Riparian Buffer Plantings

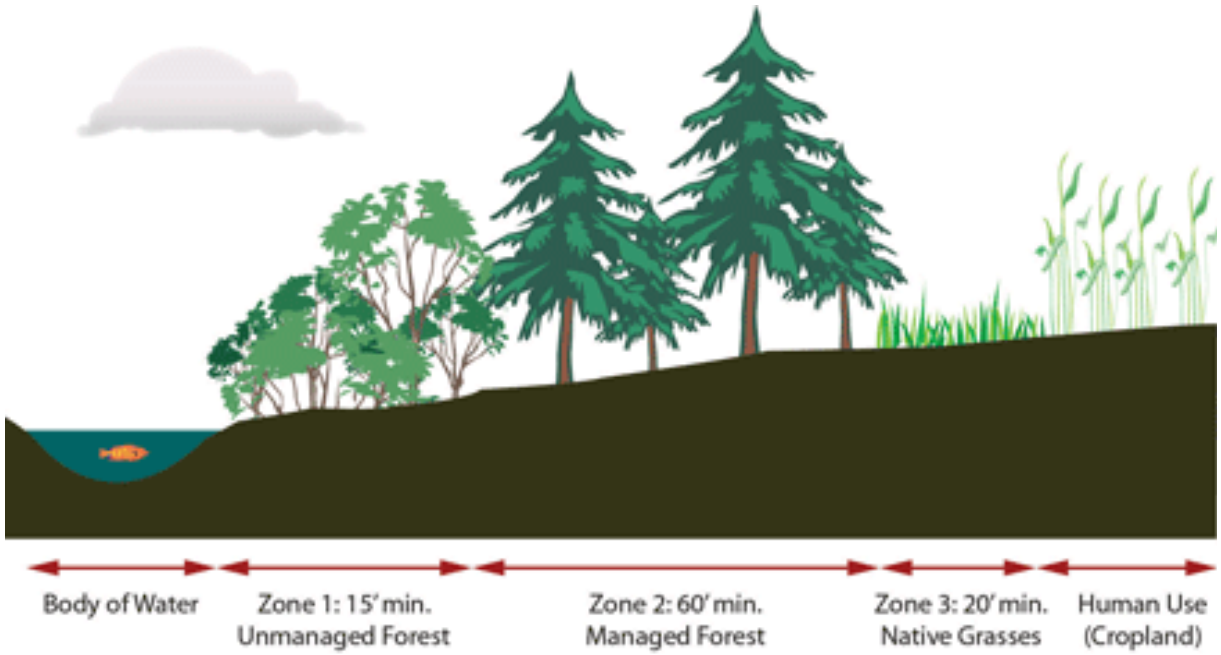


Image: Virginia Outdoor Foundation

Multiflora Rose

Mile-a-Minute Weed

A riparian buffer is land next to a river, stream, or creek that is usually vegetated with trees or shrubs, and acts as a protective filter for the river system. Riparian buffers can vary in width, from 500 feet to 50 feet, depending on the adjacent land use. A majority of Pennsylvania's streams are comprised of small streams, also known as headwater streams, which are important areas to reduce nutrients and increase water quality. Trout Creek is a headwater stream, draining to the Schuylkill River Watershed; re-establishing riparian buffers along Trout Creek will have multiple benefits, as described below.

Much of the Trout Creek streamside is forested, although invasive species such as Multiflora Rose and Mile-a-Minute Weed threaten the viability and health of what riparian buffer exists. Where the streambank is not forested, turf grass is the vegetation most utilized by homeowners along Trout Creek proper. This BMP discussion is a **starting point** for the homeowner who seeks to restore the riparian buffer, and should be used along with Native Landscape Restoration BMP so that the proper plant species are chosen. As with all BMPs included in this document, professional guidance could be enlisted to aid the homeowner in design and construction.

An important consideration for homeowners in the Trout Creek Watershed is that adjacent **land uses** will influence the buffer width and vegetation types used to establish a riparian buffer. Though a USDA Forest Service recommended "three-zone" riparian-forested buffer is ideal, (detailed discussion below), this may not always be feasible to establish especially in residential suburban situations such as Trout Creek neighborhoods.

Images: Cahill Associates, Inc.

