



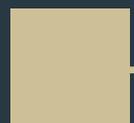
The Open Space Council  
for the St. Louis Region



# Live Willow Staking in the Meramec River Watershed

## Best Practices Report

The Open Space Council for the St. Louis Region



# About the Open Space Council

The Open Space Council for the St. Louis Region (OSC) is a nonprofit organization whose mission is to conserve and sustain land, water and other natural resources throughout the St. Louis region. Founded in 1965, OSC has a long history of engaging volunteers in the restoration and stewardship of the region's public lands and waterways. Annually, OSC hosts Operation Clean Stream in the Meramec Watershed, one of the largest and longest running river cleanups in the country. OSC also leads volunteers in habitat restoration projects such as native plantings and invasive species removal in parks and along greenways.

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## Project Partners & Funders

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American Water Charitable Foundation

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Great Rivers Greenway District

Open Space Council Members

Recreational Equipment, Inc.

St. Louis County Parks

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# Project Description

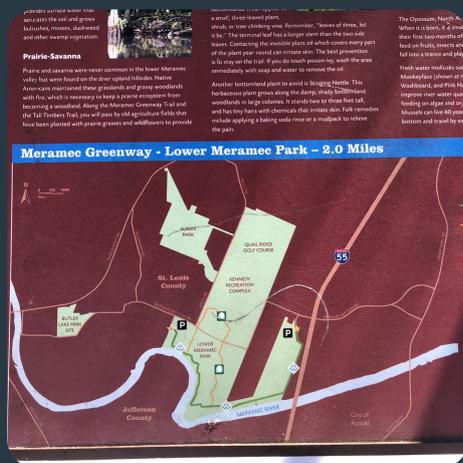
In 2019, the Open Space Council (OSC) conducted the first willow staking project in Lower Meramec Park to combat erosion happening along the park's Meramec River frontage. The work was performed by a group of community volunteers under the direction of the Open Space Council. Live willow staking is an innovative technique that helps stabilize eroding riverbank by providing a natural plant root system. Live black willows were harvested by volunteers from a nearby park where the willows were plentiful. The black willows were cut into stakes and transported to Lower Meramec Park where they were planted in the barren river bank along the Meramec River. Black willow trees are uniquely viable for this type of restoration as they can withstand significant time underwater, produce significant foliage, decreasing the impact of floodwaters on the bank while also improving wildlife habitat and preventing continued erosion. The Open Space Council has conducted several rounds of willow planting to date in Lower Meramec Park with plans to continue planting willows along the river frontage where the bank is bare mud with little to no vegetation.



From left: A volunteer harvests willows from George Winter Park; a volunteer stakes a willow on the inclined riverbank; a volunteer stakes willows along the riverbank; a group photo of volunteers who planted 660 willows during a 2020 workday event.

# Selection of Project Site: Lower Meramec Park in St. Louis County

The Meramec River is the second longest free-flowing river in the state of Missouri and is one of the state's most popular recreational watersheds. Lower Meramec Park in St. Louis County contains 2 miles of Meramec River frontage which provides recreational access to the Meramec River for fishing. The Meramec Greenway Trail along the river also provides hiking, walking and cycling opportunities for urban residents. Lower Meramec Park provides unique ecological services and wildlife habitat as the park is a combination of woodlands and open fields. Its diversity of tree species makes it "some of the best remaining woodlands in the Lower Meramec Valley," according to the Great Rivers Greenway District. Within the park, the riverbank is highly eroded with little to no vegetation. The park's popular paved trail, which is part of the Meramec Greenway, has been degraded by the eroding riverbank and has been rerouted further from the edge of the river as continued erosion is expected if no action is taken to stabilize the bank. The highly utilized trail also provides an educational opportunity as signage about the project can be placed along the trail to be visible to trail users.



(L) The Meramec Greenway Trail runs along the riverbank in Lower Meramec Park. (R) Barren riverbank suffering from erosion in Lower Meramec Park.

## Problem to be Addressed

Combat Erosion and Stabilize the Meramec Riverbank in Lower Meramec Park.

# Project Objectives

- Stabilize the section of riverbank to reduce erosion and ensure surrounding parkland is not damaged further.
- Improve the long-term health of the river section.
- Improve water quality.
- Improve quality of aquatic life.
- Improve wildlife habitat.
- Protect the trail and points of recreational access from erosion in the park.

