Riparian Planting Guide of the Ozarks

BEAVER WATERSHED ALLIANCE

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Cover photos: *Top* - volunteers help plant trees at a recently-completed streambank restoration project site (Photo by Ben Thompson); *Middle* – a dibble bar is used to dig a hole for tree seedling planting (Photo by Roland Goicoechea); *Bottom* – a tree seedling is shielded by a plastic tree protector (Photo by Bryant Baker).

Artwork: Woodoats, *Chasmanthium latifolium* (by Bryant Baker)

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ABOUT THIS GUIDE

The ***Riparian*** *Planting Guide of the Ozarks* was created to aid landowners who are interested in any of the following:

1. Enhancing an existing riparian buffer.

2. Re-planting a riparian buffer that was previously removed.

3. Planting a new riparian buffer, especially after any stream stabilization or restoration work has been done.

This guide contains information about what riparian areas are and why they are important, types of plants to choose for riparian areas and where to purchase them, how to prepare a riparian site for planting, the various tools to use for planting, and the different techniques to use when planting.

The *Riparian Planting Guide of the Ozarks* was created by the Beaver Watershed Alliance (BWA), a 501(c)(3) nonprofit organization located in Northwest Arkansas. The mission of BWA is to proactively protect, enhance, and sustain the water quality of Beaver Lake and its watershed by working with watershed landowners, land managers, and residents to implement voluntary best management practices. A special thanks to the organizations who helped review early drafts of this guide and provide recommended changes:

Arkansas Department of Parks and Tourism

Association for Beaver Lake Environment

Beaver Water District

Northwest Arkansas Master Naturalists

Ozarks Water Watch

U.S. Army Corps of Engineers

University of Arkansas Cooperative Extension Service

Natural Resources Conservation Service

Arkansas Game and Fish Stream Team

Watershed Conservation Resource Center

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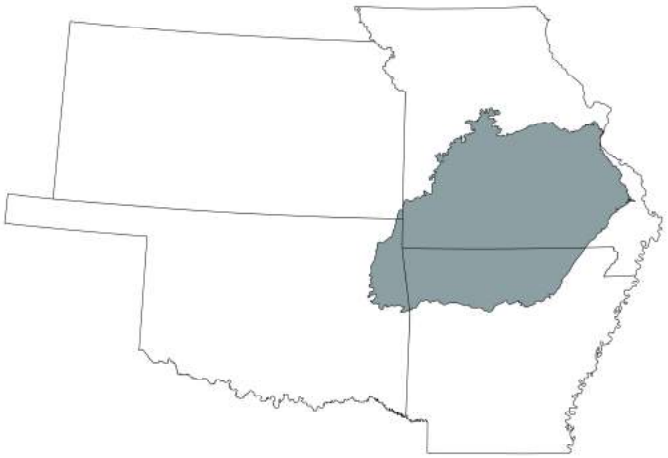
INTRODUCTION

The Ozarks Region

The Ozarks, while primarily located in Missouri and Arkansas, extend across four states including Oklahoma and Kansas. This **ecoregion** is unique not only for its geological history and composition, but also for its flora and fauna. Over 200 species are **endemic**, meaning they are not found anywhere else in the world. You would need to travel east to the Appalachian Mountains or west to the Rocky Mountains to find greater elevation changes and ecological diversity. In fact, the Ozarks, along with the Ouachita Mountains in western Arkansas and eastern Oklahoma, are referred to as the U.S. Interior Highlands for this very reason.



The Ozarks (shaded region) span 47,000 mi^2 across parts of Arkansas, Missouri, Oklahoma, and Kansas.

The Ozarks can be split into multiple **watersheds**. At the heart of the Ozarks region is the Upper White River Watershed. The White River begins near Boston, Arkansas and flows north into Beaver Lake, the drinking water source for the entire Northwest Arkansas metropolitan area. From there the White River continues to flow north and east into Table Rock Lake, Lake Taneycomo, and Bull Shoals Lake before flowing southeast through eastern Arkansas into the Mississippi River. This entire watershed spans the two states that comprise most of the Ozarks region: Missouri and Arkansas. Because so many people in the Ozarks rely on the water in these lakes and rivers for drinking, agriculture, recreation, and industry, **water quality** is a very important issue in the region.

Most of the information in this guide can be used anywhere in the Ozarks. However, the focal area for the guide, especially in regard to plant selections, is the Upper White River Watershed in the Arkansas portion of the Ozarks. This primarily includes the Beaver Lake Watershed, which is located among the Boston Mountains and the Springfield Plateau.

The Riparian Area

Perhaps one of the most influential ecosystems for water quality, erosion prevention, and wildlife habitat is the **riparian area**. This area represents the interface between land and water bodies such as lakes and streams. The riparian area acts as the final step in the filtration of pollutants such as sediment, nutrients, and heavy metals that are found in stormwater **runoff** before it enters a water body. Riparian areas also filter pollutants from streamflow. These pollutants, along with sediment from streambank erosion, can negatively impact water quality in lakes and streams by reducing water clarity,

A natural riparian area along a creek in the Boston Mountains region of the Ozarks. (Photo by Bryant Baker)

INTRODUCTION

A riparian area with shrubs, trees, and grasses along a gravel bar in the Ozarks. (Photo by Bryant Baker)

increasing the growth of algae, and harming aquatic life. Because of this critical **ecosystem service** of pollutant filtration and erosion prevention, riparian areas are often the focal areas for implementation of **best management practices** that can help improve land and water quality.

Not only do riparian areas prevent streambank erosion and filter pollutants in runoff, they can also provide habitat for wildlife, especially when forested. Many plants found in these areas are hosts to butterflies and other insects and provide food and shelter to a wide variety of animals. However, any land adjacent to water is considered part of the riparian area, or **riparian zone**, regardless of its land use. Therefore, some riparian areas can simply be the backyards in a suburban subdivision or a pasture grazed right up to the edge of a streambank.

In order to increase the effectiveness of a riparian area's functions of preventing streambank erosion, filtering pollutants, and providing quality wildlife habitat, it would ideally contain a great diversity of native plants that are specifically suited for growing near water. Plants native to the Ozarks are adapted to the soils and climatic conditions of the region, and they tend to not outcompete other plants as do many **invasive species**. Additionally, many native plants have unique relationships with particular animals found in the Ozarks. For instance, spicebush, a native small **understory** tree, is host to the Spicebush Swallowtail (*Papilio troilus*), a beautiful butterfly that can be seen flying low to the ground in forests during the spring and summer months. Knowing about the types of plants found in natural riparian areas and their functions and values for water quality can help landowners make informed decisions when altering these unique ecosystems.

Types of Plants Found in Natural Riparian Areas

Most plants that occur in riparian areas that have not been developed or grazed fall into four main categories: **graminoids** (grasses, sedges, and rushes), **forbs** or herbs, **woody vines**, and **trees and shrubs**. Each type of plant is unique and serves many invaluable functions in a healthy riparian area.

Graminoids

Switchgrass has a robust fibrous root system that is excellent for holding soil in place and preventing erosion. (Photo by Steve Renich)

Graminoids consist of true grasses, sedges, and rushes and can be identified by their **fibrous root system,** parallel leaf veins, and their tendency to have narrow leaves that grow from their base in the soil. They are also **herbaceous** (non-woody), although some true grasses, such as our native rivercane, can become woody, producing hard structural tissue as they mature. The true grasses are most common within this plant type and include well-known species such as the cultivated cereals (e.g., corn, rice, wheat), turf grasses (e.g., Bermuda grass, Kentucky blue grass), pasture grasses such as orchard grass and tall fescue, and native grasses found in natural areas such as switchgrass, woodoats, Indiangrass, and many others. These plants are not only globally and economically significant, they also provide important ecosystem services such as soil stabilization, food and habitat for birds and other wildlife, and pollutant absorption. Many true

Woodoats is a native grass found in riparian areas. (Photo by Bryant Baker)

grasses are found in great abundance in prairies, meadows, and other grasslands. However, several species grow well along streambanks and in wetland areas. The grasses can be distinguished from sedges and rushes, by their hollow, jointed stems, whereas sedges and rushes have solid, unjointed stems.

While the true grasses dominate the graminoid category, plants in the sedge and rush families are also ecologically important. Rushes and most sedges are most often found growing in wetlands and other areas where the soil stays moist. These plants are important in sensitive wet areas as they provide food and cover for many types of wildlife. However, they are typically not as palatable as many true grasses to foraging animals such as cattle, and they are often considered weeds in pastures and other managed areas. Regarding identification, the stems of these plants have particular characteristics that make them distinguishable from the true grasses. The stems of grasses are hollow, but the sedges and rushes have solid stems. Furthermore, rushes tend to have round stems compare to the angular stems of sedges. Remember, “sedges have edges, rushes are round, and grasses have knees that bend to the ground!”

Forbs

Forbs include all herbaceous flowering plants other than grasses, sedges, and rushes, and they are found in almost every ecosystem on Earth. As most wildflowers fall into the forb category, these plants are often easy to identify when in bloom. Common types of forbs include milkweeds, sunflowers, mints, smartweeds, phloxes, and many others.