Benefits

Costs

Benefits

Riparian buffers have been well documented to provide a number of economic and environmental values. Buffers are characterized by high species density, high species diversity, and high bio-productivity as a transition between aquatic and upland environments. A Riparian Buffer provides a number of benefits, including:

- Reduce flooding by slowing down stormwater runoff that travels over the land surfaces into Trout Creek.
- Reduce non-point source pollution (by trapping pollutants and debris that is carried in runoff.)
- Increase streambank stability
- Decrease streambank erosion
- Improve water quality by enhancing the infiltration of pesticides, nutrients, pathogens, and sediment.
- Increase wildlife habitat
- Increased shading lowers water temperature
- Support a diverse array of wildlife
- Provide recreation and aesthetics for residents.

Cost Considerations

Costs for a riparian buffer restoration project are site-specific since every property has different conditions that will relate to the costs.. Installing a riparian buffer involves site preparation, planting design, second year reinforcement planting, and additional maintenance. Establishment and maintenance costs should be considered up front when considering your riparian buffer design.

Image: Cahill Associates, Inc.

Both the USDA Riparian Handbook and the PADEP/PADCNR Stream ReLeaf Forest Buffer Toolkit (see Additional Resources for more information) utilize the following outline for estimating costs for establishment and maintenance:

Table 1. Riparian Forest Buffer Installation Costs Per Acre Estimated Costs

	Establishment	
Preparation	Light site preparation -- mow, disking	$ 12.00
Planting	Tree Seedlings 8x8 spacing, 430 trees/acre (Hardwoods - $1.15/seedling) 12-18" seedlings with labor included	$495.00
Subtotal		**$507.00**
	Maintenance	
Reinforcement Planting	Seedlings 50/acre Year 2 after establishment	$ 58.00
TOTAL COST	**Planting and Establishment**	**$565.00**
	Optional Costs	
Establishment	Shelters ($5.00/tree installed) Fencing (1 acre = 282 feet)	$2150.00 $ 564.00
Maintenance	Competition control -Herbicide treatment -Mowing	 $ 54.00 $ 12.00

Costs include labor estimates.

- With this basic outline we can begin to plan establishment costs, and then, estimate maintenance cost for a 10-year period. The costs shown in Table 4 are derived from USDA Forest Service, *Stewardship Incentive Program (SIP) cost-share rate structure guidance for SIP Practice 6 - Riparian and Wetland Protection and Improvement for Various States within the Northeastern Area.* All costs shown are the price of practices installed - that is including labor.

- NOTE: One mile of 35 foot wide buffer contains about 4 1/5 acres.

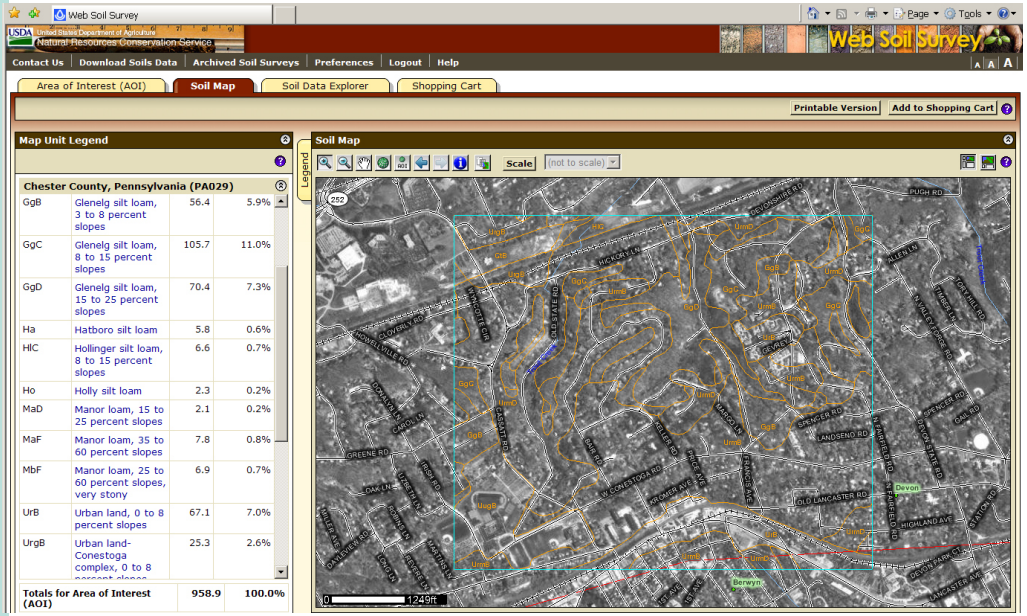
- NOTE: Volunteer labor can reduce costs signficiantly.

