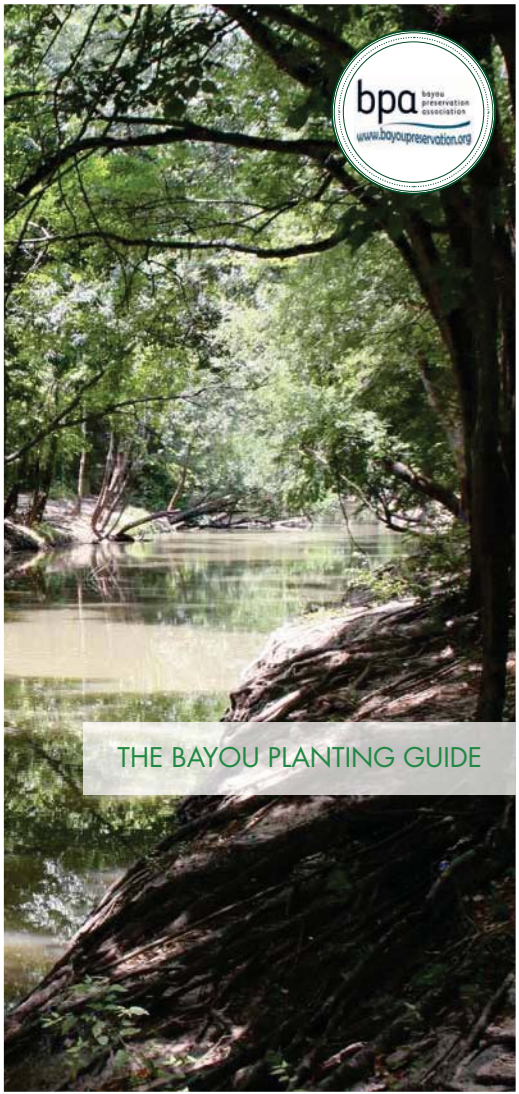

# THE BAYOU PLANTING GUIDE

BAYOU PRESERVATION ASSOCIATION MISSION:

Protect and restore the richness and diveresity of our waterways through activism, advocacy, collaboration and education.

THIS GUIDE BELONGS TO

NAME

ADDRESS

DATE

3rd Revision, Printed February 2014

# THANK YOU!

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**Concept, Text, Editing & Production**

*Author, Mark Bowen*

Judy Boyce, Ralph De Leon, The Garden Club of Houston, Terry Hershey, Steve Hupp, Kathy Lord, Mickey Merritt, Marina Rossow, Eric Ruckstuhl, Evelyn Shanley, Kevin Shanley, Brenda Buest Smith, Carolyn White and Mary Ellen Whitworth

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*Printed on recycled paper with soy-based inks.*

## FOREWORD

*by Terry Hershey*

***Terry Hershey** co-founder of the Bayou Preservation Association, board member of the Association of Floodplain Managers Foundation and the National Recreation Foundation, and former Commissioner of the Texas Parks and Wildlife Commission*

Hats off to the Garden Club of Houston for providing a grant to Bayou Preservation Association for this edition of the Bayou Planting Guide. A special thank you to Texas Forest Service for underwriting and to Bayou Preservation Association for sponsoring the first bayou planting guide. The guide is created for citizens who own land along one of the bayous, for those who have detention swales, diversion swales, rain gardens and/or ponds on their properties and for agencies who have some responsibility for bayou maintenance.

Since 1912, water and land use experts have encouraged Harris County, the City of Houston and the greater Houston area to better utilize our extensive bayou system, which extends through 22 watersheds. Our bayou corridors can and should serve a vital role providing parklands, open green spaces and water amenities.

Plans and warnings have often been ignored over the years resulting in missed opportunities to improve the quality of life and economic vitality of our community. In recent years, knowledge regarding the hydrological value of the bayou system and its ecological and economic significance has emerged as an important tool for use in urban planning.

Unfortunately, many of our bayous have been altered through straightening, stripping of bank-holding vegetation and lining with concrete bottoms as well as grass and concrete lined banks – practices that make it difficult to restore the bayous usefulness. This publication



is intended to help concerned citizens and agencies recapture some of these surrendered attributes and prevent further degradation.

Preservation of our precious few unaltered streams, generally tributaries to the main bayous and upper Buffalo Bayous, is critical. Through restoration efforts, bayou corridors can become affective again in providing rainwater absorption, floodwater management, pollutant filtration, air and climate quality improvement through planting efforts, and vital natural habitats for the wildlife that shares our space.