Natural riparian areas will typically be vegetated by a variety of different forbs. Many forbs prefer full or part sun, so they are often found at the forest edge, mixed with grasses in open areas, or along streambanks. However, many shade-tolerant forbs can be found growing in the understory of forested areas. Regardless of where they occur, these plants can stabilize the soil, provide food and cover for wildlife, attract pollinators when in bloom, and serve as hosts to many insects. While they are often considered weeds in pastures, most native forbs serve some or all of these important ecosystem services in a mixed riparian area.

Forbs like this purple coneflower serve as attractants for pollinators when in bloom. (Photo by Bryant Baker)

Woody Vines

Another important group of understory plants in riparian areas are woody vines. Generally, woody vines have large taproots in the ground near whatever support they can find to climb. Some woody vines are not always recognizable as vines in the traditional sense but may actually resemble small shrubs for part of their life cycle. Poison ivy often begins as a small shrub and then climbs support structures, such as trees, when available. Many native vines have flowers that attract butterflies and hummingbirds, fruit

enjoyed by birds and other wildlife, and leaves foraged by deer and small mammals. Unfortunately, many exotic and invasive vines have been introduced to the Ozarks, such as kudzu, purple-wintercreeper, and Japanese honeysuckle. These plants can proliferate and completely take over a forested area in just a few years.

Yellow honeysuckle is a native vine that does not become invasive like the exotic Japanese honeysuckle, which can choke out other plants. (Photo by Bryant Baker)

Trees and Shrubs

Perhaps the most identifiable types of plants found naturally-occurring in riparian areas are trees and shrubs. Riparian areas in the Ozarks are usually dominated by hardwood trees. Height and stem structure are used to distinguish trees from shrubs. Typically, shrubs are considered shorter (up to 16 feet) and have multiple stems growing from below or just above the ground. Trees are usually much taller (some Ozark natives can be more than 100 feet tall) and have a single main stem, or trunk.

Shagbark hickory is a tree commonly found near streams. (Photo by Bryant Baker)

Most trees and shrubs native to the Ozarks are **deciduous**, which means they lose their leaves in the fall. This characteristic is actually very important to riparian and stream ecosystems. Many forested Ozark streams are **headwater** streams, which are narrow and located in higher elevation areas. The trees that grow in riparian areas along headwater streams provide shade throughout the hot summer months, and perhaps more importantly, their leaves provide food for aquatic **macroinvertebrates** after they drop into the water in the fall. Many of these small aquatic creatures eat the decomposing leaves in streams, which form the base of the food web in those ecosystems. Without deciduous trees in riparian areas around headwater streams, the entire food web would be altered, which would have significant effects on fish and other wildlife downstream. In larger streams, trees along the streambank are less important for leaf fall, but they can still provide shade and habitat for many animal species, including fish-eating birds such as the green heron.

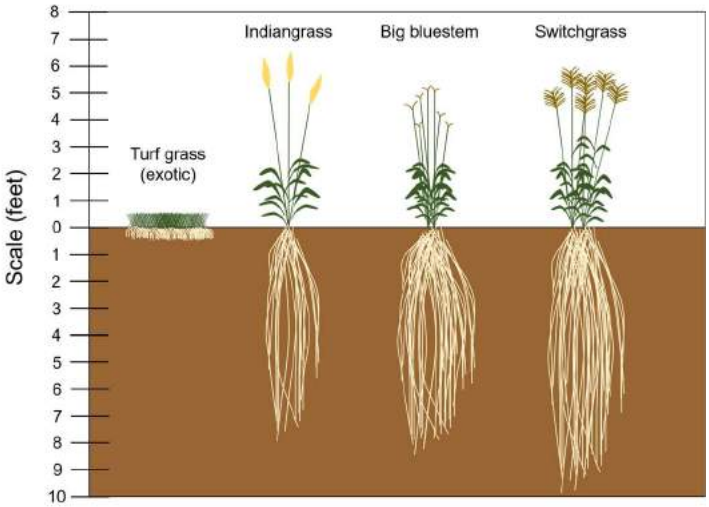
Additionally, trees and shrubs provide excellent soil stabilization in riparian areas. In fact, some trees and shrubs such as river birch and buttonbush, are specifically adapted to grow near water, are able to withstand periods of inundation during flood events, and are vital in holding streambanks in place, even when the stream experiences heavy flow. Trees and shrubs also provide food for wildlife. Oaks and hickories produce acorns and nuts that nourish many animals, including deer, bear, squirrels, and turkey throughout the winter. Dogwoods, hollies, persimmons, and many other trees

Birds and mammals, including humans, enjoy the fruits of the elderberry shrub. (Photo by Bryant Baker)

bear fruits that are eaten by a wide variety of mammals and birds. And of course, several trees yield fruits favored by humans, such as the sought-after pawpaw. Shrubs also produce fruit eaten by birds and mammals. Deciduous holly bears striking red berries that are enjoyed by several species of birds and small mammals.

Importance of Plant Roots in Riparian Areas

All of the types of plants mentioned above contribute to the root matrix formed in the soil in riparian areas. This mass of roots helps keep soil stabile and resistant to erosion. Imagine a stream flowing into a streambank that was nothing but bare soil. The loose soil would easily erode and wash into the stream. Now imagine the stream flowing into a streambank with roots of trees, grasses, and forbs reaching several foot into the soil. This hard mass of roots, soil, and gravel is much harder to erode. Vegetated riparian areas are thus much less likely to experience rapid erosion from heavy stream flow.



Native grasses have far more extensive root systems than exotic turf grasses. These deep root systems can help hold soil in place and prevent erosion. (Figure redrawn from illustration by Dede Christopher of the Tennessee Valley Authority, Benefits of Riparian Zones)

Types of Plant Life Spans

Plants can generally be categorized into one of three life span types: **perennial**, **annual**, or **biennial**. These terms refer to the amount of time it takes the plant to complete its life cycle. Perennial plants are those that live for more than two years. The aboveground stems of some perennials die back each year during the fall and winter and then grow back from their roots in the spring and summer. Plants that follow this growth cycle each year are considered **herbaceous perennials**. Conversely, trees and shrubs are perennials that do not die back each year, and they can be long-lived compared to many perennial forbs and graminoids. Plants that complete their entire life span from germination to seed production and death of all plant parts in a single year are annuals. Many annuals do not necessarily require an entire year to complete their life span, however. Some plants may produce seed in as little as a month after germinating. The final and least common type of plant life span is biennial. These plants require two years to grow, produce seed, and die completely. In the first year, a biennial will grow roots, stems, and leaves during the first year, and will become dormant during the winter. The following spring or summer, the plant will grow, flower, produce fruit and seed, and then die.

Woodoats is a warm season grass, as evidenced here by the early growth in late spring. (Photo by Bryant Baker)

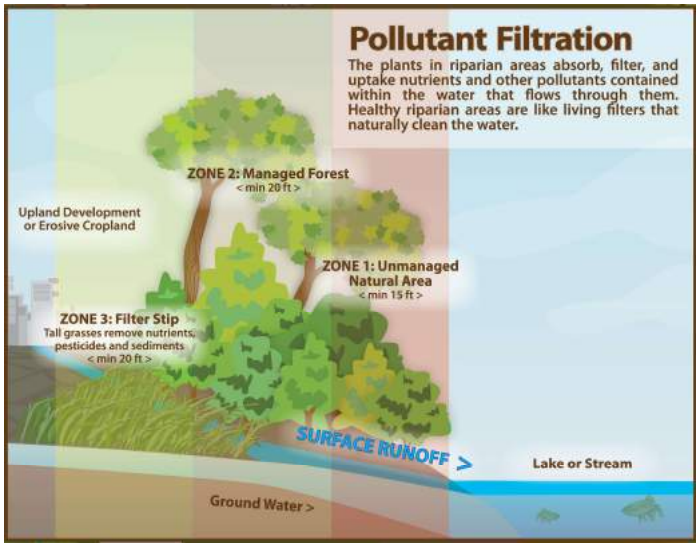
Another characteristic that is useful for identifying and growing plants, especially grasses, is which season they tend to grow. **Warm season** plants are those that reach peak

growth during the late spring and summer months. These plants are typically dormant during the cooler fall and winter months. **Cool season** plants tend to reach peak growth earlier in the year when environmental conditions are still cool and moist. Many cool season plants may even actively grow during the winter. Knowing whether a plant is warm or cool season can help determine what time of year it will be producing flowers for pollinators, fruit and seeds for wildlife, or simply when it reaches its peak ground cover.

Wetland Indicator Status

The wetland indicator status (WIS) is a rating given to a plant species to designate its probability of occurring in a wetland in the United States. A plant's WIS depends on what region of the country the plant is located. There are 13 wetland regions in the U.S. as defined by the U.S. Army Corps of Engineers in the National Wetland Plant List. These regions were determined based on elevation and climatic characteristics. The Ozarks are entirely within the wetland region known as Eastern Mountains and Piedmont, which also includes much of the Appalachian Mountains. Therefore, the WIS given for plants in this guide are in reference to the Eastern Mountains and Piedmont wetland region designation. While the WIS is primarily used for determining whether a plant will occur in a wetland, it can also be useful for describing which part of a riparian area a particular plant might be found or where it will be most successful.

