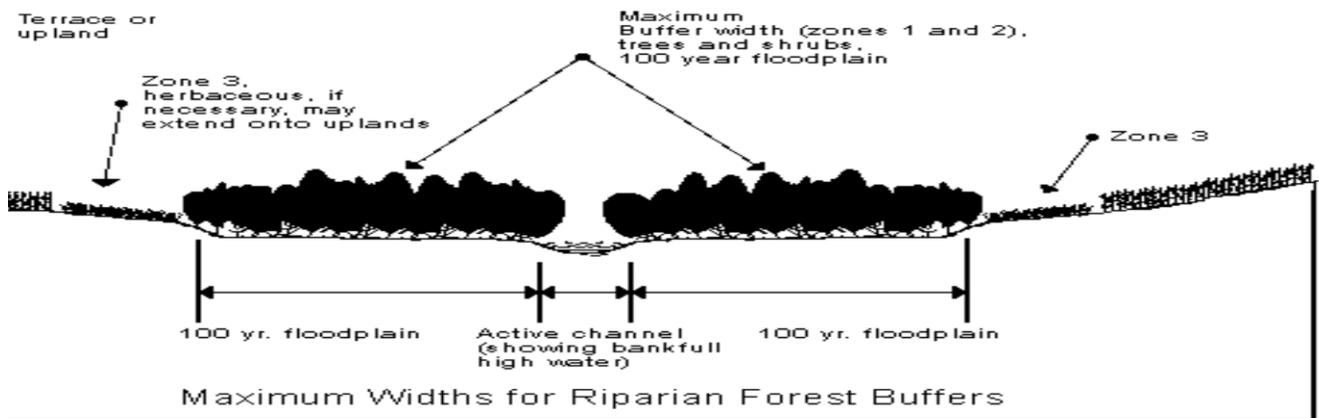


Figure 2 Maximum Widths for Riparian Buffers



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

Extend the width beyond the minimum 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 can pass pollutants directly to the outlet. Where such pollutants are to be filtered, use Conservation Practice Standard STRUCTURE FOR WATER CONTROL (Practice Code – 587), to accomplish DRAINAGE WATER MANAGEMENT (Practice Code – 554). Alternative to drainage water management, the structure for water control can be used to distribute drainage water through perforated drain pipe set parallel to the riparian area, using criteria in SUBSURFACE DRAIN (Practice Code – 606) 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, and may cause bank stability problems.

Zone 3

Where ephemeral, concentrated flow or sheet and rill erosion and/or sedimentation are concerns in the area up-gradient of Zone 2, an additional Zone 3 will be established (see figure 2). Zone 3 is a vegetated strip consisting of grasses or grasses and forbs. Stiff-stemmed grasses established at the up-gradient edge of Zone 2 will accelerate deposition of sediment. Use minimum and maximum width and vegetative establishment criteria from Conservation Practice Standard FILTER STRIP (Practice Code – 393) in designing Zone 3.

Zone 3 may be included in the 100 year flood plain or it may begin at the boundary of the 100-year floodplain and extend onto adjacent uplands.

Manage the dominant tree canopy to maintain maximum vigor of overstory and understory species. Periodic thinning and/or prescribed burning may be necessary to allow adequate light to reach the forest floor to maintain a good cover of grasses and forbs. Forest canopy cover may reach 100% during the first 10-15

years but should be thinned to approximately 80% to maintain vigor and influence species composition of both the understory and overstory.

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

Select buffer species listed in Table 1 capable of achieving desired height and crown density required for shade production. Place drooping or wide-crowned trees and shrubs nearest the water course or body. Establish the buffer canopy to achieve at least 50 percent crown cover with an average projected canopy shade (shadow) length equal to or greater than the width of the water course or 30 feet for water bodies.

Summer Sun Shadow Lengths

Listed below is a shadow length table for design tree heights in Illinois.

10:00 AM to 2:00 PM			
Tree Height (ft)	June	July	August
40	23	25	32
50	29	31	40
60	35	38	48
70	41	44	56
80	47	50	64
90	52	57	72

(Source: ASHRAE Handbook, 1972.)

To determine the appropriate combination of shadow length relative to tree height, identify the appropriate month of concern then select the appropriate shadow length that equals the water body dimensions that need shading. The tree height value on the left will be the needed projected mature height for the design shading lengths. Account for effective tree heights when determining shading lengths. Adjustments should be made for incised streams and topographic features that would add to the effective height of woody vegetation. For example, a tree 50 feet tall along an incised stream with normal flow elevation 10 feet below stream bank would have an effective tree height of 60 feet.

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

Extend the width beyond the minimum 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 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.