## Live Staking Volunteer Events

### Selection of Live Stakes: *Salix Nigra*

OSC chose to plant black willows (*Salix Nigra*) as they are native to the St. Louis region and readily available. Black willows are unique in that they can withstand significant time underwater without dying. Black willows are also an exceptional soil-binding species whose fibrous roots help prevent erosion. Black willows provide native habitat for multiple wildlife species but in particular they are among the first plants to provide nectar and pollen for honeybees (Row 2010). Live black willow stakes were harvested for the project from George Winter Park in which black willows were growing plentifully around a spring. St. Louis County Parks allowed the harvesting of the willows as an in-kind contribution to the project. Live stakes can often be purchased through local nurseries.



(L) Black willows intermixed with sycamores in George Winter Park, the site of the harvest. (Above) Stakes at the planting site.

# Conducting a Site Visit: Ground Conditions

Conducting a visit to the site a few days prior to the planting can help determine if the ground conditions are conducive for planting. OSC found that the best conditions for planting in terms of volunteer access and ease of planting were a wet riverbank beneath a layer of new frost. The frost made the ground easy to traverse for volunteers as the ground was solid and not too muddy. After penetrating the inch of newly frozen ground, the stakes could still be planted easily by hand or with a few taps of a mallet. A somewhat wet and muddy riverbank is more ideal than a riverbank that is dry and hard which might require drilling pilot holes with rebar before planting the stakes.

## Volunteer Precautions & Safety

In Missouri, the weather in the early spring and late winter when conditions are right for live willow staking can often be quite cold and wet. Volunteers should be advised to dress for the weather and come prepared to get wet and muddy. In extremely muddy conditions, volunteers may be advised to bring a change of clothes or waders. Volunteers should wear closed-toe waterproof shoes. Volunteers should be briefed on safety procedures before beginning the workday. Volunteers should wear gloves at all times and be mindful of their footing on the riverbank.



“ Ecological repairs have to start somewhere, and we need to use what we have. Using native riparian vegetation to make repairs to a riparian ecosystem is as poetic as it is practical. ”  
- Paul Crombie, willow staking volunteer



(L) Staff with St. Louis County Parks demonstrate proper pruning of a harvested stake. (R) A volunteer wears a hi-vis safety vest and gloves while working to plant a stake.

# Equipment Needed: Harvesting

## Loppers

- Standard gardening loppers are used to cut the willows at their base and then cut them into smaller stakes.

## Hand Pruners

- A pair of hand pruners are used for pruning off smaller branches from the main cut stake.

## Yardstick

- A yardstick is a helpful tool for measuring where to cut the stakes into smaller pieces.

## Buckets

- Standard buckets from a hardware store are used for storing the stakes with a little bit of water overnight or until they can be planted. About 20 stakes can fit in one bucket.

## Work Gloves

- Standard leather work gloves are recommended for each volunteer.

## Hi-vis Safety Vests

- Hi-vis safety vests for volunteers are recommended so organizers can easily keep track of volunteers moving across a large work area for safety purposes.



Volunteers at willow harvesting event in March 2019

## Volunteer Time Management

If the site is easily accessible, live willow harvesting can be a very time efficient activity. With easy access to the site where the willows were growing, a group of 19 OSC volunteers planted 660 stakes in about 90 minutes.

## When to Harvest

Live willow stakes are best harvested and then planted when the plant is dormant. This is the late fall until the early spring before the plants start to bud (Descamp 2004). OSC has performed willow harvesting and staking in late February and early March. In 2020, OSC will conduct a planting in early December.

# Equipment Needed: Staking

## Mallets

- OSC used standard rubber mallets (16oz). Metal mallets can splinter the live willow stake if used too forcefully. Depending on ground conditions, volunteers may be able to push stakes into the soft ground without the use of a mallet.

## Rebar

- Standard metal rebar pieces (approximately 2 - 3') may be used to “drill” pilot holes if the ground is not soft enough to penetrate with the live stake itself. Rebar should be tapped into the ground with the mallet and then removed after it has created a sufficiently deep hole (deep enough for  $\frac{2}{3}$  of the live stake to be planted underground).

## Work Gloves

- Standard leather work gloves are recommended for each volunteer.

## Hi-vis Safety Vests

- Hi-vis safety vests for volunteers are recommended so organizers can easily keep track of volunteers moving across a large work area for safety purposes.



Volunteers at willow staking event in February 2020

# Volunteer Time Management

If conditions are conducive and the site is easily accessible, live willow staking can be a very time efficient activity. With wet, conducive ground conditions, a group of 15 OSC volunteers harvested 660 stakes in about 90 minutes.

# When to Plant

Live willow stakes are best harvested and then planted when the plant is dormant. This is the late fall until the early spring before the plants start to bud (Descamp 2004). OSC has performed willow staking in late February and early March. In 2020, OSC will conduct a planting in early December.