WIS	Abbr.	Description
Obligate	OBL	Almost always found in or near water. These plants grow along streambanks and shoreline.
Facultative Wetland	FACW	Typically found in or near water such as along streambanks, but sometimes found upland.
Facultative	FAC	These plants can be found throughout a riparian area—in both wet and dry areas.
Facultative Upland	FACU	Typically found in dry upland areas, but sometimes found closer to the water.
Upland	UPL	Almost always found in dry areas such as the section of riparian area furthest from the water.



Three-Zone Forest Buffer (Courtesy University of Arkansas Cooperative Extension Service)

Riparian Buffers

A riparian area on land that is managed for agricultural, residential, recreational, or other purposes may no longer have the vegetation that existed before development. Unfortunately, water bodies on or near developed lands have the greatest risk for water quality degradation. For this reason, well-vegetated riparian areas on developed lands are very important for providing services that can sustain or improve water quality. A **riparian buffer** is a strip of vegetation next to a water body that is commonly 30 - 300' wide or at least as wide as the stream channel on each side of the stream bank. Riparian buffers minimize negative impacts of developed lands near the water, prevent erosion and property loss, and provide wildlife habitat. Riparian buffers have been shown to reduce the amount of sediment, nutrients, and bacteria in runoff by up to 70%. This function is especially important when buffering against heavily-used areas such as roads, parking lots, row cropped fields, and other areas prone to **erosion**. Riparian buffers can also filter floodwater that moves from the stream onto adjacent land. This can be particularly important to agricultural producers as the buffer can catch large storm debris such as logs, rocks, and trash, reducing the need for cleanup on a pasture following a storm event. Additionally, these buffers can provide recreational opportunities, aesthetic value, and even economic benefits such as timber production.

An effective riparian buffer should be designed to best treat runoff flowing from the nearby developed land that will impact water quality in the receiving water body, and from the stream through the buffer. Thus, considerations such as how the impacting land is being managed, what type of water body will be benefitting from the buffer, and how else the riparian buffer will be used should be taken into account before designing a riparian buffer. Regardless of land use, a riparian buffer should be at least as wide as the adjacent stream. A very effective type of buffer is the **Three-Zone Forest Buffer**:

Zone 1: Unmanaged Natural Area

The size of this zone depends on the slope and size of the stream but is ideally at least 15' wide beginning at the water's edge. Zone 1 includes the streambanks or shoreline and can have a mixture of grasses, forbs, and woody plants, depending on the slope and frequency of flooding. For stream riparian buffers, plants in this zone should have hardy, extensive root systems that will hold the soil in place under high flow conditions. There should also be tall trees that can provide shade for the stream and food and shelter for wildlife.

An example of a Three Zone Forest Buffer. (Photo courtesy USDA)

An unmanaged natural area (Zone 1) and a managed forest (Zone 2) behind it. (Photo by Bryant Baker)

Particularly, perennial grasses such as eastern gamagrass, switchgrass, and rice cutgrass and trees and shrubs such as black walnut, river birch, American sycamore, eastern redbud, silky dogwood, and buttonbush are ideal for Zone 1.

Zone 2: Managed Forest

Moving further away from the water body, the next zone again depends on the slope of the land and size of the stream but is ideally at least 20' wide and forested. It is important to choose a variety of trees, shrubs, and understory forbs and grasses to be planted in this zone. The types of trees and shrubs chosen for Zone 2 should be well-adapted to both wet and dry conditions. Higher diversity can be beneficial to wildlife by providing food sources to wildlife throughout the year. Regardless of which plants are grown in this zone, it should be managed for good forest health. Trees should be monitored for disease and pests, unwanted exotic plants should be removed, and the forest should be periodically thinned to encourage growth of desirable plants.

Zone 3: Filter Strip

The zone nearest the impacting land also depends on slope of the land and size of the stream but is ideally at least 20' wide. Hardy plants with the highest capacity for slowing and filtering runoff should be considered for Zone 3 as it is the first step in the riparian buffer's natural filtration process. Particularly, perennial grasses and forbs well-adapted to drier conditions should be chosen for this zone. Bunch grasses such as switchgrass, big bluestem, little bluestem, and Indiangrass and wildflowers such as coneflower, various sunflowers, milkweeds, and many other forbs function well in this upland section of a riparian buffer. This zone can be managed to control weeds or other unwanted plants, especially early on during establishment when the plants are experiencing slower growth rates. Mowing before annual weeds produce seed can help reduce their recurrence and increase the success of desirable plants.

A managed filter strip (Zone 3) consisting of grasses and wildflowers. (Photo by Bryant Baker)

Considerations Before Planting a Riparian Buffer

Keeping, re-establishing, or establishing a riparian buffer can be beneficial for minimizing the impact of an adjacent land use, preventing streambank erosion, and providing wildlife habitat. Establishing or enhancing a riparian buffer may also be necessary after stream restoration work has been carried out. Streambanks often experience erosion and many cases of this destructive process can be severe enough to require stabilization or stream restoration work to be carried out. Additionally, riparian areas are sometimes in the path of necessary utility service work. This type of work can have a substantial impact

on the riparian area and any existing riparian buffer. Therefore, these areas will likely need to be re-vegetated after any stream work is completed. When planting a new riparian buffer or enhancing an existing one, there are several techniques that can be used to ensure success and viability of the plants.

This riparian area was cleared by a municipality in order for a new water line to be installed (top). Tree seedlings and grass seed were planted during a restoration effort (bottom). (Photos by Bryant Baker)

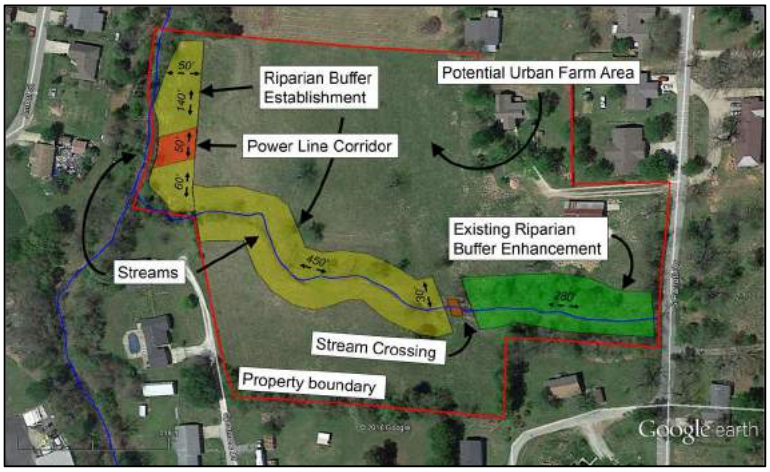
Determine Environmental Conditions of Riparian Area

Plants native to the Ozarks grow well in the natural soils in the region. However, some plants thrive under particular conditions compared to other plants. Knowing how wet the soil stays throughout the year can greatly benefit the process of plant selection when establishing a new riparian buffer. Some riparian areas may have soils that drain slowly and therefore stay wet for longer periods of time. Even Zone 3 of a riparian buffer, which can be up to 300 ft away from a water body, may have perpetually wet soils that would be good for plants with a WIS of OBL, FACW, or FAC. Soils with slow drainage in riparian areas can be determined simply by observation or by conducting a **percolation test**. This test consists of digging a hole 6 – 8” in diameter and approximately 12” deep, filling it with water several times to saturate the soil, and then filling it with water to measure the amount of time it takes to completely drain. The longer the soil takes to drain the water in the hole, the higher the likelihood the soil in that area will remain wet after precipitation. Determining the frequency of flooding can also help predict how often the soil in a particular section of a riparian area will be wet. Riparian areas with gentle slopes and broad, flat **floodplains** can experience more flooding than those with steeper adjacent land such as bluffs. Soil type will also influence the types of plants that will grow best. Gravelly soil nearer the water body may be more conducive to plants such as sandbar willow, bur oak, and various grasses and forbs. A soil sample can be tested by the Cooperative Extension Service in your area to determine the approximate **soil texture**, or the combination of sand, silt, and clay in the soil. Your soil test will also determine the soil nutrient concentrations and pH level. While it is not recommended to add lime or fertilizer to riparian soil due to potential for immediate water quality degradation, knowing these soil characteristics can further aid in choosing plants that will adapt well to the site.

Riparian areas along floodplains experience periodic flooding, and vegetation prevents erosion. (Photo by Bryant Baker)

Develop a Site Plan

A site plan is a very important tool when establishing a new riparian buffer. The first step is to perform a simple survey of the area of a potential buffer. Questions to ask about the site:



A site plan developed using Google Earth. This plan is relatively simple, showing only general areas and dimensions.

- What is the general condition of the area?
- What plants are already growing there? Are they invasive?
- What are the environmental conditions of the site (see previous section)?

The second step is to determine the dimensions and characteristics of your planned riparian buffer establishment or enhancement. This would include deciding how wide it should be so that it meets your needs and maximizes the buffer's effect as well as choosing which types of plants should be in particular areas. The width of a riparian buffer is dependent on a few characteristics of the site such as slope, soil type, vegetation, and stream dimensions. Buffers should always be at least the width of the stream on either side; however, it is best to have a buffer width of 50' minimum. Generally, the width of a buffer should be increased as slope and soil erodibility increase. Soils with higher contents of silt and fine sand can be more susceptible to erosion than other soil types. Riparian buffers should also be wider if wildlife habitat creation is a major goal of the buffer. A minimum width of 100' will provide general habitat for reptiles, amphibians, and other small wildlife. After determing the width of your planned buffer, it can be very helpful to draw a site plan. You can do this on paper or by using free software such as Google Earth®, which allows you to make measurements using aerial photography. The site plan can be detailed and include the location of each plant, or it can be relatively simple and include just the approximate areas where plantings will occur. It may also be useful to note characteristics of particular areas around the site. For example, marking locations where the soil is relatively rocky or compacted can help remind you where to use different tools that are more suitable for planting in certain areas.

