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Riparian Buffers: Types and Establishment Methods

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A riparian buffer is a strip of vegetation established next to waterways in managed landscapes (such as urban or agriculture) that is designed to capture stormwater runoff, nutrients and sediment (Figure 1).

Figure 1. A riparian forest buffer.
Photo by USDA NRCS

These areas also improve habitat for aquatic organisms. In essence, riparian buffers lessen the impact of land management practices on waterways and help maintain healthy aquatic communities (for more information on the role of buffers, see fact sheet FSA5026, *Riparian Buffers: Functions and Values*).

There are several types of riparian buffers that can be implemented. The specific buffer type employed depends on the conditions near the waterway, the type or size of the waterbody and the primary objectives of the buffer. There are six common buffer styles including grass buffers, three-zone forest buffers, two-zone forest buffers, wildlife buffers, urban buffers and naturalized buffers. Alterations to the common buffer types can be made to generate modified versions. All of these buffers can help to maintain water quality while meeting other associated objectives.

Types of Riparian Buffers

Grass Buffer

This buffer consists only of grasses and forbs (such as wildflowers) and is typically used along small streams and other drainages that flow through crop fields and pastures. Grass filter strips are usually narrow and contain several grass species that slow and disburse runoff. Grass buffers also can provide valuable wildlife habitat. Native grasses, which are often better adapted than non-natives and less invasive, are desirable for planting. Grasses are most effective at filtering sediment. Grass buffers may require periodic maintenance to control invasion by unwanted plant species and to reestablish grasses. Suggested buffer width is 20 to 30 feet (Figure 2).

Figure 2. A grass buffer in an agricultural field. *Photo by USDA NRCS*

Three-Zone Forest Buffer

A three-zone forest buffer system has the flexibility to achieve both water quality and other landowner objectives (Figure 3). Zone 1, ranging in width from 15 to 30 feet, contains trees along the edge of the stream and is usually left undisturbed. Trees in this zone stabilize the streambank

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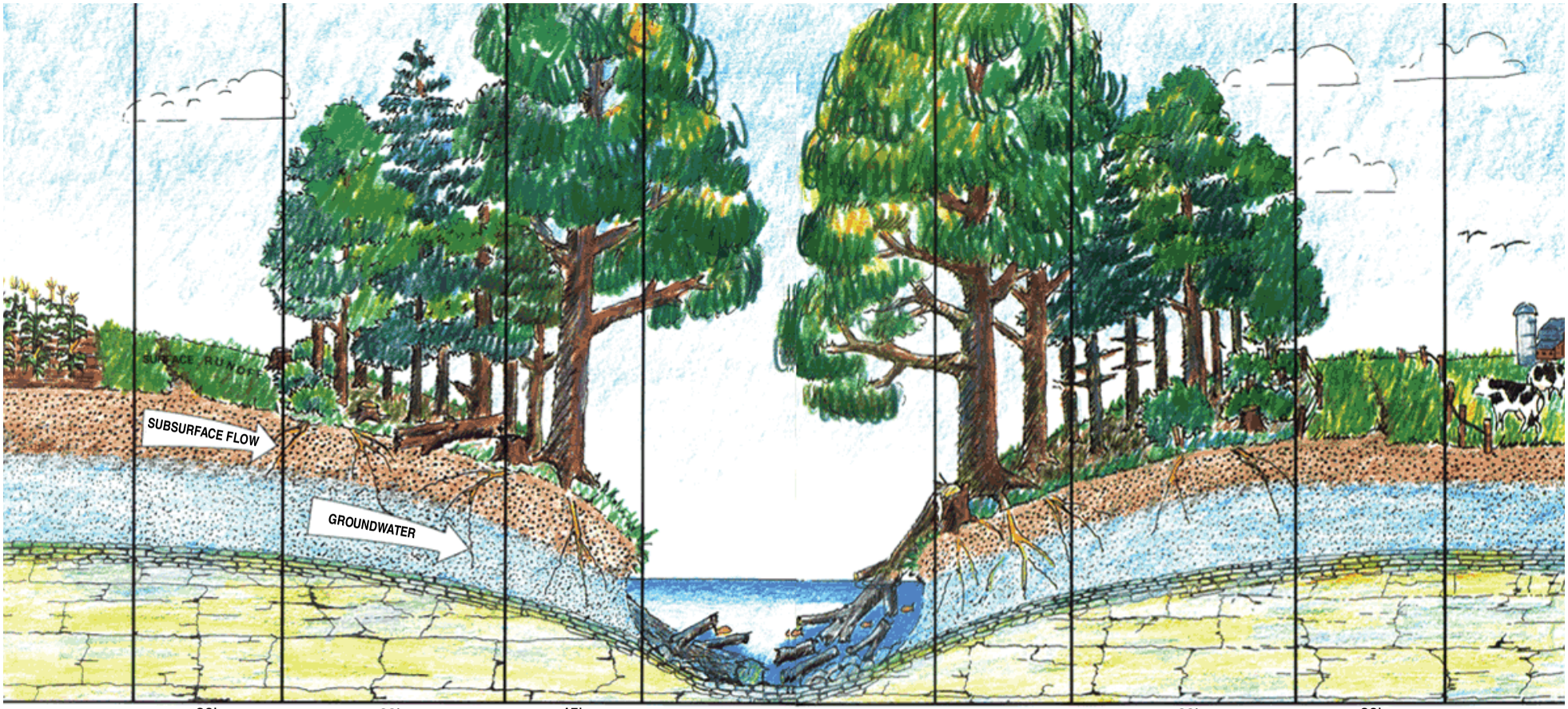