Ease of Development/Construction
The PADEP/PADCNR-advocated summary below is recommended for homeowners during the **planning stages** of a buffer restoration project. Proper planning will lead to easier construction and budgeting.

1. **Obtain Landowner Permission and Support**
   Consider talking with your neighbors to collaborate on a design – you may save money if you buy plants in bulk from your local native nursery. In addition, there are grants available for tree plantings for groups of homeowners who organize to plant trees in their neighborhood.

2. **Make Sure Site is Suitable for Restoration**
   If streambanks are extensively eroded, consider alternative location. Rapidly eroding streambanks may undermine seedlings. Streambank restoration may need to occur prior to riparian buffer restoration. Obtain professional help or talk with a Township representative to evaluate your needs for streambank restoration.

3. **Analyze Site's Physical Conditions**
   The most important physical condition of the site is the soil, which will control plant selection. Evaluate the soil using the online soil mapper provided by USDA (http://websoilsurvey.nrcs.usda.gov/app/) to determine important soil characteristics such as flooding potential, seasonal high water table, topography, soil pH, soil moisture, etc. Also, include a simple field test with direct observation of soil conditions. Again, you may want to talk to a Township representative to evaluate your needs.



Here in Trout Creek, the slope of the buffer is important to consider. Much of the creek is drained by properties whose front and side yards are extremely sloping. This is an important item to note when planning a riparian buffer restoration.

Image: United States Department of Agriculture

Forests provide as much as 40 times the water storage of a cropped field and 15 times that of grass turf.

4. Analyze Existing Vegetation

Existing vegetation present at the restoration site should be examined to determine the strategy for buffer establishment, using the Native Plant List provided in the Additional Resources section:

- Identify Desirable Species - Native tree and shrub species that thrive in riparian habitats in Pennsylvania should be used. These species should be identified in the restoration site and protected for their seed bank potential. Several native vines and shrubs (blackberry, greenbriar, poison ivy, Virginia creeper, and spicebush) can provide an effective ground cover during establishment of the buffer, though should be selectively controlled for herbaceous competition.
- Identify Undesirable Species: Consider utilizing undesirable species such as the black locust for their shade function during buffer establishment. Consider controlling invasive plants prior to buffer planting.
- Identify Sensitive Species: Since riparian zones are rich in wildlife habitat and wetland plant species to be aware of any rare, threatened or endangered plant (or animal) species. Contact the Delaware County Planning Commission for the county's Natural Areas Inventory Plan.

5. Draw a Sketch of the Site

Prepare a sketch of the site that denotes important existing features, including stream width, length, streambank condition, adjacent land uses and stream activities, desired width of buffer, discharge pipes, obstructions, etc. This is a critical component of the plan and will help the homeowner budget for plantings.

6. Create a Design that Meets Multiple Objectives

Consider landowner **objectives**: Consider the current use of the buffer by the landowner, especially if the buffer will be protected in perpetuity. Consider linking the buffer to an existing (or planned trail system).

Buffer **width**: Riparian buffer areas do not have a fixed linear boundary, but vary in shape, width, and vegetative type and character. Many factors including slope, soil type, adjacent land uses, floodplain, vegetative type, and watershed condition influence what can be planted. The most commonly approved minimum buffer widths for water quality and habitat maintenance are 35 –100 feet. Buffers less than 35 feet do not protect aquatic resources long term.

Consider **costs**: The planting design (density, type, mix, etc.) will ultimately be based on the financial constraints of the project. Consider phasing your plantings over 2 or 3 seasons in order to help defray direct costs.