Site Preparation

Before planting a new buffer, certain steps may need to be taken to prepare the site for planting. There are two ways to establish plants in a riparian area: from seed or by transplanting seedlings and/or more mature potted plants. When establishing from seed, the area to be planted must first be cleared of other vegetation. Most wildflower and grass seed should be planted in the fall between the months of October and December. Because many plants will be dying back at this time of year, it is important to eradicate the existing, undesirable vegetation earlier. If mowing is the method used to remove vegetation, it is best to mow before any annuals present produce seed. Other, more persistent perennial weeds may need to be controlled using chemical methods. Products with glyphosate or triclopyr (Rodeo® or Garlon 3A®, respectively) can be effective

This riparian buffer was planted with bare root seedlings spaced 12' apart in three separate rows. (Photo by Bryant Baker)

against undesirable plants, especially woody invasive species such as bush honeysuckle, Chinese privet, or multiflora rose. It is very important to follow the label directions when using any herbicide. For example, spraying with products approved for use near water should not occur before a rain event and care should be taken to avoid spraying untargeted plant species. Before using any herbicides in a riparian area, check in with your local Cooperative Extension office to get free guidance on which product should be used and how to use it safely and effectively.

Herbicides can be used to remove unwanted invasive plants from riparian areas so that more beneficial plants can be planted. (Photo by Courtney Thomas)

Establishing a Riparian Buffer from Seed

Native seed will be more successful if incorporated 1/8” into the soil; however, warm season grasses do better when planted 1/4 - 1/2” into the soil. When using a seed mix that includes both forbs and grasses, incorporate the seed no more than 1/8” into the soil in order to ensure the forb seeds are not too deep to fully sprout. If being cast by hand, light raking afterward will help improve seed-to-soil contact, especially if the soil was tilled before casting the seed. Native grass and wildflower see can be mixed with 50 lb/ac of clay-based cat litter to improve movement through a manual spreader, as these seeds are often very small and light. Seed drilling equipment can also be used to incorporate the seed into the soil and it should be able to drill to a depth of 1/2”. Regardless of the seeding method used, taking care to protect disturbed soil in a riparian area can be beneficial to water quality following planting. **Geotextiles**, the preferred material for soil protection, are specially-designed fabrics that allow movement of water into the soil and space for plants to grow, but keep the soil from washing away. Geotextiles are particularly useful for restored streambanks that have been recently planted. Less expensive options such as straw can also be used to help reduce erosion from rain, or a light mulch can be added to protect the soil from erosion, retain soil moisture, and protect the seeds from temperature fluctuations.

When establishing a buffer completely from seed, it may be necessary to trim the vegetation during the first growing season. After allowing the plants to reach a height of 18 – 24”, mowing to a height of 8” can help reduce fast-growing weeds that can outcompete native seedlings for resources. It is important to trim the vegetation no shorter than 8”, as this will ensure the slow-growing native seedlings will not be damaged. Trimming should not continue past the end of the summer. You can also monitor the site for more weed growth and spot-remove undesirable plants as needed.

A handheld or backpack spreader can be used on areas with difficult terrain. (Photo by Bryant Baker)

Planting Seedlings

Seedlings or more mature potted plants can also be used to establish some or all of a new riparian buffer. This method is particularly useful for trees, shrubs, and some forbs. A

Geotextiles allow for plants to grow while keeping the soil in place. (Photo by Ben Thompson)

popular and less-expensive technique to transplant trees and shrubs is to use bare root seedlings. These seedlings are grown in a nursery until they reach a height of 4" – 24" and have established roots. Farms and nurseries that sell bare root seedlings can typically ship them soon after they are removed from the soil to preserve their roots and stems. Since bare root seedlings do not come in pots with soil, they are relatively simple to plant. Planting bare root seedlings or mature plants during the fall and early spring, when the plant's aboveground stem and leaves are dormant but the roots can actively grow, will increase the likelihood of successful establishment.

When establishing a new riparian buffer using trees, spacing is an important consideration. Trees should be planted with at least 10 – 12' of space from each other. This will allow the trees to have enough space to develop branches without shading each other out. For example, if a 50' wide buffer is being planted along one side of a stream reach 100' long, the maximum amount of trees needed would be 50 trees. This would allow for five rows spaced 10' apart, with 10 trees per row each also spaced 10' apart.

Choosing the Right Tools

Several types of planting tools can be useful depending on the soil. A shovel can be used if the soil is relatively easy to dig. However, a sharpshooter shovel, which has a longer and narrower blade, works best for planting seedlings. Dibble or planting bars are easier and more efficient than shovels, especially if the soil is somewhat rocky. These tools are designed to make a V-shaped wedge in the soil that is perfect for bare root seedlings. For hard and/or rocky soils, a hoedad is likely the best choice for use when planting seedlings. This tool is similar to a hoe, but has a longer and thinner blade that can penetrate hard soil easily.

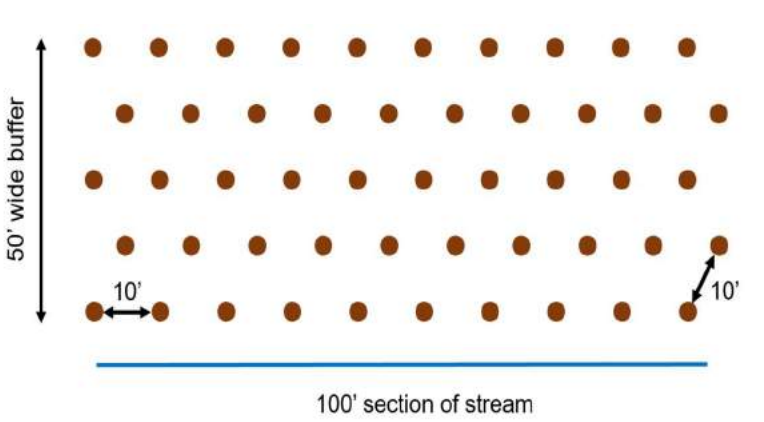
Three common tools for planting seedlings. Left to right: sharpshooter shovel, dibble bar, and hoedad (top). A single shank soil ripper (bottom)

It may be the case that the soil in the area where trees will be planted is compacted or has a hard clay layer inhibiting digging with one of the tools mentioned above. In these cases it may be necessary to use a soil ripper pulled by a tractor to create a line of loosened soil. Ripping should be done in the fall prior to planting seedlings in the later winter or early spring, or at least two months before planting occurs. Considering tree spacing as mentioned previously, riplines should follow the planned tree rows in a new riparian buffer.

Important Planting Tips

From the moment seedlings are received, great care should be taken to keep the roots moist. The optimal storage temperature for bare root seedlings is 33 – 40 °F (*e.g.* refrigerator or walk-in cooler). Seedlings can be stored at 40 – 50 °F (*e.g.* root cellar) for short periods of time. However, storage above 50 °F may result

in seedling damage. The longer and warmer seedlings are stored, the greater the risk for seedling damage to occur. Ideally, seedlings are planted immediately after receiving them. When planting bare root seedlings, it is essential to ensure that the roots are completely vertical, or "hanging", in the soil. If the ends of the roots are turned upward, they will have difficulty growing and establishing. Likewise, the roots need to be completely covered in the soil. Exposed roots will die, which will reduce the chance for seedling survival. The following page contains a diagram that demonstrates both of these concepts. Keeping the seedlings in a bucket of water, especially on hot or windy days, to prevent them from dying out before being place in the soil. Once the roots have completely dried out, the plant will not recover. Furthermore, once a seedling has been planted, it needs to be "watered in" immediately, especially if the soil is already dry. Simply pour water into the soil around the seedling until the ground is soaked, but not soggy. The water needs to be deep enough for the roots to access it.



An example of tree spacing for a 50' wide buffer along 100' of stream.

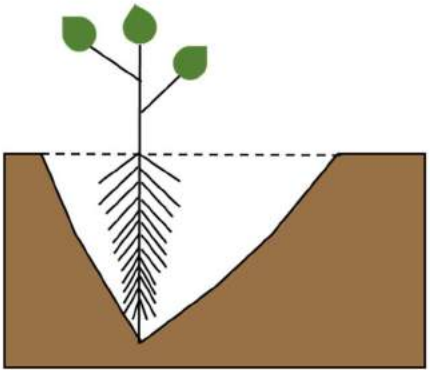
Seedlings may need to be held upright so that they are straight and at the correct depth when planting. (Photo by Roland Goicoechea)

After seedlings are planted, **tree protectors** can be used to further aid in successful establishment. Some tree protectors not only minimize the impact of foraging animals such as deer but they can also enhance the amount of sunlight that reaches the leaves of the seedling, and protect from errant mowers and string trimmers. The type of tree protector shown below is made of a plastic material that amplifies usable light to the leaves, reduces the effect of wind damage, increases the humidity, and reduces harmful ultraviolet light. Tree protectors will need to be replaced if damaged and removed once the tree's foliage is growing completely above the top of the protector or before the stem is constricted inside. As the tree grows, different types of protectors such as wire sleeves can be used to help protect the base of the tree from being damaged.