	20'	60'	15'		15'	60'	20'	
CROPLAND	**ZONE 3 RUNOFF CONTROL**	**ZONE 2 MANAGED FOREST**	**ZONE 1 UNDISTURBED FOREST**	**STREAM BOTTOM**	**ZONE 1 UNDISTURBED FOREST**	**ZONE 2 MANAGED FOREST**	**ZONE 3 RUNOFF CONTROL**	**PASTURE**
Sediment, fertilizer and pesticides are carefully managed.	Concentrated flows are converted to dispersed flows by water bars or spreaders, facilitating ground contact and infiltration.	Filtration, deposition, plant uptake, anaerobic denitrification and other natural processes remove sediment and nutrients from runoff and subsurface flows.	Maturing trees provide detritus to the stream and help maintain lower water temperature vital to fish habitat.	Debris dams hold detritus for processing by aquatic fauna and provide cover and cooling shade for fish and other stream dwellers.	Tree removal is generally not permitted in this zone.	Periodic harvesting is necessary in Zone 2 to remove nutrients sequestered in tree stems and branches and to maintain nutrient uptake through vigorous tree growth.	Controlled grazing or haying can be permitted in Zone 3 under certain conditions.	Watering facilities and livestock are kept out of the Riparian Zone insofar as practicable.

Figure 3. Illustration of a three-zone riparian forest buffer.
Source: USDA Forest Service

and provide shade and habitat for aquatic organisms. Zone 2, ranging in width from 30 to 100 feet, filters sediment that passes through zone 3 and absorbs nutrients while providing wildlife habitat. This zone contains trees that can be utilized for timber production. Zone 3, 20 to 30 feet wide, is usually a grass strip that functions to slow down and spread runoff. A modified three-zone buffer contains a shrub and small tree zone between the edges of zones 2 and 3 to give a feathered effect which may be more desirable for wildlife and aesthetically pleasing. Suggested minimum total buffer width on each side of a stream is 50 to 100 feet, but this width should be wider with increasing slope.

Two-Zone Forest Buffer

A two-zone forest buffer would simply be a modification to the three-zone forest buffer, where the grass zone would not be established. This buffer would result in managed and unmanaged forest zones. While this buffer type may be desirable to some landowners, excluding the grass buffer will result in a loss of value and environmental function of the riparian buffer.

Wildlife Buffer

Riparian forest buffers, with multiple vegetation layers and various habitat features, support a greater diversity of wildlife than adjacent upland forests. This buffer is similar to the three-zone buffer but puts more emphasis on trees, shrubs and grasses that are beneficial to wildlife for food and shelter. A wildlife buffer is usually wider, up to 300 feet, to better function as a travel corridor and connector between larger tracts of forest. Suggested buffer width is up to 300 feet.