# Harvesting the Live Willow Stakes

Live black willows were harvested by OSC volunteers from George Winter Park in St. Louis County, where the willows were growing plentifully around a spring. Healthy willows with trunks roughly between 1" – 2" thick were identified and then cut at their base, close to the ground, on an angle with loppers or a hand saw. All branches were pruned off of the plant (See Diagram 1) and then the plant was cut into smaller stakes.

After being cut into stakes, the stakes need to be “sharpened” by making two cuts, one flat and one on an angle. (See Diagram 2) Each stake should have a sharpened end (this end will be inserted into the riverbank).



Diagram 1



Diagram 2

## ***A Note About Stake Length***

In the first round of the willow project which occurred in March 2019, OSC volunteers cut the willow plants into 3' stakes. In the second round which occurred in February 2020, OSC volunteers cut willow plants into 1.5' stakes. The shorter stakes (1.5') made it easier for volunteers to push more of the stake underground during the planting. The shorter stakes seemed to have better re-sprout rates.



A volunteer with a bundle of cut stakes.

# Storing the Cut Willow Stakes

Store stakes in a cool, damp place in buckets of several inches of water with the root end (the sharpened cut end) down in the water. OSC stored the willows in a St. Louis County parks maintenance garage building. Store for as short of a period as possible, 2 weeks maximum (Descamp 2004).

## *A Note About Storage Time*

In the first round of the willow project which occurred in March 2019, OSC stored the willow stakes in buckets for less than a week. In the second round which occurred in February 2020, the stakes were planted only one day after harvesting.



Stakes stored in buckets of water.

# Planting the Live Willow Stakes

To plant a willow stake, push the stake, pointy side down, into the ground and try to get  $\frac{2}{3}$  of the stake to be underground. To help put the stake in the ground, tap the top of the stake with the rubber mallet until the stake is sufficiently planted. Plant the stakes with a 1.5 - 2' radius between stakes. Stakes should be staggered along along the lines of planting (See Diagram 3).

## *A Note About Stake Radius*

In the first round of the willow project which occurred in March 2019, OSC volunteers planted the willows with a 3' radius. In the second round which occurred in February 2020, OSC volunteers planted the stakes closer together with 1.5-2' radius.

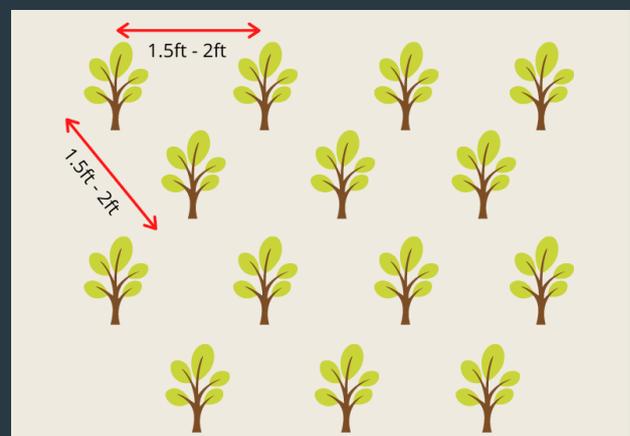


Diagram 3

# Monitoring

The growth rate and survival overall of the planted black willow stakes are the two primary indicators of a successful willow planting. Mature black willows can grow 30 to 60' tall and have a diameter of 14 to 24." In the right conditions, black willows can grow at a rate of 3 to 4' per year (Iowa 2020). The monitoring of the site over the coming years will focus on tracking the growth rate of the black willows planted and their root development.

Other indicators that will be tracked to determine the progress made on the project objectives will be measurement of erosion on the sections of riverbank, testing of water quality, and counting of wildlife species.

In partnership with other regional conservation organizations, the Open Space Council has created the Community Stewardship Alliance (CSA) program. This program seeks to establish a core group of volunteers who will "adopt" Lower Meramec Park and will lead stewardship activities for the long-term improvement of the park. CSA Site Ambassadors are dedicated and trained volunteer leaders who will coordinate with the CSA organizational partners to plan and coordinate volunteer restoration activities in targeted parks. The CSA Site Ambassadors for Lower Meramec Park will be selected in 2021 and will be responsible for planning additional black willow plantings and also monitoring the black willows at all current and future planting sites within the park. The CSA Site Ambassadors will submit a report on a bi-annual basis about the progress of willow staking projects.