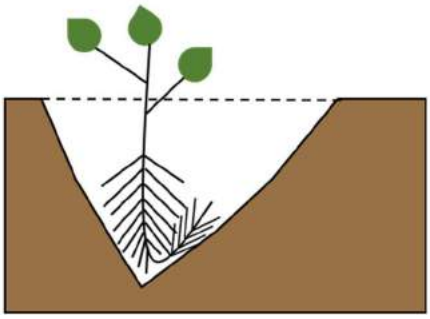
All that is needed to install a plastic tree protector is a wooden stake, mallet (or other heavy object to drive a stake into the ground), and cable ties. Most of the seedling should be encased by the protector after installation. It is important to obtain protectors

Tree protectors substantially improve the success rate of transplanted seedlings. (Photo by Bryant Baker)

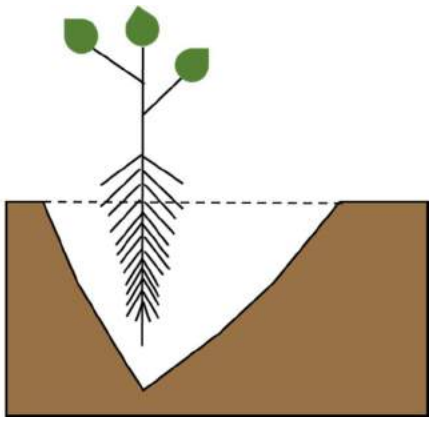
Planting Depth



Correct – *Roots completely covered and not bent*

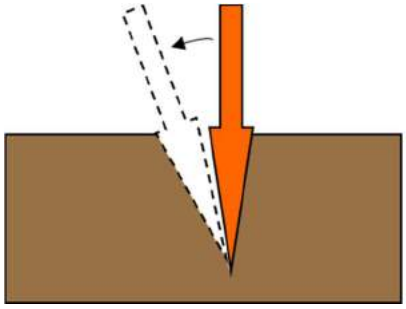


Incorrect – *Planted too deep, causing the roots to bend up*

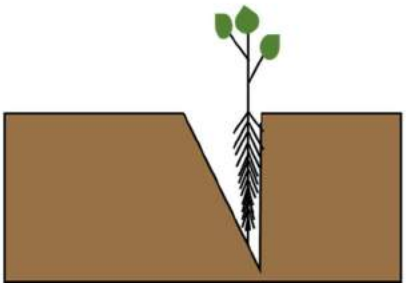


Incorrect – *Planted too shallow with some roots exposed*

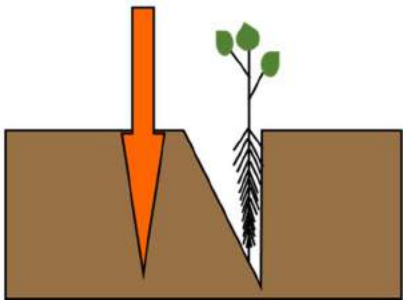
Dibble Planting



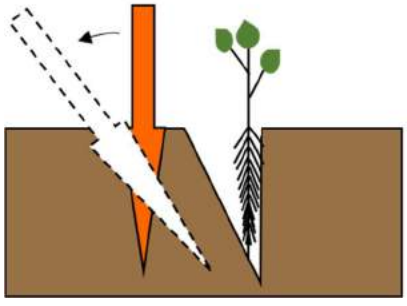
1. Wedge dibble bar into soil and pull back to create a V-shaped hole.



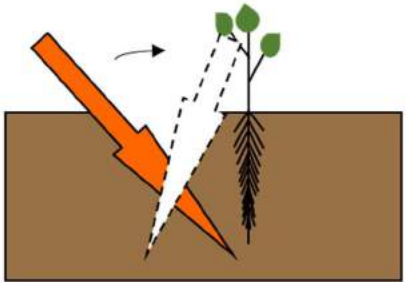
2. Remove dibble bar and place seedling in hole, following instructions above.



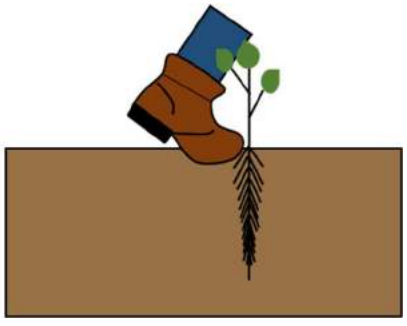
3. Remove dibble bar and wedge into soil next to hole.



4. Pull dibble bar back to push soil closer to the roots.



5. Push dibble bar to move soil closer to the roots near the surface.



6. Remove dibble bar and use your feet to firm the soil around the seedling.

that are appropriately-sized for the tree seedlings you are planting. There are many dealers nationwide that sell these products, such as Forestry Suppliers in Mississippi. To further protect freshly-planted seedlings, planting sites can be enclosed with a fence that will restrict deer access.

Tree protectors are fairly easy to install and can greatly improve the chances of seedling survival. (Photo by Bryant Baker)

Where to Buy Native Ozark Plants

Native seed, seedlings, or mature plants can be difficult to find due to most nurseries' focus on ornamental plants, which are often exotic and even invasive. However, with the popularity of native landscaping on the rise, native plants are becoming easier to find at local nurseries and can even be ordered through a nursery in many cases. Some nurseries specialize in a particular type of product such as bare root seedlings or seed mixes. Nurseries that specialize in seed mixes will often make mixes custom to your needs. The Riparian Plants Reference Table beginning on page 26 in this guide can be a useful tool in choosing which plants will do well in your riparian area.

Determining whether you will be planting seed, seedlings, or potted plants will be useful in deciding which nurseries to contact. It is also important to note that many nurseries will ship plants to you. However, the timing of shipment may depend on weather or other factors. Be prepared to delay planting up to a week or more if a large winter storm affects the nurseries' ability to harvest and ship plants. For Ozark native plants, there are several state-run and private nurseries in Arkansas and Missouri that already sell seed, seedlings, and mature plants:

Nursery	City, State	Phone	Website	Specialty
Arkansas Forestry Commission	North Little Rock, AR	(501) 907-2485	forestry.arkansas.gov	Bare root seedlings
Ernst Conservation Seed	Meadville, PA	(800) 873-3321	ernstseed.com	Native seed mixes
Forrest Keeling	Elsberry, MO	(573) 898-5571	fknursery.com	Bare root seedlings
George O. White State Forest Nursery	Licking, MO	(573) 674-3229	mdc.mo.gov	Bare root seedlings
Holland Wildflower Farm	Elkins, AR	(479) 643-2622	hollandwildflowerfarm.com	Native seed mixes
Pine Ridge Gardens	London, AR	(479) 293-4359	pineridgegardens.com	Potted plants
Ripley County Farms	Doniphan, MO	(573) 996-3449	ripleycountyfarms.com	Bare root seedlings
White River Nursery	Fayetteville, AR	(479) 442-2061	whiterivernursery.com	Potted plants

Japanese honeysuckle, despite its pretty and fragrant flowers, is a highly invasive vine. (Photo by Jennifer Ogle)

Invasive Plant Species: Avoid Planting!

When considering which plants to include in a riparian buffer, it is important to choose species that are native to the Ozarks because they contribute to increased forest health, improve water quality, and will provide the most benefit to wildlife. Native plant species are those that occur naturally in a particular area and are well-adapted to the climate and local habitat conditions in which they occur. In the United States, a plant is considered to be native if it was known to occur here before the time of European settlement. Natives provide quality habitat and food to wildlife, improve overall forest health, and contribute to water quality by stabilizing streambanks and capturing sediment and nutrients that might otherwise run off into the stream.

Invasive plant species, on the other hand, have been introduced, either accidentally or on purpose, to an area from outside of their native range, and display qualities that enable them to grow quickly and spread to the point where they disrupt natural ecosystem processes. Because most invasive plants are tolerant of a range of soil types, moisture conditions, and sunlight levels, they are often able to colonize a variety of habitat types. Although many invasive plants produce extensive root systems, their roots often don't grow as deeply into the ground as the roots of native trees and so are not as effective as natives in controlling soil erosion.

Once an invasive plant species becomes established in a new area, it is very difficult to control and it may be able to reduce the diversity of native plants by outcompeting them for nutrients, sunlight, and physical space. This, in turn, reduces the amount of food and shelter available for wildlife. Many invasive plants also produce chemicals that inhibit the growth of the plants growing near them, including some native tree species, which can result in a decline in forest health. When choosing plants to include in your riparian buffer, it is a good idea choose natives, as native plants will give you the best chance of achieving long-term success on your restoration project.

Local community groups can be great partners in riparian enhancement activities. (Photo by Bryant Baker)

Maintaining a Riparian Buffer

The work to create a new riparian buffer or enhance an existing buffer does not stop at putting plants in the ground. It is important to maintain a riparian buffer over the years to ensure it functions properly. This includes:

- Newly-planted trees may need to be watered for the first two years, especially during the hot summer months. Trees should experience deep watering periodically so that all of their roots have access to water. Make sure

not to overwater seedlings, as this can also damage the plants. After the first two years, your trees and shrubs should be relatively established and able to experience a wider range of moisture conditions.