Urban Buffer

Buffers in urban areas are important for intercepting runoff and pollutants from developed areas. These buffers are designed to better withstand human impacts and utilize larger planting stock. The larger trees and shrubs also provide a more immediate visual impact while being more resistant to human use. Using species that display colorful spring flowers and fall leaves adds to the aesthetic appeal. Urban buffers can also function as greenways along streams and may include a recreational trail. Urban buffers and greenways can be used to teach homeowners and developers about the importance of protecting streams and water quality and still allow limited use. Suggested buffer width is 50 to 100 feet (Figure 4).

Naturalized Buffer

This buffer is established from tree, shrub and grass seed that has been blown in or otherwise carried in naturally from the surrounding area. Vegetation that already exists or establishes naturally can be supplemented by interplanting tree and shrub seedlings as needed to achieve desired stocking densities. This buffer type represents an inexpensive buffer that can still effectively intercept runoff. Suggested buffer width is 50 to 100 feet.

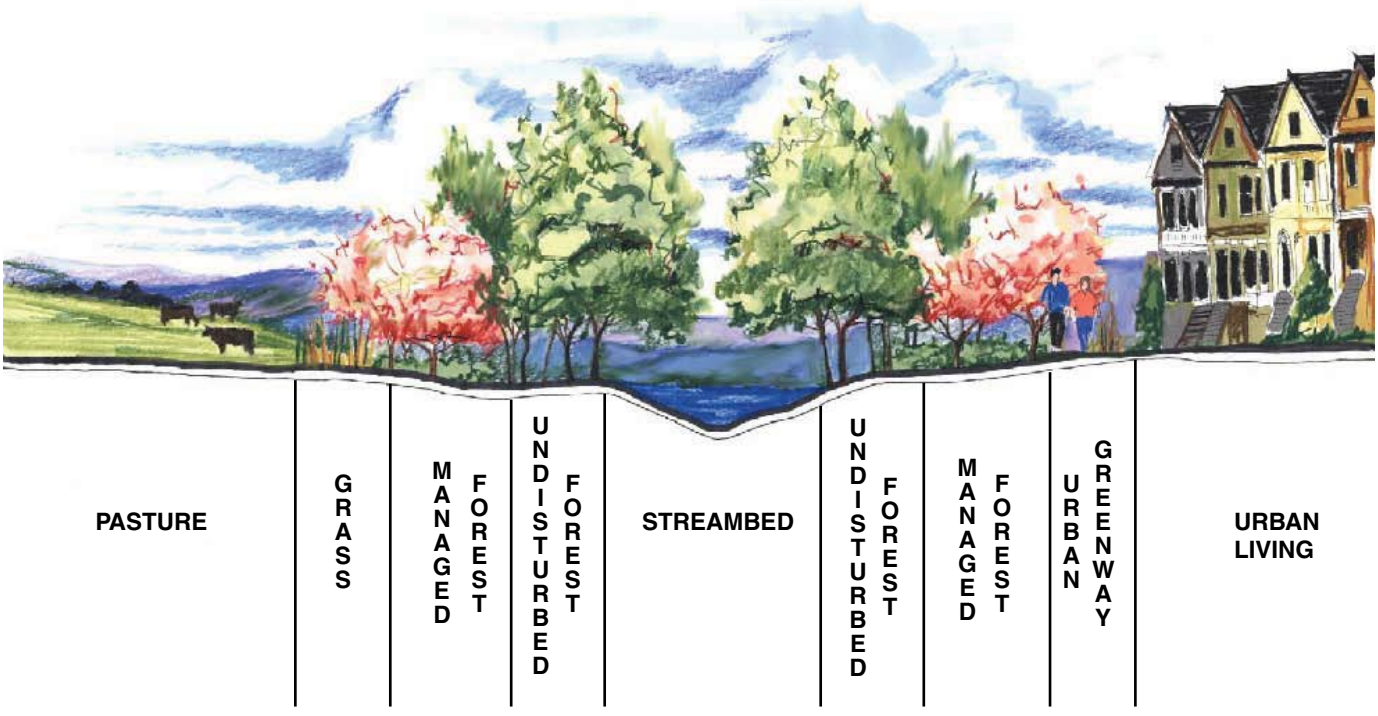

Figure 4. An example of an urban buffer.