Within Zone 1 as a minimum, establish, favor or manage species capable of producing stems and limbs of sufficient size to provide an eventual source of large woody debris for in-stream habitat for fish and other aquatic organisms. See Table 1 for recommended species.

Riparian Wildlife Width Guidelines

The following guidelines represent the standard minimum riparian forest buffer widths for selected species:

Species	Minimum Width (ft.)
Bald eagle, cavity nesting ducks, heron rookery, turkey, pileated woodpecker	600
Beaver, dabbling ducks, mink, song birds, squirrels, mink	300
Deer, frog, salamanders	200

Minimum widths are the sum of the combined width of Zone 1 and Zone 2 on one or both sides of water courses or water bodies.

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

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

Consider allelopathic impacts of plants.

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

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.

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

Favor tree and shrub species that are native and have multiple values such as those suited for timber, biomass, nuts, fruit, browse, nesting, aesthetics and tolerance to locally used herbicides. Consider species that resprout to facilitate prompt regeneration after harvest or any impact. If black walnut is to be planted refer to [Guide to Selection of Soil Suitable for Growing Black Walnut in Illinois](#) in REFERENCES.

For sites that have a history of being wet or flooded, consider using plants produced by a containerized air-root pruning method.

Air root-pruned plant stock tends to be larger plants with thick, fibrous roots and capable of beginning seed production within 4-5 years.

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

A riparian forest buffer will be most effective when used as a component of a sound resource management system that includes integrated crop management and sediment and erosion control practices.

Consider the positive and negative impacts beaver, muskrat, deer, rabbits and other local

species may have on the successful management of the riparian and stream system.

PLANS AND SPECIFICATIONS

Prepare specifications for applying riparian forest buffer practices for each site. Use approved specification sheets, Illinois job sheets, technical notes, and narrative statements in the conservation plan, or other acceptable documentation. Incorporate requirements for operation and maintenance of the practice into site specifications.

Plant List

Table 1 lists woody plant species (trees and shrubs) commonly associated with and suited to riparian areas. Key attributes are listed for each plant to assist with the design process for establishing new buffers. For additional species recommendations, based on soils, see Conservation Tree/Shrub Suitability Groups, Section II of the Illinois Field Office Technical Guide.

Where equipment access corridors are necessary adjacent to stream channels, recommended low shrub species include but are not limited to: red-osier dogwood (*Cornus stolonifera*), gray dogwood (*C. racemosa*), buttonbush (*Cephalanthus occidentalis*), arrow-wood (*Viburnum recognitum*), swamp privet (*Forestiera acuminata*), and winterberry (*Ilex verticillata*).

Planting Rates

Initial plant densities for trees and shrubs should be based on their potential height, crown characteristics and growth form, in addition to planting objectives. Refer to practice standard TREE/SHRUB ESTABLISHMENT (Practice Code – 612), Planting Rates – General, for guidelines on planting densities.

Preparation of Planting Sites

Refer to practice standard TREE/SHRUB SITE PREPARATION (Practice Code – 490) for

specifications on preparing planting or seeding sites.

OPERATION AND MAINTENANCE

Periodically inspect the riparian forest buffer and protect the buffer from adverse impacts such as excessive vehicular and pedestrian traffic, pest infestations, concentrated flows, pesticides, livestock or wildlife damage and wildfire.

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

Conduct maintenance activities (periodic harvests or thinning) to keep the riparian zones in a healthy, vigorous growing condition. During any manipulation of species composition, stand structure and stocking by cutting or killing selected trees and understory vegetation will maintain the intended purpose(s). Refer to standard Conservation Practice Standard FOREST STAND IMPROVEMENT (Practice Code – 666).

Fertilizers, pesticides and other chemicals used to maintain buffer function shall not impact water quality or non-target species.

As applicable, control concentrated flow erosion or mass soil movement in the up-gradient area immediately adjacent to Zone 2 to maintain buffer function.

Develop additional operation and maintenance requirements on a site-specific basis to assure performance of the practice as intended.