- You will likely still need to check the buffer for invasive plants each season. Remove plants such Japanese honeysuckle, bush honeysuckle, and kudzu. These invasive plants can quickly establish and outcompete native species desirable for your buffer.
- If you used tree protectors, check that they are still intact after periods of high wind. Replace any damaged or lost protectors as needed.

Check for areas where your plants did not survive. Those areas may need to be replanted with different plants that are more suitable for the soil, moisture, or light conditions. There may also be areas that can be planted in the future to fill in riparian buffers.

It is important to find areas where existing riparian buffers can be filled in with more plants. (Photo by Bryant Baker)

Big bluestem (Photos by Bryant Baker)

Big bluestem
Andropogon geradii
Perennial – Warm Season; FAC

Big bluestem is a warm-season bunchgrass that grows 4 - 6' tall, and even taller when conditions are favorable. It prefers dry to medium soils and full sun exposure. Big bluestem is a perennial that develops an extensive root system over time, and is used to control wind erosion.

Eastern gamagrass
Tripsacum dactyloides
Perennial – Warm Season; FACW

Eastern gamagrass can grow up to 8' tall and prefers moist soils. While it is known for its high palatability as a forage for livestock, this grass has become increasingly important for use in streambank stabilization. Its strong root system makes it ideal for keeping soil in place, especially along streambanks or other areas prone to erosion.

Eastern gamagrass (Photo by Bryant Baker)

Indiangrass
Sorghastrum nutans
Perennial – Warm Season; FACU

Indiangrass is a warm-season bunchgrass that grows 3 - 5' tall. This perennial grows well in sun with dry to medium soils, and can tolerate heavy clay. Indiangrass is used to control wind erosion. Small mammals and birds eat the seeds of the plant in the fall.

Indiangrass (Photo by John Pennington)

Fox sedge (Photos courtesy Prairie Moon Nursery)

Fox sedge
Carex vulpinoidea
Graminoid; OBL

Named for its fruiting heads that are said to resemble a fox's tail, it is a common graminoid that occurs naturally in wet areas, including along streams. It grows 18 – 30" tall and prefers sun to light shade and medium to wet soils, but can also tolerate drier soils. Birds, including waterfowl, eat the seeds and use the dense leaves for cover. The plant also serves as a food source to many species of moth caterpillars, grasshoppers, and beetles.

Little bluestem

Schizachyrium scoparium
Perennial – Warm Season; FACU

This grass grows 1.5 - 2' tall in full sun with dry to medium soils, and can tolerate sandy or clay-loam soils. This perennial, warm-season bunchgrass forms dense mounds that turn a deep amber color in fall. Plants provide food and cover for ground birds and small mammals.

Little bluestem (Photo by Bryant Baker)

Switchgrass

Panicum virgatum
Perennial – Warm Season; FAC

Switchgrass typically grows from 3 - 5' tall, although some cultivars vary in height. It does well in dry or poorly drained soil, but it is particularly useful in Zone 3 (see page 8) in riparian buffers. Switchgrass is very important for erosion control, cover for wildlife, and food for birds.

Switchgrass (Photo by Bryant Baker)

Virginia wildrye in a Zone 3 grass and forb filter strip (Photo by Bryant Baker)

Virginia wildrye

Elymus virginicus
Perennial – Cool Season; FACW

Virginia wildrye can grow 2 - 3' tall and prefers moist soils. As it is shade tolerant, this grass can often be found in the understory of riparian areas, where it is useful as a soil stabilizer and forage for deer, birds, and small mammals. Its cousin, Canada wildrye, has larger seedheads and is typically found in dryer upland sites in full sun.

Woodoats (northern sea oats)

Chasmanthium latifolium
Perennial – Warm Season; FACU

Woodoats typically grows 2 - 4' tall in part to full shade. This grass grows best in dry to moist soils and is often found in the understory near streams. It is useful for erosion control and its seeds are eaten by birds and other small wildlife. The seedheads provide wonderful texture to a buffer during the winter.

Woodoats (Photo by Bryant Baker)

Ashy sunflower

Helianthus mollis
Perennial

Ashy sunflower is an upright perennial that grows 2 - 4' tall and typically grows in sun and dry to medium soils, but can tolerate a range of soil conditions. It is especially useful in the upland, outer zone of a riparian buffer where it can slow runoff and provide food and habitat for wildlife. Large, showy yellow flowers are produced in summer and into fall. Ashy sunflower gets its name from the rough hairs that cover the plant.

Ashy sunflower (Photo by R.W. Smith)

Cardinal flower (Photo by Eric Hunt)

Cardinal flower

Lobelia cardinalis
Perennial, FACW

Cardinal flower is a perennial forb that grows very well in riparian areas. Plants grow 2 - 4' tall, preferring part shade and rich, wet soil and produce showy red flowers in the late summer and early fall. These flowers are sought out by butterflies and hummingbirds for their nectar.

Purple coneflower

Echinacea purpurea
Perennial; FACU

Purple coneflower is a perennial forb that typically grows in dry to medium soils in sun to part shade, and grows 2 – 5' tall. This species tolerates drought and poor soils. Its showy flowers attract insects and its seeds are eaten by birds. This forb is easy to establish and thrives on a variety of sites.

Purple coneflower (Photo by Bryant Baker)

Slender mountain-mint (Photo by Eric Hunt)

Slender mountain-mint

Pycnanthemum tenuifolium
Perennial; FACW

Slender mountain-mint is a perennial that grows 2 - 3' tall and has very thin, needle-like leaves. In summer plants produce many clusters of small, fragrant, white flowers that attract bees and butterflies. It prefers sun to part shade in dry to medium soils. Its leaves smell of mint when crushed.

Spreading aster (Photo by Eric Hunt)

White wild indigo

Baptisia alba
Perennial; FACU

White wild indigo is a nitrogen-fixing perennial that grows 2 - 4' tall in dry to medium, well-drained soils in full sun to part shade, but can also tolerate clay and dry, rocky soils. Plants develop large, deep root systems. Flowers attract butterflies and other insects in the spring.

Spreading aster

Symphyotrichum patens
Perennial; FAC

Spreading aster is a 2 - 3' tall perennial and grows well in sun to part shade and dry to medium soils. The violet flowers with yellow centers appear in late summer to fall, providing a nectar source to insects when many other plants are not flowering.

White wild indigo (Photo by Eric Hunt)

Whorled milkweed (Photo by Eric Hunt)

Whorled milkweed

Asclepias verticillata
Perennial; FACU

Whorled milkweed is a perennial forb that grows 1 - 2.5' tall and produces white flower clusters in summer. It prefers dry to medium, well-drained soils in full sun. This and other native milkweeds are used by a variety of butterflies, including monarchs, and their nectar attracts many species of insects.

Wild bergamot

Monarda fistulosa
Perennial; UPL

Wild bergamot, also called beebalm, is a perennial that grows 2 - 4' tall and prefers dry to medium, well-drained soils in full sun to part shade. The plant is easy to establish and its showy, fragrant, pink flowers bloom for a long period in the summer, attracting hummingbirds and butterflies.

Wild bergamot (Photo by Bryant Baker)

Buttonbush (Photo by John Pennington)

Buttonbush

Cephalanthus occidentalis
Multi-stemmed shrub; OBL

Buttonbush is a shrub that grows 5 - 12' tall and requires medium to wet soils in sun to part shade. It is useful for erosion control along stream banks. Dense, spherical clusters of white flowers attract butterflies, bees, and other insects, and fruits are an important food for waterfowl in the fall.

Gray dogwood

Cornus racemosa
Multi-stemmed shrub; FACW

Gray dogwood is a thicket-forming shrub that grows 6 - 12' tall and prefers sun to part shade. This shrub grows best in medium to wet soils along streambanks and is useful for erosion control. Clusters of white flowers are produced in spring and into summer. The fruits are eaten by birds.

Gray dogwood (Photo courtesy NetPS Plant Finder)

Elderberry (Photo by Bryant Baker)

Elderberry

Sambucus canadensis
Single- or multi-stemmed shrub; FACW

Elderberry is a thicket-forming shrub that grows up to 12' tall. This plant can be commonly found in riparian areas and moist woodlands. Its large clusters of white flowers attract butterflies and its fruits provide food for many species of birds. Ripened fruits are also sought out to be used in making jelly and wine.

Indigo-bush

Amorpha fruticosa
Single- or multi-stemmed shrub; FACW

Indigo-bush is a shrub that grows 4 - 12' tall and prefers sun to part shade and medium to wet, well-drained soils. Shrubs branch near the top of the plant, where many fragrant purple flowers attract butterflies and bees in the spring. Indigo-bush is a nitrogen-fixing plant that grows well along streambanks. Plants can often be found growing in riparian thickets.

Indigo-bush (Photo by Bryant Baker)

Ninebark

Physocarpus opulifolius
Multi-stemmed shrub; FACW

Ninebark grows 5 - 8' tall and can form thickets. It grows along streams and tolerates a wide range of soil types and moisture levels, but prefers dry to medium soils and sun to part shade. White flowers are produced in late spring, and red fruits in fall.