Choosing a Buffer Type

There are many considerations that must be accounted for when establishing a riparian buffer. The first step is to determine which buffer type will best fit the current environment (site conditions), meet a landowner's objectives for management and fit within available cost-share programs.

Site Analysis

A site analysis involves determining factors such as soil type, soil productivity, soil moisture, type of waterway, slope and many others. A good source for much of this information is county soil surveys. These surveys published by the USGS are available at local NRCS and county Extension offices. A valid site analysis will assist in making sure the proper buffer and vegetation types are selected for the site conditions.

Ownership Objective

Establishing the proper objectives should be based on three concepts: (1) the landowner's desired values, (2) the desired environmental function and (3) the site conditions. Establishing the proper management objectives can make the difference in buffer success or failure.

For example, a landowner with agricultural land may wish to maintain some economic production from the riparian area and increase wildlife value. This landowner would probably best benefit from a three-zone riparian forest buffer. The three-zone buffer would provide the environmental benefit needed and produce merchantable trees while also providing habitat for wildlife. On the other hand, another farmer's objective may be to remove as little land area as possible from production. In this case, the farmer should probably choose the grass buffer, as it is typically much narrower than other buffer types while still providing necessary buffer functions.

Cost-Share Programs

There are several cost-share programs available to landowners for establishing buffers. These programs help pay for items such as fencing, site preparation, seed or seedlings, planting and many other practices. Some programs will provide rental payments while others focus on cost share for establishment practices. Some of the programs offer both rental payments and cost share for establishment. An interested landowner should contact their local FSA, NRCS or county Extension agent for guidance to finding the proper cost-share program (Table 1).

Table 1. Some available cost-share programs for riparian buffers.

Program	Oversight
Conservation Reserve Enhancement Program (CREP)	USDA – Farm Service Agency (FSA)
Wetland Reserve Program (WRP)	USDA – Natural Resources Conservation Service (NRCS)
Conservation Reserve Program (CRP)	
Environmental Quality Incentives Program (EQIP)	USDA – Natural Resources Conservation Service (NRCS)
Wildlife Habitat Incentives Program (WHIP)	USDA – Natural Resources Conservation Service (NRCS)

Establishing a Riparian Buffer

As with any natural resource, proper planning is essential to successful buffer establishment. In addition to matching buffer type to the site and ownership objectives, many factors must be considered prior, during and after buffer establishment including vegetation type, site preparation, quality planting job, post-establishment care and evaluation and maintenance.

Vegetation Type

Major considerations for selecting vegetation types are not only dictated by the type of buffer being established but factors such as species/site relationships, species/objective relationships, proper stock sizes and planting access (Table 2). The type of soils present and the management objectives (such as timber, wildlife, etc.) should always drive the selection of tree, shrub and grass species to be established. Stock size may be driven more by buffer type than other considerations. Tree and shrub stock types include cuttings, bare-root seedlings, container-grown and balled and burlapped (B&B). For example, the urban buffer will generally require larger stock sizes to allow for immediate impact on buffer usage by people.

Site Preparation

When establishing a buffer, some form of site preparation will almost always be required. This could involve either mechanical or chemical operations. Mechanical operations are usually directed at preparing the soil for tree or grass planting. Agricultural areas will typically have a layer of hardened soil under the surface that can prevent tree roots from reaching proper depths for water and mineral uptake. A "ripping" operation is typically utilized to break the

Table 2. Examples of species (natives are preferable) that are suitable for planting in riparian buffers.