Revitalization of a portion of Buffalo Bayou, from Shepherd to the Turning Basin, has been proposed in conjunction with the 2002 Thompson Design Plan, sponsored by the Buffalo Bayou Partnership. This plan has the potential to restore some of the attributes of a river and provides an economic boost to an under-utilized section of downtown to the Turning Basin.

The Memorial Park Demonstration Project along Memorial Park and River Oaks Country Club is planned to restore a portion of Buffalo Bayou to a more natural and sustainable configuration with fluvial geomorphologic features and native plantings.

A citizen-pushed endeavor, termed the Quality of Life Coalition, has pinpointed the economic value of our riverine system. Knowledge of native vegetation, trees, and plants is critical to efforts to protect and restore our watersheds.

In November 2012, City of Houston voters passed a resolution by a wide margin to establish more park space along our bayous with the "Parks By You" referendum. What a resounding endorsement of the value of our bayous!

The Bayou Preservation Association was incorporated as a tax-deductible nonprofit organization in 1966 by a group of citizens alarmed by what was happening to our rivers. The organization began an effort to protect Buffalo Bayou from the concreted fates of Brays Bayou and White Oak Bayou. Knowledge of fluvial geomorphology, the study of riverine landforms, was becoming increasingly important. Locally, people began to recognize that straightening and stripping rivers of their curves and vegetation contributed to downstream flood transference.



In the case of Buffalo Bayou, George Mitchell, then president of the BPA, enlisted the help of Congressman George H.W. Bush, who requested the Army Corps of Engineers conduct a re-study of the plan in 1966 and 1967. Subsequently, the Corps withdrew its structural solution. In the 1970's, the Corps began to heed the call for nonstructural solutions to riverine flooding. In other states, previously concreted waterways were being restored to their natural condition.

What was once perceived as a "green" environmental issue is now also recognized as an important economic issue. Expenditures that were once devoted to altering Mother Nature's rivers are now directed toward changing our previous detrimental behavior. Through the Federal Flood Insurance Program, some relief is being granted to those already improvidently located in the floodplain. Efforts are also underway to prevent additional imprudent development. In Harris County, repetitive losses due to flooding place a serious strain on private and public budgets. Both the Harris County Flood Control District and FEMA are now buying out repeatedly flooded properties and removing high-risk buildings as quickly as funding permits.

Finally, this planting guide comes as a crucial and overdue endeavor. It is important for the owners and managers of property along our bayous to realize that to continue enjoying bayou views and other benefits, we must work together with nature to preserve and restore streambanks.

This publication provides essential knowledge. Mindful of the Association of State Floodplain Manager's mantra, "No Adverse Impact," we must remember that our impact on the land in bayou watersheds affects those who live downstream.

*"We all look at Nature too much, and live with her too little."*

*- Oscar Wilde*

## INTRODUCTION

*by Carolyn White and Steve Hupp*

Navigating the greater Houston area, from prairie uplands and edges of the piney woods to coastal wetlands and bays, the waterways of our region host a diverse mix of plants and wildlife unmatched in its richness. These bayous, along with their associated wetlands, provide connections between unique habitats. These riparian areas are also vital to maintaining water quality, buffering flood risk potential, providing nurseries for fish, controlling erosion and supporting recreational pursuits.

Wetlands are transitional areas between uplands and water. They host water-dependent vegetation in their water-logged soils. Within the greater Houston area, there are three major types of wetlands: tidal or estuarine wetlands located along the coast, freshwater wetlands of the prairies and flat woods, and forested wetlands along rivers and bayous.

Systematic changes in wetland plant species follow the transition from inland freshwater habitats to coastal saltwater habitats as two critical parameters change, salinity and elevation above the water surface. Changes in salinity within the wetlands dictate the diversity of plants that are supported.

Plant diversity decreases as salinity increases. In addition, as one moves higher in elevation, away from and above the water surface, the mixture of species comprising the plant community also changes. This variation in plant life associated with a water system is especially dramatic in riparian areas. Riparian areas comprise the unique vegetative zone found along rivers and bayous.

Over a short distance, the list of plants that can be supported shifts depending upon the amount of and duration of water they receive from rivers or bayous. Riparian vegetation is particularly important in maintaining water quality and providing habitats.