Ninebark (Photo by Bryant Baker)

Ozark witch hazel

Hamamelis vernalis
Multi-stemmed shrub; FACU

Ozark witch hazel (Photos by Eric Hunt)

Ozark witch hazel is a shrub that typically grows 6 – 10' tall and can form thickets if allowed. It is often in gravelly stream beds and along streambanks as it is very tolerant of flooding. This species prefers full sun or part shade and medium soils. Plants produce striking, fragrant flowers in the winter that attract butterflies and provide beautiful color until spring. This shrub adapts well to a variety of sites.

Sandbar willow

Salix interior
Multi-stemmed shrub; FACW

Sandbar willow is a suckering, thicket-forming shrub growing 3 - 20' tall on sandbars and steambanks, and is often used in streambank restoration projects. Plants prefer full sun with medium soils. Sandbar willow provides shelter for many game birds and browse for deer.

Sandbar willow (Photo by Bryant Baker)

Spicebush (Photo by Bryant Baker)

Spicebush

Lindera benzoin
Single- or multi-stemmed shrub; FAC

Spicebush is a somewhat shade-tolerant shrub that grows up to 12' tall. Plants can be found along streamsides and generally in wooded areas throughout the Ozarks. This species is very apparent during the early spring when its branches are covered with vibrant clusters of yellow flowers.

American sycamore

Platanus occidentalis
Single-stemmed tree; FACW

American sycamore in early spring (Photo by Bryant Baker)

Sycamore is considered the most massive native tree in eastern North America, often reaching 140' tall at maturity. This tree is an early colonizer on streambanks and is great for erosion control. The distinctive, thin bark is brown when young, but on older trees is mottled with brown, green, and white. It prefers medium to wet well-drained soils in full sun. Fruits are tan, spherical, and mature in the fall.

Black gum (Photo by Eric Hunt)

Black gum

Nyssa sylvatica
Single-stemmed tree; FAC

Black gum is medium-sized tree that slowly grows 30 to 50' tall in medium to wet soils. This tree is easy to establish and can tolerate both flooding and drought, making it an excellent tree for riparian areas. The flowers are a great source of nectar to bees and fruits are enjoyed by many birds and other wildlife.

Black walnut (Photo by Eric Hunt)

Black walnut

Juglans nigra
Single-stemmed tree; FACU

Black walnut is a tree growing 75 - 90' tall with a long, straight trunk, and requires full sun and grows best in somewhat deep, medium, well-drained soils Spherical fruits remain closed at maturity, and the husk decomposes after falling to the ground. The tree's wood is highly valuable for use in woodworking.

Bur oak (Photo by Jennifer Ogle)

Bur oak acorn (Photo by Eric Hunt)

Bur oak

Quercus macrocarpa
Single-stemmed tree; FAC

Bur oak, also called mossycup oak, is 60 - 100' tall and is most often found growing along streambanks where it is very useful for erosion prevention. It grows in full sun and prefers dry to medium soil, but can tolerate a range of soil conditions. This tree produces the largest acorns of any native oak, distinguishable by their moss-like burs (hence the common names), which are eaten by a variety of wildlife.

Eastern redbud (Photo by Bryant Baker)

Eastern redbud

Cercis canadensis

Single- or multi-stemmed tree, FACU

Eastern redbud is a small tree that grows up to 30' tall in medium soils that get consistent moisture. While it does not thrive in flood-prone areas, it is still a great tree to plant in the more upland areas of riparian buffers. This species is best-known for its showy clusters of pink flowers in the early spring. The flowers can even be eaten raw in salads or fried!

Red maple (Photo by Bryant Baker)

Red maple

Acer rubrum

Single-stemmed tree, FAC

Red maple is a distinctive maple that grows 40 – 70' tall in medium to wet soils. This species is commonly found in riparian areas where it grows well mixed with other trees. Plants produce beautiful red flowers in early spring before leaf growth. Red maples attract birds and a large variety of other wildlife.

River birch in winter (Photo by Bryant Baker)

River birch

Betula nigra

Single- or multi-stemmed tree, FACW

River birch is a tree that grows 40 – 70' tall, with a short, forked trunk and an open growth habit. It is a good riparian tree that grows best in sun to part shade and medium to wet soils. Leaves and young twigs are browsed by wildlife, and turkey and other birds eat the seeds in spring. The characteristic bark provides nice texture to a riparian buffer, especially during the winter when there are no leaves present.

Shagbark hickory
(Photos by Bryant Baker)

Shagbark hickory

Carya ovata

Single-stemmed tree; FACU

Shagbark hickory grows 70 - 90' tall and has distinctive bark that separates into long, wide plates with ends that curl outward, giving trees a shaggy appearance. This hickory needs full sun and tolerates a wide range of soil conditions. Fruits have a thick husk which holds a sweet, edible nut. Bats use shagbark hickories as roost trees in spring and into fall. The tree produces some of the strongest wood in North America.

RIPARIAN PLANTS REFERENCE TABLE

Common Name	Scientific Name	Zone			Light			Soil			WIS				
		1	2	3	Sun	Part Shade	Shade	Dry	Med	Wet	OBL	FACW	FAC	FACU	UPL
Fox sedge	*Carex vulpinoidea*	X			X	X				X		X			
Redtop panicgrss	*Panicum rigidulum*	X			X					X		X			
Rice cutgrass	*Leersia oryzoides*	X			X	X				X		X			
Shallow sedge	*Carex lurida*	X			X	X				X	X				
Soft rush	*Juncus effusus*	X			X					X		X			
Buttonbush	*Cephalanthus occidentalis*	X			X	X			X	X	X				
Ninebark	*Physocarpus opulifolius*	X			X	X		X	X			X			
Sandbar willow	*Salix interior*	X			X				X			X			
Silky dogwood	*Cornus obliqua*	X			X	X			X	X		X			
Black willow	*Salix nigra*	X			X	X			X	X	X				
River birch	*Betula nigra*	X			X	X			X	X		X			
Eastern gamagrass	*Tripsacum dactyloides*	X	X		X	X			X			X			
Switchgrass	*Panicum virgatum*	X	X		X	X			X	X			X		
Virginia wildrye	*Elymus virginicus*	X	X		X	X			X			X			
Woodoats	*Chasmanthium latifolium*	X	X			X	X		X	X				X	
Cardinal flower	*Lobelia cardinalis*	X	X		X	X			X	X		X			
Tickseed sunflower	*Bidens aristosa*	X	X		X	X			X	X		X			
Elderberry	*Sambucus canadensis*	X	X		X	X			X	X		X			
False indigo	*Amorpha fruticosa*	X	X		X				X	X		X			
Roughleaf dogwood	*Cornus drummondii*	X	X		X	X			X	X			X		
Ozark witchhazel	*Hamamelis vernalis*	X	X		X	X			X					X	
Deciduous holly	*Ilex decidua*	X	X		X	X			X			X			
Southern arrowwood	*Viburnum dentatum*	X	X		X	X			X				X		
Carolina buckthorn	*Frangula caroliniana*	X	X		X	X			X				X		
American sycamore	*Platanus occidentalis*	X	X		X				X	X		X			
Black cherry	*Prunus serotina*	X	X		X	X			X					X	
Red maple	*Acer rubrum*	X	X		X	X			X	X			X		
Black gum	*Nyssa sylvatica*	X	X		X	X			X	X			X		
Shumard oak	*Quercus shumardii*	X	X		X			X	X				X		
Black walnut	*Juglans nigra*	X	X		X				X					X	
Bur oak	*Quercus macrocarpa*	X	X		X			X	X				X		
Hackberry	*Celtis occidentalis*	X	X		X	X			X	X				X	

RIPARIAN PLANTS REFERENCE TABLE

Life Span Ann.	Life Span Per.	Height (ft)	Spread (ft)	Bloom Color	Bloom Time (months)	Fruit Maturity (seasons)	Wildlife Supported
	X	1-3'	0.5-2'	Green	May - Jul	Sum - Fall	
	X	1-4'	1-2'	Red	Aug - Oct	Sum - Fall	
	X	2.5-5'	1-2'	Green	Jun - Oct	Sum	
	X	3-6'	2-3'	Green/Brown	Aug - Nov	Fall	
	X	2-4'	2-4'	Yellow/Green	Jun - Aug	Fall	
	X	5-12'	4-8'	White	Jun - Jul	Sum	
	X	5-8'	4-6'	White/Pink	May - Jun	Sum	
	X	3-15'	3-15'	White/Yellow	Mar - Apr	Sum	
	X	6-12'	6-12'	White	May - Jul	Sum	
	X	40-70'	40-70'	Yellow	Mar - Apr	Sum	
	X	40-70'	40-60'	Green/Brown	Feb - Mar	Spr	
	X	4-8'	4-6'	Brown	Apr - Jun	Sum	
	X	3-6'	2-3'	Green/Brown	Aug - Nov	Fall	
	X	2-4'	1-2'	Yellow	Mar - May	Sum	
	X	2-5'	1-2.5'	Green	Jun - Sep	Fall	
	X	2-4'	1-2'	Red	Jul - Sep	Fall	
X		1-3'	1-2'	Yellow	Jul - Aug	Sum - Fall	
	X	5-12'	5-12'	White	Jun - Jul	Sum - Fall	
	X	4-12'	6-15'	Purple	Apr - Jun	Sum	
	X	6-15'	6-15'	Yellow/White	May - Jun	Sum - Fall	
	X	6-10'	8-15'	Yellow/Red	Jan - Apr	Sum - Fall	
	X	7-15'	5-12'	White	May	Fall	
	X	6-10'	6-10'	White	May - Jun	Fall	
	X	10-15'	10-15'	Green/Yellow	May - Jun	Fall	
	X	75-100'	75-100'	Yellow/Red	Apr	Fall - Win	
	X	50-80'	30-60'	White	Apr - May	Sum	
	X	40-70'	30-50'	Red	Mar - Apr	Spr	
	X	30-50'	20-30'	Green/White	May - Jun	Fall	
	X	40-60'	30-40'	Green	Apr	Fall	
	X	75-90'	75-90'	Yellow/Green	May - Jun	Fall	
	X	60-100'	60-100'	Yellow/Green	Apr	Fall	
	X	40-60'	40-60'	Green	Apr - May	Sum	