TREES (by flood tolerance)		
Tolerant	**Moderately Tolerant**	**Intolerant**
Bald cypress		
Overcup oak	Sugarberry	Persimmon
Black willow		
Water tupelo	Green ash	Blackgum
Swamp tupelo	River birch	Loblolly pine
		Shortleaf pine
	American elm	White ash
	Water oak	Sweet pecan
	Willow oak	Cherrybark oak
	Nutall oak	
Small Trees	**Shrubs**	**Grasses**
Redbud		Indiangrass
American plum	Elderberry	Little bluestem
Serviceberry	Red chokeberry	Big bluestem
Fragrant sumac	Shrub willow	Switchgrass
Crabapple	Beautyberry	
Flowering dogwood		

"hardpan" in the soil. Ripping or subsoiling involves opening a slit in the ground 18 to 30 inches deep. Ripping is typically performed a few months prior to planting (Figure 5).

Figure 5. A mechanical sub-soiler.

Chemical applications are employed to help control unwanted, competing vegetation and are almost always needed. Because hardwoods (not pine) are typically planted in the tree zones of buffers, the herbicides available for use are few in number. The most common is sulfometuron methyl, which is labeled for preemergent applications (before March) in hardwood plantings. Proper application is critical to avoid seedling damage to hardwood tree species. Therefore, always consult with a professional when planning a herbicide application and always refer to the respective herbicide label.

Chemical competition control in grass zones may be required as well. Often these areas contain non-native species (such as fescue) which must be controlled prior to establishing more favorable native grasses. There are several herbicides for controlling fescue – Imazipic (Plateau) is a common herbicide that is available through the Arkansas Game and Fish Commission (contact your local AG&FC wildlife biologist for more information). Other herbicides, including sulfometuron methyl, control a range of grasses including fescue. Because the grass zone borders the tree zone, applying chemicals such as imazapyr to control grasses (usually bermuda) may have negative impacts on nearby hardwood seedlings. Again, consult with a licensed herbicide applicator when conducting an application.

Quality Planting Job

Quality seedlings should be obtained from nurseries located less than 200 miles north or south of the planting location. They should be properly cared for prior to and during planting. This care can make the difference in survival success or failure. With hardwood seedlings, survival rates can be increased by ordering 10 to 20 percent more seedlings than are required and selecting only the best 80 or 90 percent of the seedlings for planting. This "culling" operation may ensure that the better seedlings (larger seedlings with 8 to 10 lateral roots) which have a greater chance of surviving are planted. Always store the seedlings properly prior to planting (this usually means in a cooler at 45ºF) and keep the roots moist. If a planting crew is being used to plant seedlings, discuss the planting job prior to planting and maintain oversight throughout the planting operation.

Post-Establishment Care

Post-planting care can be an important step in ensuring seedling survival and rapid growth. Additional herbicide applications may be required to control grasses, forbs and brush around seedlings (note: most post-planting herbicide applications are constrained to grass-only herbicides). Tree shelters can also be beneficial to recently planted hardwood seedlings. The shelters provide a "greenhouse effect"

that enhances the growth of seedlings (Figure 6). However, they may be difficult to maintain in flood-prone areas. If larger trees are planted (such as in the urban buffer), mulching, staking and irrigation may be required.

Figure 6. Tree shelters can improve survival and growth of seedlings.

Evaluation and Maintenance

As with most vegetation establishment operations, evaluation of establishment success is the basis for making additional management decisions for a particular buffer. Survival checks can be conducted by identifying a small sample of seedlings to be monitored over time. Most cost-share programs will have this as a component of the contract. It is often required to have a survival rate of 70 percent or higher. In the event of significant mortality, supplemental planting may be required.

Checklist for Riparian Buffer Success

- ☐ *Establish objectives*
- ☐ *Site analysis*
- ☐ *Choose correct buffer type*
- ☐ *Select proper vegetation types*
- ☐ *Perform site preparation*
- ☐ *Quality planting job*
- ☐ *Post-establishment operations*
- ☐ *Evaluation and maintenance*

Riparian buffers provide an excellent opportunity to provide multiple environmental, ecological and social benefits while assisting landowners in creating multiple-use opportunities for their lands. Landowners should examine the options available for establishing buffers, make a plan based on objectives, establish a timeline of activities and stick to the schedule. There are many operations that must be performed sequentially and must be properly timed in their application (such as mechanical site preparation and timing of tree planting). The old saying “plan your work and work your plan” certainly applies to riparian buffer establishment.

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