Critical functions of a riparian ecosystem with canopy cover include providing shade, which moderates water temperature and increases the oxygen necessary to support aquatic life; providing inputs of nutrients; filtering



sediments and pollutants from runoff; and promoting bank stability.

While there is some regulatory protection for wetlands through a permit process, many smaller wetlands and especially riparian corridors are not adequately protected by existing laws and their enforcement. Development trends also constrain land available to support freshwater wetlands in the Houston area.

Loss of saltwater wetlands along the upper Texas coast and bays has resulted from land subsidence due to geologic compaction of ancient coastal plain sediments, hastened by extraction of oil, gas and groundwater. Freshwater inflows required to support estuarine wetlands along the bays of the upper Gulf Coast region are also threatened. The increases in impervious cover from development has reduced the infiltration of rainfall and reduced the amount of shallow groundwater that also supports riparian habitats.

It is important for individual landowners to act as stewards by fostering healthy riparian and wetland vegetation on their properties. This guide provides a key to the native vegetation associated with riparian habitats in the Houston region for the purposes of conservation and enhancement.

Riparian restoration practices involving vegetation are outlined for landowners, decision makers and other stakeholders. In addition to being useful along bayou corridors, many of the plants profiled in this guide are also suitable for use in and around bioretention areas, swales, ditches, bogs, seasonal wetlands, bottomlands, moist forests and wet prairies.

This updated second edition of the Bayou Planting Guide doubles the number of plants profiled and lists species that are often commercially available.

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**Carolyn White** is an environmental planner, Advisory Board member of the Bayou Preservation Association, and member of the Water Quality Committee.
**Steve Hupp** is the Bayou Preservation Association's Water Quality Director.



# THE BAYOU PLANTING GUIDE

## TABLE OF CONTENTS

## RESTORING OUR BAYOUS

The following general suggestions relate to four major types of land restoration efforts conducted along riparian corridors in southeast Texas. For additional technical assistance, see Resources (page 93) and Recommended Reading (page 93).

### RIPARIAN WETLAND RESTORATION TIPS

Wetlands are transitional areas between water and uplands. They host water-dependent plants in their waterlogged soils.

- Avoid scraping or otherwise severely disturbing toe (foot of a bank, see Glossary) of the streambank or water's edge on project sites to keep from causing unacceptable levels of erosion. Install live stakes, seedling, plugs or containerized plants manually.
- Use erosion control fabric or tacked-down straw to prevent erosion and to increase the odds of plant survival.
- Locate plants with regular moisture needs low enough (toe or water's edge) to ensure adequate moisture is present during low water periods. Conversely, check plant descriptions and check out local native and naturalized ecosystems for reference, to determine which plants will tolerate heavy water flow and submersion during high water periods.
- Weed manually or mechanically (with caution) as needed and fill in bare areas after weeding with more plants if possible.

### RIPARIAN WOODLAND RESTORATION TIPS

Riparian woodlands consist of various types of woodland forest ecosystems located along streams that are mostly, if not completely, dominated by trees.

- Plant densely with a substantial number of trees from seedling size to 15-gallon container size. Expect a moderate percentage of plant loss when seedlings are planted.
- Keep in mind that native trees in woodlands are often capable of growing much closer to each other than non-native trees in cultivated landscape settings. Restoration efforts will be most successful on a long-term basis if a woodland ecosystem is established rather than a simple collection of trees.
- Plant during winter months if possible, so trees have the best chance to become established enough to survive their first summer in the ground.
- Remove noxious weeds manually as needed. Undesirable grasses can often be allowed to grow between trees over the short term. As the trees begin providing an increasing amount of shade, most grasses as well as many sun-loving pioneer weeds will begin to decline in health. At that point, shade-tolerant understory shrubs, groundcover and perennials can be established with greater ease.
- Mulch new trees and seedlings three to four inches thick with pine straw or coarsely shredded native mulch.
- Avoid removing lower limbs on young trees if possible. Trees will develop more qualitatively if greater quantities of branches are present.
- Please note that purchasing trees in container sizes of 65-100 gallons rarely provides a good return on the initial investment when a large numbers of trees are needed. When planted at the same time, 15-gallon trees and 100-gallon trees are often the same size after 10 years.
- Water new trees as needed and pay especially close attention to their health during the first summer following planting.

> *"There is no unemployed force in Nature. All decomposition is recomposition."*
>
> *- Ralph Waldo Emerson*

### PRAIRIE RESTORATION TIPS

A prairie is a grassland of native grasses, sedges, rushes and forbs with woody plants making up less than 10 percent of the plant community. Prairie ecosystems can occur along the banks and slopes of streams when adequate sunlight is present.