Choose the appropriate **plants**: This manual encourages the use of native plants in stormwater management facilities. Since they are best suited to our local climate, native species have distinct

genetic advantages over non-native species. Ultimately using native plants translates into greater survivorship with less replacement and maintenance – a cost benefit to the landowner. Please refer to the plant list in Additional Resources for a comprehensive list of native trees and shrubs available for stormwater management facility planting.

Choose the **plant size**: Plants can be purchased as seeds, container seedling, bare-root seedlings, plugs, or nursery stock. Ultimately, financial resources will guide the decision since larger plant material will generally cost more. On the other hand, larger plants will generally establish more rapidly.

7. Draw a Planting Plan

Some rules of thumb for tree spacing and density based on plant size at installation:

Seedlings	6-10 feet spacing
Bare Root Stock	14-16 feet spacing
Larger & Container	16 – 18 feet spacing

The formula for Estimating Number of Trees and Shrubs is as follows:

Plants = length x width of corridor (ft) / 50 square feet

This formula assumes each tree will occupy an average of 50 sq. ft., random placement of plants approximately 10 feet apart, and mortality rate of up to 40% that can be absorbed by the growing forest system.

Once a homeowner has a planting density and mix, drawing the planting plan is fairly straightforward. The plan can vary from a highly technical (drawn to scale) plan, or a simple line drawing of the site. All plans must show the site with areas denoted for trees and shrub species, along with notes for plant spacing and buffer width.

8. Prepare Site Ahead of Time

Existing site conditions will determine the degree of preparation needed prior to planting. Invasive infestation and vegetative competition are extremely variable, and therefore must be considered in the planning stages. Site preparation should begin in the fall prior to planting. Enlist professional to determine whether use of chemical controls are necessary to prepare site for planting. Release desired existing saplings from competition by undesired species with either herbicide application (consult a professional) or physical removal. If utilizing a highly designed planting layout, mark site ahead of time with flags, spray paint, or other markers so that the appropriate plant is put in the right place.

Aesthetics

9. Determine Maintenance Needs

An effective buffer restoration project should include management and maintenance guidelines, as well as an awareness of allowable and unallowable uses in the buffer. Weed control is essential for the survival and rapid growth of trees and shrubs, and can include any of the following:

- Organic mulch, preferably leaf-compost, leaf litter
- Weed control fabrics
- Shallow cultivation
- Pre-emergent herbicides
- Mowing

Non-chemical weed control methods are preferred since chemicals can easily enter the water system.

Aesthetics

As with any landscaping effort, "…beauty is in the eye of the beholder." There are multiple examples of homes with existing riparian buffers in the Trout Creek Watershed which suggests a very attractive result. Initial phases of Restoration may be less than ideal aesthetically, as trees take time to mature and develop a reasonable canopy; special shorter-term "woodland floor" perennial species can be planted to improve aesthetics as the trees are maturing. Proper maintenance will serve to preserve aesthetics and keep the area being restored from appearing unkempt.

In establishing a new riparian forest buffer, it is usually both economical and practical to select a group of no more than 6 to 12 species.

***Zone 1** is located along the streambank and provides detritus and shade to the stream. This zone is likely to be flooded and should therefore be dominated by flood tolerant hardwood species. Hardy shrub species, such as dogwoods and willows, can also be planted along the streambank to provide stabilization.*

***Zone 2** contains a managed forest and may include hardwoods and conifers that have more intermediate flood tolerances.*

***Zone 3**, if needed, may contain grasses or other features helpful in slowing and infiltrating water. Shrubs and small trees may also be desirable in Zone 3 to provide a diversity of habitats for birds and wildlife.*

Township Review
No Township review is necessary for a homeowner to undertake this BMP. The Township should be informed of the Riparian Buffer Restoration plan so that Township staff are aware of special maintenance practices being imposed and its intentional nature.

Site Constraints
Most properties adjacent to Trout Creek can undertake this Riparian Buffer restoration BMP. The stream often flows through a front yard with a road way providing a delimiting boundary. Adjacent land uses need to be considered in the initial planning phase of this project, as certain land uses create a constraint for proper riparian buffer establishment.

Variations
Much research has been done on the benefits of riparian buffers, primarily by the USDA. Based on this research, the USDA recommends the following Design Criteria for proper riparian forested buffer establishment and function. A Riparian Buffer consists of **three distinct zones**, as shown in the previous image (page 2) and below.