**Note:** Due to the size of the Meramec River and other external environmental variables, any changes in water quality results, macro-invertebrate counts and wildlife counts may not be direct consequences of the willow planting project. However, these metrics can be helpful in assessing the overall health of the river section and parkland.



# Measurements

**Objective:** Stabilize the section of riverbank to reduce erosion and ensure surrounding parkland is not damaged further.

## **How to Track:**

- Count how many willows survived 6 months after planting to determine survival rate.
- Select a portion of the willows and measure their growth in height and diameter. Select a portion of the willows and perform a “tug test” to gently tug on the stakes to assess root development.
- Visually assess the erosion on the riverbank (note increase or decrease) and document with photographs.
- Measure erosion on the bank by measuring a piece of “control” rebar which has been buried in the bank and painted with a ring at ground level. Measuring the rebar each year will show the level of erosion (in rebar length)



A volunteer counts the stakes that “leafed out” during a site visit in August 2019. Photo: St. Louis County Parks

**Objective:** Improve water quality

## **How to Track:**

- Conduct a water quality monitoring chemical test 4 times a year in compliance with the Missouri Stream Teams Volunteer Water Quality Monitoring program.

**Objective:** Improve quality of aquatic life

## **How to Track:**

- Conduct a Macro-invertebrate count 2 times a year in compliance with the Missouri Stream Teams Volunteer Water Quality Monitoring program.

# Measurements, continued

**Objective:** Improve wildlife habitat

**How to Track:**

- Count and track wildlife communities observed in the park. Tracking of bird species can be conducted through the Cornell Lab of Ornithology's community science portal "eBird" on a quarterly basis.

**Objective:** Protect the trail and other points of recreational access from erosion in the park.

**How to Track:**

- Visually assess if the trail or other points of access are in danger of erosion and document with photographs.

**Objective:** Improve the long-term health of the river section

**How to Track:**

- Review measurements and reports cumulatively on a multi-year basis to help build a better picture of the section's overall health.

## Flooding

The Meramec River is subject to major flooding, with several major flood occurring in 2015 and 2017. In 2019, the Meramec River experienced more significant flooding than in 2020. In the spring 2019, the Meramec River crested at major flood stage, an estimated 25.1 feet. Flooding continued in the fall, and the greenway trail in Lower Meramec Park was inaccessible to foot traffic and was closed due to the flooding. In spring 2020, there was some minor flooding along the Meramec River. All the willow stakes from the 2019 and 2020 plantings remained planted in the riverbank after the flooding; none were washed away. However, those that were planted in 2019 and experienced a flood soon after had a higher mortality rate than those planted in 2020 which experienced less flooding after being planted. The 2019 willow stakes were also longer in length and spaced out more on the riverbank.

# Before & After

## 2019 Willow Planting

*Bank before planting*



*Bank after planting*



Photo: St. Louis County Parks

On the right, a section of barren riverbank photographed prior to planting and on the left, the riverbank after 350 willows were planted - photographed in August 2019. 18 willows were reported to be "leafing out" and showing growth. These stakes were 3' tall and planted with a 3' radius.

## 2020 Willow Planting

*Bank before planting*



*Bank after planting*



Photo: Great Rivers Greenway

On the right, a section of barren riverbank photographed prior to planting and on the left, the riverbank after 660 willows were planted - photographed in July 2020. Nearly all willows were reported to be "leafing out" and showing growth. These stakes were 1.5' tall and planted with a 1.5' - 2' radius.

# Works Cited

Descamp, Wendy. "Collecting, Installing, Storing and Caring for Live Stakes." [Http://Depts.washington.edu/](http://Depts.washington.edu/), University of Washington Botanic Gardens, 10 June 2004, [depts.washington.edu/propplnt/Chapters/Stakes%20combined.htm](http://depts.washington.edu/propplnt/Chapters/Stakes%20combined.htm).

Iowa State University Extension. "Black Willow." Natural Resource Stewardship. 2020, [naturalresources.extension.iastate.edu/forestry/iowa\\_trees/trees/black\\_willow.html](http://naturalresources.extension.iastate.edu/forestry/iowa_trees/trees/black_willow.html).

Row, John, and Wayne Geyer. "Black Willow Plant Fact Sheet - USDA PLANTS." Plant Fact Sheets, United States Department of Agriculture Natural Resources Conservation Services, May 2010, [plants.usda.gov/factsheet/pdf/fs\\_sani.pdf](http://plants.usda.gov/factsheet/pdf/fs_sani.pdf).



## *For more information...*

Contact the Open Space Council at 314-835-9225 or email at [info@oenspacestl.org](mailto:info@oenspacestl.org) for more information.



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