- Scalp existing non-native grasses and weeds to the ground, remove the debris and then lightly rough up the topsoil layer to a one-inch depth with a steel bow rake (soil rake) or a comparable tool.
- Plant any plants intended for the restoration area, that are in plugs or containers, before seeding.
- Broadcast prairie plant seeds by hand or with a seed spreader (available at most feed stores and nurseries) after mixing the seeds with coarse sand at the ratio of one part seed mix to four parts sand in order to make broadcasting easier.
- Proceed by rolling or pressing the seeds into the soil to keep them in place and to minimize loss to birds.
- Weed aggressively, by hand if possible, for the first several years after planting and mow to a six-inch height once a year or implement a controlled burn once each year if possible.
- Use weed eaters as needed to keep weeds and non-native grasses less than one foot in height the first two years if weeding by hand has not kept unwanted weeds in check.

### WILDFLOWER MEADOW RESTORATION TIPS

> *"I am at two with nature."*
>
> *- Woody Allen*

Wildflower meadow restoration projects typically involve adding native wildflowers (but not tall prairie grasses) to existing non-native grassland that is periodically mowed. Wildflower meadows can occur along the top banks and slopes of streams provided adequate sunlight is present.

- Select well-drained, sunny sites for wildflower seeding projects for best results. Add seeds in early fall to optimize germination.
- Choose regionally adapted wildflower blends. Consider wildflower mixes produced by Wildseed Farms, www.wildseedfarms.com, (800) 848-0078; or Native American Seed, http://seedsource.com, (800) 728-4043.
- Scalp existing non-native grasses and weeds to the ground. remove debris and rake soil with a steel bow rake to a depth of one inch.
- Broadcast seed at recommended rates by hand or with a seed spreader after mixing one part seed mix to four parts coarse sand to make spreading easier.
- Roll the ground after broadcasting seeds to press them into the soil.
- Wildflowers must be given a chance to go to seed in the spring. The naturalization process requires the skipping of a few mowing cycles in the spring. Wild-

flowers need to be left alone for two to three weeks after flowering has finished. Avoid mowing lower than six inches to avoid damaging perennial wildflowers.

- Wildflowers generally do not need to be fertilized. Fertilization can actually give weeds an advantage.
- Supplemental seeding will be necessary for several years after the initial seeding. Newly seeded areas may need to be watered periodically to prevent the soil from becoming completely dry.

## EROSION CONTROL TIPS

**MULCHING.** Tacked-down straw, including pine straw, is the most effective mulch for bayou slopes, followed by coarsely ground, recycled native mulch, shredded to three to six-inch lengths. Avoid fine-textured mulches or those likely to decompose quickly. Install a three to six-inch mulch layer. Mulch layers need to be touched-up periodically during the first few years of restoration until plantings have become dense. Jute netting, netting made of organic fibers, can provide additional strength to banks until plants have had a chance to become established. Jute netting should be overlaid with other mulches.

*"Plant and your spouse plants with you; weed and you weed alone."*

*- Jean-Jacques Rousseau*

**BANK RESTORATION.** If slope failure should occur, consult "Biotechnical and Soil Bioengineering Slope Stabilization," by Sotir and Gray for ideas regarding bioengineering solutions for streambank restoration. Other resources for natural channel design and stream restoration are available through various consultants including Dave Rosgen of Wildland Hydrology Consultants. Slope failure has occurred when erosion has degraded a streambank to the point that plants alone will not be capable of stabilizing a streambank. According to environmental planner Carolyn White, channel stability is the ability of a stream to transport the water and sediment of its watershed in such a manner as to maintain its dimensions, patterns and profile over time without either aggrading or degrading.



**TOP BANK BERMS.** Consider improving the grade along the top bank above erosion-prone slope areas in order to spread out and lesson the force of water runoff. Or, consider establishing top bank berms (raised soil areas) to divert water runoff from highly erosion-prone slope areas.

**MINIMIZE SOIL DISTURBANCES.** Tilling, needlessly stripping helpful vegetation, careless grading and construction activities create bare soil or disturbed soil conditions which are far more erosion prone. Avoid stripping a site clean when conducting restoration projects. Remove only aggressive alien weed species that present a threat to restoration success.