Zone 1: Zone 1 will begin at the top of the streambank and occupy a strip of land with a fixed width of *15-feet* measured horizontally on a line perpendicular to the streambank. The purpose of Zone 1 is to create a stable ecosystem adjacent to the water's edge, provide soil/water contact area to facilitate nutrient buffering processes, provide shade to moderate and stabilize water temperature encouraging the production of beneficial algal forms, and to contribute necessary detritus and large woody debris to the stream ecosystem.

Dominant vegetation will be composed of a variety of native riparian tree and shrub species and such plantings as necessary for streambank stabilization during the establishment period. A mix of species will provide the prolonged stable leaf fall and variety of leaves necessary to meet the energy and pupation needs of aquatic insects.

Large overmature trees are valued for their detritus and large woody debris. Zone 1 will be limited to bank stabilization and removal of potential problem vegetation. Occasional removal of extreme high value trees may be permitted where water quality values are not compromised. Logging and other overland equipment shall be excluded except for stream crossings and stabilization work.

Zone 2: Zone 2 will begin at the edge of Zone 1 and occupy an additional strip of land with a minimum width of *60-feet* measured horizontally on a line perpendicular to the streambank. Total minimum width of Zones 1 & 2 is therefore *75 feet.*

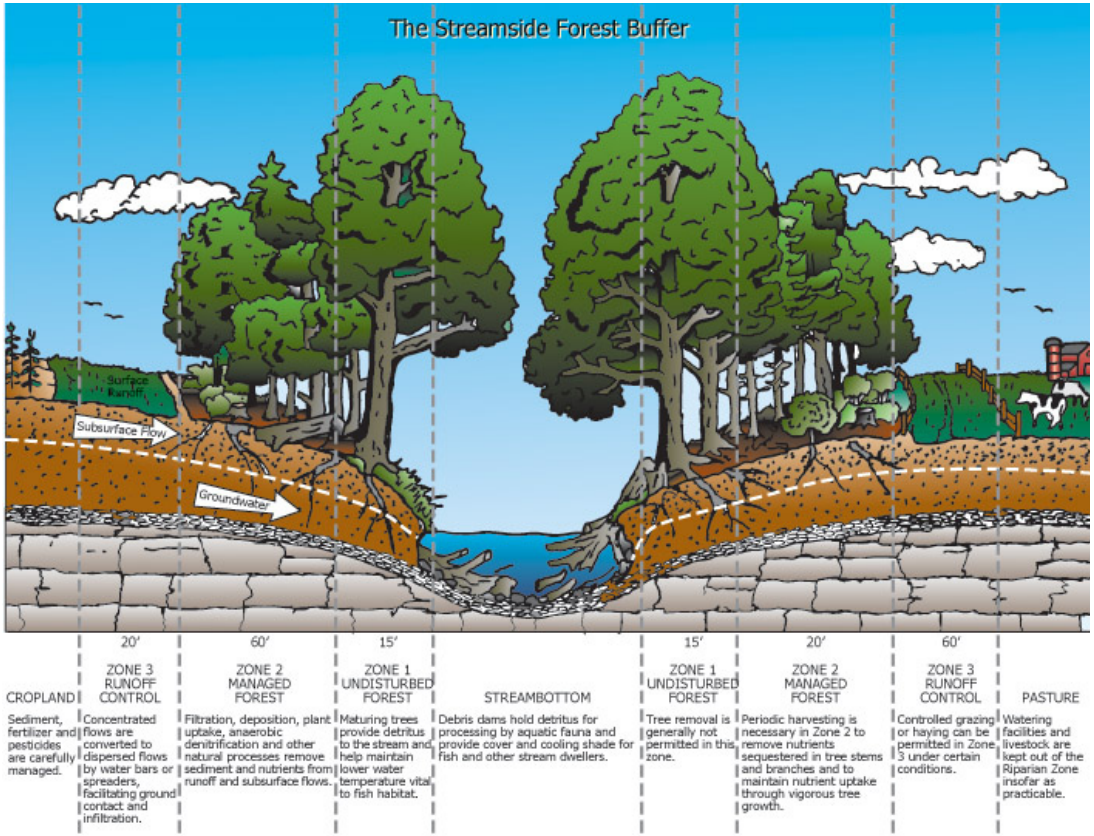


Image: United States Department of Agriculture; D.J.Welsch

The purpose of Zone 2 is to provide necessary contact time and carbon energy source for buffering processes to take place, and to provide for long term sequestering of nutrients in the form of forest trees. Outflow from subsurface drains must not be allowed to pass through the riparian forest in pipe or tile, thus circumventing the treatment processes. Subsurface drain outflow must be converted to sheet flow for treatment by the riparian forest buffer, or treated elsewhere in the system prior to entering the surface water.