REFERENCES

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Table 1. Tree and Shrub Plant List for Riparian Forest Buffers

Species (Common/Scientific)	pH Range	Flooding Tolerance	Large Debris	Shade Value	Wildlife Merit	Height (feet)	IL Plant Suitability Zone	
arrow-wood	Viburnum recognitum	5.1-6.5	H	L	L	H	8	All
baldcypress	Taxodium distichum	6.1-6.5	VH	M	M	M	80	II, III
birch, river	Betula nigra	4.0-6.5	M	H	M	M	50	All
buttonbush	Cephalanthus occidentalis	6.1-6.5	VH	L	L	L	10	All
cottonwood	Populus deltoides	6.6-7.5	H	H	M	H	90	All
dogwood, gray	Cornus racemosa	6.1-8.5	H	L	L	H	8	All
red-osier	Cornus stolonifera	6.1-8.5	H	L	L	H	12	All
hackberry	Celtis occidentalis	6.6-8.5	M-L	M	M	M	60	All
*hickory, shellbark	Carya laciniosa	5.0-6.6	M	M	H	H	70	All
water	Carya aquatica		VH	M	M	H	70	III
holly, swamp	Ilex decidua	4.0-8.5	VH	L	L	M	16	All
winterberry	Ilex verticillata	4.5-8.0	VH	L	L	M	20	II, III
locust, honey	Gleditsia triacanthos	6.1-7.5	H	H	M	L	70	All
*water	Gleditsia aquatica		VH	M	M	L	60	III
maple, boxelder	Acer nagundo	5.1-7.5	M	H	M	M	40	All
silver	Acer saccharinum	5.5-7.5	M	H	H	M	80	All
red	Acer rubrum	4.5-6.5	M	M	H	M	70	All
*oak, bur	Quercus macrocarpa	4.0-8.5	H	M	H	H	80	All
pin	Quercus palustris	5.5-6.5	M-L	H	M	H	75	All
willow	Quercus phellos	4.5-6.5	M	M	H	H	70	III
shingle	Quercus imbricaria		M	M	M	H	65	All
overcup	Quercus lyrat	4.5-7.5	VH	M	H	H	70	II, III
swamp white	Quercus bicolor	6.6-7.5	M-H	M	H	H	70	All
cherrybark	Quercus pagodifolia	4.5-6.0	M	M	H	H	75	III
swamp chestnut	Quercus michauxii	4.5-6.5	M-H	M	H	H	75	III
shumard	Quercus shumardii		M-L	M	H	H	80	II, III
*pawpaw	Asimina triloba	4.7-7.2	M	L	L	H	25	All
*pecan	Carya illinoensis	6.6-7.5	M	M	H	H	80	All
*persimmon	Diospyros virginiana	6.1-6.5	M	M	M	H	50	II, III
privet, swamp	Forestiera acuminata		VH	L	L	L	14	All
sugarberry	Celtis laevigata	4.4-7.7	M-L	M	M	H	80	II, III
sweetgum	Liquidambar styraciflua	4.5-7.0	M	H	H	H	90	III
sycamore	Platanus occidentalis	6.6-8.5	H	H	M	H	90	All
water tupelo	Nyssa aquatica		VH	H	H	H	90	III
*walnut, black	Juglans nigra	6.6-8.5	M-L	M	M	H	80	All
willow, black	Salix nigra	6.6-7.5	H	H	L	M	60	All
sandbar	Salix exigua (interior)	4.0-7.8	VH	L	L	L	6	All
peachleaf	Salix amygdaloides	6.6-7.5	H	L	L	L	30	All
pussy	Salix discolor	6.6-7.5	H	L	L	L	20	I

*Heavy seeded species preferred for seeding and planting to increase species diversity.

VH = very high; **H** = high; **M** = medium; **L** = low

pH Range: from Hightshoe, G.L., 1988, Native Trees, Shrubs and Vines for Urban and Rural America and/or IL NRCS PLANTS Database.

Flooding Tolerance: General capacity of the plant to withstand standing water. **VH** = able to survive deep, prolonged flooding for more than one year; **H** = able to survive deep flooding for one growing season, with mortality occurring if flooding is repeated the following year; **M** = able to survive flooding or saturated soils for 30 consecutive days during the growing season; **L** = unable to survive more than a few days of flooding during the growing season without mortality.

Large Debris: Potential for the plant to produce debris larger than ten inches in diameter before senescence. **H** = large debris likely within life span of the plant; **M** = large debris possible within life span of the plant; **L** = large debris unlikely within life span of the plant.

Shade Value: The density or fullness of shade provided by an individual plant's crown in full leaf out condition. **H** = large crown providing full shade; **M** = partially open or medium sized crown that provides patchy or incomplete shade; **L** = very open or small crown that provides minimal shade.

Wildlife Merit: The potential for the plant to provide useful cavity sites and/or quality fruit production for wildlife. **H** = excellent large cavity potential and/or high quality fleshy fruit or nut production; **M** = moderate cavity potential or fruit production; **L** = low cavity potential and dry, non-nut fruit production.

Height: Potential height at physical maturity.

Illinois Plant Suitability Zone: See Illinois NRCS Field Office Technical Guide, Section I - Maps.