**VEGETATION DIVERSITY.** By planting a diverse mixture of overstory, understory and ground-dwelling native plant species, the variety of root structures will collectively lead to a mosaic-like fabric of roots capable of providing enormous erosion resistance to streambanks. Vegetation helps prevent rainfall-related erosion and wind erosion, and is beneficial by filtering sediment out of water runoff. Vegetation helps improve streambank absorption capacity so that more moisture is retained in the streambank.

**STAKE STONE TOES.** If stone toes are present along bayou bottom areas, consider driving cut branches (stakes) into the soil through openings in the stones. Willow, elderberry and cottonwood cuttings are conducive to being used as stakes.

**HERBICIDES.** Careful use of herbicides can be a useful tool in vegetation management for habitat restoration, particularly in removal of non-native, invasive plant species. Herbicides kill target species and should be managed to not kill non-target species. The killing of non-target species can lead to bare soil and increased erosion. If herbicides run off into bayous, the active ingredients may kill aquatic vegetation and/or harm other aquatic life. Herbicides also degrade the quality of soils by suppressing helpful microbe populations. Weed species should be controlled manually, mechanically, and by outcompeting them through active restoration of tough native species, whenever possible. Herbicides can be valuable tools for controlling non-native, invasive vegetation, when they are used properly by an educated and careful user. Pinpointed applications on targeted individual plants can be done with no to minimal effect on non-target plants. Avoid general broadcast of herbicide as this leads to bare soils, erosion and impacts in waterways. Always read and follow the instructions on



the label (by law), for the herbicide and the type of application being performed.

**FEASIBILITY.** Assess whether or not vegetative restoration alone will provide a sufficient remedy along a streambank, or whether the risk of slope failure exists. If slope failure is a possibility, professionally installed and permitted bioengineering solutions may be needed. Local governmental agencies such as city public works departments, the Army Corps of Engineers and county flood control districts are responsible for permitting issues. For more information, consult the booklet "Guidelines for Streambank Restoration" (see bibliography), the book, "Soil Bioengineering Slope Stabilization" (see bibliography), and the book, "Stream Corridor Restoration, Principles, Process and Practices " by the Federal Interagency Stream Restoration Working Group, 1998.

## PLANTING TIPS

**OBSERVE.** Study riparian ecosystems in the general area to determine which plants are affective in the immediate vicinity. Find out which plants are typically among the dominant species, which species occur on an accent or complementary basis and which plants appear to function well as companion plants.

Keep in mind that some of the plant species observed may be undesirable, aggressive alien weed species capable of taking over a bayou corridor and compromising its biological diversity. Some native species that were historically present in the area, but are currently absent, may be worthy of reintroduction. Also, consider that streambank characteristics can vary enormously from place to place, even within a small bio-region.

**CHOOSE NATIVES.** The term native is generally defined as referring to those plants that were present in a given area when European explorers arrived in the area and started chronicling plant species. Native plant species are ultimately time-tested plants and usually perform reliably when reintroduced and sited properly in their native ranges.

**BE CAUTIOUS WITH NON-NATIVE SPECIES.** It is generally advisable to avoid introducing non-native plants to native riparian ecosystems, since they may take over or cause unforeseen problems. While it is true that several

non-native plant species can make complementary companions to native plants in cultivated gardens and landscapes, riparian ecosystems are not considered cultivated. Unwanted dispersion from water movement can spread non-native species.

> *"Nature will out."*
>
> *- Aesop*
> *(6th cent. B.C.)*

Complementary non-native plant species for cultivated gardens are those that tolerate local conditions, provide wildlife habitat, food, and medicine, benefit soils or provide other useful functions without becoming pests after escaping cultivation.

On the other hand, aggressive and invasive non-native plants can damage riparian ecosystems by displacing native plants and by reducing biological diversity, a process that can lead to land degradation involving decreased habitat value (fewer types of berries, nuts, leaves, nectar sources, cover, etc.) and a reduction in the variation of different root structures and plant canopies, leading to compromised bank stability.

The following aggressive and invasive non-native plant species are occasionally planted along and near bayou corridors but should be strictly avoided: *Triadica sebifera* (Chinese Tallow), *Ligustrum sinese* (Chinese Privet), *Wisteria sinensis* (Chinese Wisteria) and *Lonicera japonica* (Japanese Honeysuckle). Aggressive non-natives often do not experience the same natural checks and balances (diseases and pests) that may keep them from causing severe damage to ecosystems in their lands of origin. For information on the "Dirty Dozen", visit www.bayoupreservation.org.