Predominant vegetation will be composed of riparian trees and shrubs suitable to the site, with emphasis on native species, and such plantings as necessary to stabilize soil during the establishment period.

Zone 3: Zone 3 will begin at the outer edge of Zone 2 and have a minimum width of *20-feet*. Additional width may be desirable to accommodate land-shaping and mowing machinery. Grazed or ungrazed grassland meeting the purpose and requirements stated below may serve as Zone 3.

The purpose of Zone 3 is to provide sediment filtering, nutrient uptake, and the space necessary to convert concentrated flow to uniform, shallow, sheet flow through the use of techniques such as grading and shaping, and devices such as diversions, basins, and level lip spreaders.

Vegetation will be composed of dense grasses and forbs for structure stabilization, sediment control, and nutrient uptake. Mowing and removal of clippings are necessary to recycle sequestered nutrients, promote vigorous sod, and control weed growth.

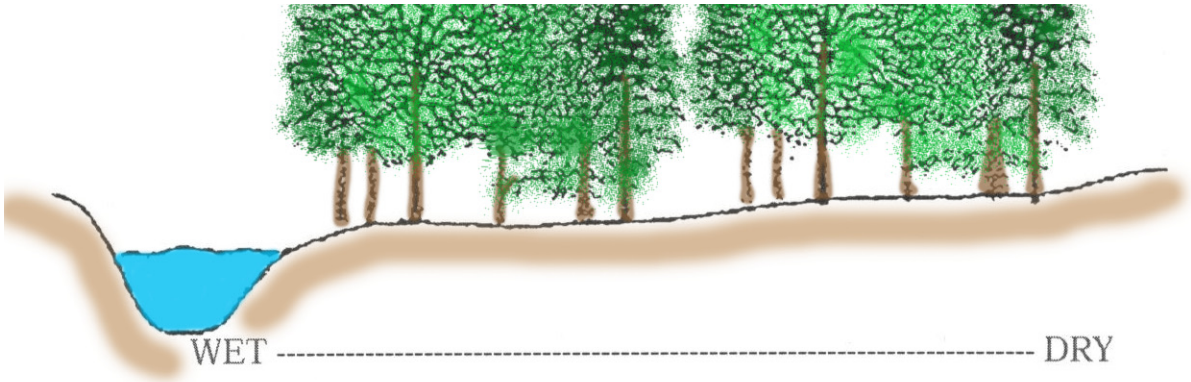
Vegetation must be maintained in a vigorous condition. The vegetative growth must be hayed, grazed, or otherwise removed from Zone 3. Maintaining vigorous growth of Zone 3 vegetation must take precedence and may not be consistent with wildlife needs.

Vegetation Selection by Zone

Zone 1 & 2 vegetation will consist of native streamside and upland tree species as identified on the following image. Deciduous species are important to be used in Zone 2 due to the production of carbon leachate from leaf litter which drives bacterial processes that remove nitrogen, as well as the sequestering of nutrients in the growth processes. In our climate, the use of evergreens is also important due to the potential for nutrient uptake during the winter months. In all riparian buffer planting projects, a variety of species is important to meet the habitat needs of insects important to the aquatic food chain.

Zone 3 vegetation should consist of perennial grasses and forbs. Appendix 7 of the Chesapeake Bay Riparian Handbook provides detailed summary information on choosing native plants for riparian buffers. Please consult the Resources section of this guide for more information, as well as your local native nursery.

Make sure to plant appropriate species in each zone so that you maximize survival rates. Check out the Resources found in this CD Guide for more detailed information.