RIPARIAN PLANTS REFERENCE TABLE

Common Name	Scientific Name	Zone			Light			Soil			WIS				
		1	2	3	Sun	Part Shade	Shade	Dry	Med	Wet	OBL	FACW	FAC	FACU	UPL
Shagbark hickory	*Carya ovata*	X	X		X	X			X					X	
Blue vervain	*Verbena hastata*		X		X				X	X			X		
Spicebush	*Lindera benzoin*		X		X	X			X				X		
White oak	*Quercus alba*		X		X			X	X					X	
Northern red oak	*Quercus rubra*		X		X			X	X					X	
Kentucky coffeetree	*Gymnocladus dioicus*		X		X				X				not ranked		
Eastern redbud	*Cercis canadensis*		X		X	X			X					X	
Flowering dogwood	*Cornus florida*		X		X	X			X					X	
Indiangrass	*Sorghastrum nutans*		X	X	X			X	X					X	
Blue false indigo	*Baptisia australis*		X	X	X	X		X	X				not ranked		
Obedient plant	*Physostegia virginiana*		X	X	X				X			X			
Purple coneflower	*Echinacea purpurea*		X	X	X	X		X	X					X	
Slender mountain-mint	*Pycnanthemum tenuifolium*		X	X	X	X		X	X			X			
Spreading aster	*Symphyotrichum patens*		X	X	X	X		X	X				X		
Sweet Joe Pye weed	*Eutrochium purpureum*		X	X	X	X			X				X		
Tall ironweed	*Vernonia gigantea*		X	X	X	X			X	X			X		
White wild indigo	*Baptisia alba*		X	X	X	X		X	X					X	
Whorled milkweed	*Asclepias verticillata*		X	X	X	X		X	X					X	
Wild bergamot	*Monarda fistulosa*		X	X	X	X		X	X						X
Big bluestem	*Andropogon gerardii*			X	X			X	X				X		
Little bluestem	*Schizachyrium scoparium*			X	X			X	X					X	
Purple lovegrass	*Eragrostis spectabilis*			X	X			X	X					X	
Sideoats grama	*Bouteloua curtipendula*			X	X			X	X				not ranked		
Ashy sunflower	*Helianthus mollis*			X	X			X	X				not ranked		
Blackeyed Susan	*Rudbeckia hirta*			X	X				X					X	
Showy goldenrod	*Solidago speciosa*			X	X			X	X				not ranked		
Foxglove beardtongue	*Penstemon digitalis*			X	X			X	X				X		
Plains coreopsis	*Coreopsis tinctoria*			X	X				X				X		

Graminoids
Forbs
Shrubs
Trees

Zone = Three-Zone Forest Buffer (see pg. 8 for more information)
Soil = Soil moisture conditions (Med = medium)
WIS = Wetland Indicator Status (see pg. 7 for more information)

RIPARIAN PLANTS REFERENCE TABLE

Life Span Ann.	Life Span Per.	Height (ft)	Spread (ft)	Bloom Color	Bloom Time (months)	Fruit Maturity (seasons)	Wildlife Supported
	X	70-90'	50-70'	Green/Yellow	Apr - May	Fall	
	X	2-6'	1-2.5'	Blue/Purple	Jul - Sep	Fall	
	X	6-12'	6-12'	Green/Yellow	Mar	Fall	
	X	50-80'	50-80'	Yellow/Green	May	Fall	
	X	50-75’	50-75’	Yellow/Green	May	Fall	
	X	60-80'	40-55'	Green/White	May - Jun	Fall	
	X	20-30'	25-35'	Pink	Mar - Apr	Sum	
	X	15-30'	15-30'	White	Apr - May	Sum - Fall	
	X	3-5'	1-2'	Yellow	Aug - Oct	Fall	
	X	3-4'	3-4'	Blue/Purple	May - Jun	Sum	
	X	3-4'	2-3'	Pink	Jun - Sep	Fall	
	X	2-5'	1.5-2'	Pink/Orange	Jun - Aug	Sum - Fall	
	X	2-3'	2-3'	White	Jul - Sep	Fall	
	X	2-3'	1.5-2'	Purple/Yellow	Aug - Oct	Fall	
	X	5-7'	2-4'	Pink	Jul - Sep	Fall	
	X	5-8'	3-6'	Purple	Aug - Sep	Fall	
	X	2-4'	2-2.5'	White	Apr - May	Sum	
	X	1-2.5'	1-2'	White/Green	Jun - Sep	Fall	
	X	2-4'	2-3'	Pink	Jul - Sep	Fall	
	X	4-6'	2-3'	Red/Brown	Aug - Nov	Fall	
	X	2-4'	1.5-2'	Green/Brown	Jun - Dec	Fall - Win	
	X	1-2'	1-2'	Red/Purple	Jul - Aug	Fall	
	X	1.5-2.5'	1.5-2'	Purple	Jul - Aug	Fall	
	X	2-4'	1-3'	Yellow	Jul - Sep	Fall	
	X	2-3'	1-2'	Yellow	Jun - Sep	Fall	
	X	2-3'	2-3'	Yellow	Jul - Sep	Fall	
	X	3-5'	1.5-2'	White	Apr - Jun	Sum	
X		2-4'	1-1.5'	Yellow/Red	Apr - Jun	Sum	

Ann. = Annual

Per. = Perennial

Butterflies

Bees

Songbirds

Hummingbirds

Waterfowl

Small mammals

Deer

GLOSSARY OF TERMS

Annual – plant that completes its life span in a single year

Best management practice – land management activity that can reduce or prevent pollution of surface and groundwater

Biennial – plant that completes its life span in two years

Cool season plants – plants that reach peak growth earlier in the year during cool, moist conditions

Deciduous trees and shrubs – in the Ozarks, trees or shrubs that lose their leaves during the fall

Ecoregion – geographical area that can be defined by particular ecological features such as climate, terrain, and organisms

Ecosystem services – benefits that ecosystems provide to humans

Endemic – organism that is only found on Earth in a single defined area

Erosion – removal and subsequent transport of material such as soil or rocks by water or wind

Floodplain – low-lying area adjacent to a stream that is inundated during periods of high flow

Forb – herbaceous (see below), flowering non-graminoid plant

Geotextile – permeable textile used for soil stability, erosion control, and increased drainage

Graminoid – herbaceous (see below), non-forb plant

Headwater – furthest upstream and highest stream in a watershed (also known as sourcewater)

Herbaceous – plants that have no persistent woody growth aboveground

Invasive plant species – nonnative plant that can become intrusive and outcompete other plants

Macroinvertebrate – invertebrate animals larger than 0.5 mm found in lakes and streams that are vital for the food web and whose presence can be important for determining the health of a waterbody

Perennial – plant whose life span is greater than two years

Percolation test – a method for determining the infiltration or absorption rate of soil

Riparian area (zone) – area immediately adjacent to a water body such as a lake or stream

Riparian buffer – vegetative buffer in a riparian area that helps protect a water body from adjacent land use

Runoff – overland flow of water that occurs during a rain event

Shrub – short, woody plant that often has multiple stems originating near the base of the plant at ground level

Soil texture – combination of sand, silt, and clay of a soil that is described using categories such as “clay loam” or “loamy sand” and which can be informative in regard to various soil characteristics

Three-Zone Forest Buffer – riparian buffer design that consists of an unmanaged natural area nearest the water body (Zone 1), a managed forest further upland (Zone 2), and a filter strip furthest from the water body that acts as the first step in the buffer’s filtration process (Zone 3)

GLOSSARY OF TERMS

Tree – woody perennial plant that is typically characterized by having a single stem (trunk) and that grows to a considerable height

Tree protector – usually a plastic or wire tube that is placed around the base of a tree or a newly-planted seedling to protect the plant from being damaged and increase its chance of survival

Understory – area beneath a forest's canopy that is characterized by shorter trees, shrubs, grasses, and forbs that are at least partially shade-tolerant

Warm season plants – plants that reach their peak growth in the late spring and summer months

Water quality – chemical, physical, and biological characteristics of water relative to the designated use of a particular water body

Watershed – area that drains water to a single point in the landscape

Woody vine – woody perennial plant that has roots in the ground near whatever support it can climb