**PLANT IN WAVES.** It is advisable to approach a plant restoration project as a three to seven-year process. The risk of substantial plant loss due to floods, drought or other factors can be greatly minimized by planting the bulk of the plants over the first year or two at different times during the same year. Additional plantings in subsequent years can help with fine tuning and filling in areas that have suffered plant losses.

**ORGANIZED CHAOS.** Plant in semi-random but planned patterns that resemble those found in natural ecosystems.



Visit climax-plant community models (mature ecosystems) before undertaking restoration projects. Implement diverse planting schemes rather than monocultural (one species) or limited diversity schemes. Avoid menagerie plantings with an emphasis on planting of one of every known species that might have a chance of survival.

Instead, plant larger numbers of several different co-dominant plant species (foundation, staple plants) that are commonly found in large quantities in native ecosystems. Subsequently, plant smaller numbers of a larger variety of accent or complementary species to increase overall diversity, performance, habitat value and ornamental interest. Avoid lining plants up in rows so that roots can more quickly form mosaic growth patterns to stabilize banks quicker.

**SPACING.** Conventional planting schemes (specimen landscape collection) in cultivated landscapes involving non-native plants often emphasize distant spacing patterns between woody species (trees and shrubs) to prevent disease and insect problems. Conversely, native companion plants can often be spaced closer to one another than non-natives because these plants have been historically conditioned to grow together as integrated components of multi-species ecosystems.

**PRACTICE LAYERING.** When restoring a woodland, prairie or wetland, it is important to make sure multiple vertical layers of plants are represented. Plant overstory, understory, and ground dwelling plants together. Layering increases the overall resilience and habitat value of an ecosystem.

**WHEN DIGGING.** Dig holes for container-grown plants at least twice as wide as the diameter of the root ball. Dig holes slightly more shallow than the depth of root balls so the top of the root ball is slightly above grade (ground level) when planting is finished. Dig planting holes with jagged sides, so that spreading roots will be less likely to grow in circles causing eventual plant death or lack of vigor from root girdling.

**AVOID ROOT-BOUND PLANTS.** Steer clear of planting plants with roots already growing in circular patterns around the edge of the root ball. Check plants before purchasing them to try to prevent this problem. If you find yourself stuck with root-bound plants, prune some of the outlying roots as if cutting into a pie. Then pull the roots



and spread them outward when placing the root ball in the planting hole, so that the roots will have a chance to grow outward, rather than in circles.

Keep in mind that even moderately root-bound plants often revert back to root-girdling growth patterns even if root pruned. The girdling problem is mostly related to woody plant species such as trees and shrubs. Many herbaceous perennials will outgrow root-bound conditions.

**BACKFILL WITH NATIVE SOIL.** Backfill planting holes with native soil, the same soil that was removed from the hole. Do not add improved soils around the sides of the root ball. Improved soils below around level can lead to root rotting since they often contain more moisture-retentive organic matter than the surrounding native soils. Also, the organic matter (compost, bark mulch, rice hulls) in improved bedding soils will eventually decompose, causing the level of soil around the root ball to drop, possibly exposing roots or leaving sink holes around the root ball.

> *"I think that I shall never see*
> *A billboard lovely as a tree.*
> *Indeed, unless the*
> *billboards fall*
> *I'll never see a tree at all.*
>
> *- Ogden Nash*

**SEEDINGS.** Sharpshooters are spades with long, narrow blades that can be used to slice the soil and create a planting wedge suitable for inserting seedlings without lateral roots. After inserting a seeding into the sliced opening, the soil can be pressed into place around the seedling with firm foot pressure.

**CUTTINGS.** Fresh cuttings of black willow, eastern cottonwood and rough-leaf dogwood can be driven into slopes and toes as live stakes, which are living, woody plant cuttings capable of rooting with relative ease. Live staking is an effective system for securing natural material erosion control fabrics such as jute mesh, coir or other blanket surfaces.

Cuttings can be acquired from native or naturalized population, with permission. Stems to be used for cuttings should be cut 8-12 inches from the ground. Side branches should be removed. The stakes will work best if they are 1.5 inches in diameter and 2 to 3-feet long. The bottom ends should be cut at an angle and the tops should be flat. A dead blow hammer (filled with sand) can be used to drive in the stakes.

> *"Even if I knew that tomorrow the world would go to pieces, I would still plant my apple tree."*
>
> *- Martin Luther*

Stakes can be spaced 2 to 3 feet apart in staggered patterns. Eighty percent of the length of stakes should be driven into the ground at right angles to slopes. If buds are present, make the end on which they occur the top end.

Consult the book, "Biotechnical and Soil Bioengineering Slope Stabilization," by Sotir and Gray for information about advanced techniques for using cuttings including fascine, brushlayer and branchpacking installation. Cuttings should be used during the dormant season, they need to be kept moist during storage, and they should be used when fresh on the same day as installation.

**STAKING** Placing stakes around trees for stability is only recommended if trees are very top heavy. Staking trees with balanced tops and bottoms retards their resilience and development.

## THE KEYS FOR SUCCESSFUL ESTABLISHMENT

**ESTABLISHMENT PERIOD.** Case studies have indicated it generally takes at least seven to ten years of intensive work and monitoring to restore an ecosystem or natural habitat.

**WEEDING.** Preventing alien invasive plants such as Chinese tallow from taking over newly restored areas may be the most serious threat to success. Weeds should be removed by hand or mechanically depending on the situation. Increasing plant density may help restored ecosystems outcompete seeds of invasive plants.



**WATERING.** Ideally, planting should take place between fall and early spring to minimize the chances of plant death due to drought stress. During the first year, new plantings should be watered twice per week for the first four weeks (on average), once every two weeks from November to February, once per week during the months of October, March and April, and once to twice per week from May to September. Schedule adjustments should be made during drought or rainy periods. Plantings should require less supplementation during the second year. It is extremely important to water as slowly and deeply as possible to encourage deep rooting and to minimize erosion. It may be necessary to water a specific area two to three times back to back in order to be able to water deeply enough without causing runoff.

**SOIL FERTILITY.** It is often not necessary to fertilize streambanks if the fertility of existing soils has not been degraded. Consider testing soil as needed to assess fertility levels or toxin levels if needed. If fertilizing, use low analysis, slow release, dry natural organic fertilizers such as alfalfa meal 3-1-2, Microlife 6-2-4, or Earth's Essentials 5-1-3. These fertilizers can be applied in early spring and again in the fall at an average rate of 20 pounds per 1,000 square feet. Trees should not be fertilized individually. Instead, fertilizers should be broadcast over the entire soil area. It is important not to use quick release, high nitrogen or phosphorous fertilizers due to the runoff pollution that will result. Slow release organic fertilizers are preferable to time release chemical fertilizers due to the fact that organic fertilizers add helpful organic matter to bayou slopes and stimulate the development of the soil food web (beneficial microbial populations). The soil microbes help make nutrients available to plants, help convert organic matter to humus and help fight off disease causing pathogenic microbes.

**MULCH.** Maintain adequate mulch layers during establishment periods where possible to prevent erosion, to minimize weed intrusion and to preserve moisture. Pine straw often works best, followed by coarse shredded native mulch. Pine straw may need to be tacked down on steep slopes. Erosion control fabrics are useful for providing extra support to slopes during the establishment period.



**SUPPLEMENTAL PLANTINGS.** Supplemental plantings will usually be necessary on a periodic basis for several years to fill in sections with struggling plants, to replace dead plants and to compensate for environmental or construction related damage to restored bayou areas.

**ANIMAL DAMAGE.** In some instances it may be necessary to protect new plantings from forage damage by using tree shelters, selective fencing or by reintroducing predators if appropriate. Careful consideration should be given to whether desired plant species will survive foraging damage. Some plant species such as Ruellia will suffer severe damage early, and then they will self-propagate aggressively until a sustainable population level has been achieved.

> *"Nothing in nature is isolated. Nothing is without reference to something else. Nothing achieves meaning apart from that which neighbors it."*
>
> *- Goethe; 1749-1832*

**MONITORING.** Streambank restoration projects should be monitored routinely during the first seven to ten years, and especially after each significant high-water period. Erosion damage discovered during monitoring must be addressed proactively in order to sustain streambank integrity. Detailed field notes should be kept that chronicle the changes that occur over the years to facilitate a deeper understanding of the natural and unnatural processes affecting a particular bayou corridor. The success or demise of specific plant species, challenges with aggressive weed species and changes in the course and condition of the bayou should be chronicled. The effects of erosion and sedimentation as well as the maturation or degradation of the overall riparian ecosystem should be carefully noted.