TREES

Silver Maple
Box Elder
Persimmon →
Black Ash
Red Ash
Pawpaw →
Sweet-bay Magnolia
Sycamore →
Cottonwood
Swamp White Oak
Oak,Willow →
Willow, Sandbar & Black

SMALL TREES/SHRUBS

River Birch
Smooth Alder
Chokeberry, Red
Chokeberry, Black →
Groundselbush
Dogwood, Red Osier & Silky
Summersweet →
Winterberry →
Inkberry →
Swamp Rose
Swamp Azalea
Meadowsweet →
Highbush Blueberry →
Witherod →
N. Arrowwood

TREES

← Maple, Red →
Bitternut Hickory →
← Redbud →
Hackberry →
American Beech →
← Ash, White →
← Honey Locust →
Kentucky Coffee Tree →
← Sweet-gum
Tuliptree →
Black-gum →
← Large-toothed Aspen →
← Oak, Pin →

SMALL TREES/SHRUBS

← Black/Sweet Birch →
Mountain Laurel →
← Hornbeam →
Yellow Birch →
← Shadbush (A.arborea & canadensis) →
← Dogwood, Gray & Flowering →
Fringe Tree →
American Hazelnut →
← Black Huckleberry
← Common Spicebush →
← Rosebay Rhododendron
← Southern Arrowwood
← Ninebark
← American Elder →
Bayberry →
← Highbush Cranberry →
Red Elm

TREES

White Pine
Black Cherry
Sassafras
Canada Hemlock
Oak, White
← Oak, Red
Oak, Chestnut
Hickory, Shagbark
Maple, Sugar
Black Walnut

SMALL TREES/ SHRUBS

Hop-hornbeam
Witchhazel
Staghorn Sumac
Nannyberry
Blackhaw

Arrows denote that certain species can tolerate either a wetter or drier environment.

Maintenance

Maintenance

The riparian buffer is subject to many threats, including herbivory, invasion by exotic species, competition for nutrients by adjacent herbaceous vegetation, and human disturbance. Proper maintenance is important to ensure the long-term effectiveness and sustainability of a restored riparian buffer. The most critical period during buffer establishment is maintenance of the newly planted trees during canopy closure, typically the first 3 to 5 years. Ongoing maintenance practices are necessary for both small seedlings and larger plant materials. Maintenance and monitoring plans should be prepared for the specific site and caretakers need to be advised of required duties during the regular maintenance period.

Maintenance measures that should be performed regularly:

1. **Watering**
   - Plantings need deep regular watering during the first growing season, either natural watering via rainfall, or planned watering, via caretaker.
   - Planting in the fall increases the likelihood of sufficient rain during planting establishment.
2. **Mulching**
   - Mulch will assist in moisture retention in the root zone of plantings, moderate soil temperature, provide some weed suppression, and retard evaporation
   - Use coarse, organic mulch that is slow to decompose in order minimize repeat application
   - Apply 2-4 inch layer, leaving air space around tree trunk to prevent fungus growth.
   - Use combination of woodchips, leaves, and twigs that are stockpiled for six months to a year.
3. **Weed control**

   Weed competition limits buffer growth and survival, therefore weeds should be controlled by either herbicides, mowing, or weed mats:
   - **Herbicides:** This is a short-term maintenance technique (2-3 years) that is generally considered less expensive and more flexible than mowing, and will result in a quicker establishment of the buffer. Herbicide use is regulated by the PA Department of Agriculture. Proper care should be taken to ensure that proximity to water features is considered.
   - **Mowing:** Mowing controls the height of the existing grasses, yet increases nutrient uptake, therefore competition for nutrients will persist until the canopy closure shades out lower layers. A planting layout similar to a grid format will facilitate ease of mowing yet yield an unnaturally spaced community. Mowing may result in strikes on the trunk unless protective measures are utilized. Mowing should occur twice each growing season. Mower height should be set between 8 –12 inches.
   - **Weed Mats:** Weed mats are geo-textile fabrics that are used to suppress weed growth around newly planted vegetation by providing shade and preventing seed deposition. Weed mats are installed after planting, and should be removed once the trees have developed a canopy that will naturally shade out weeds.

Deer Considerations: Deer will browse all vegetation within reach, generally between 5-6 feet above the ground. Approaches to minimize damage include: 1) selecting plants that deer do not prefer (ex. Paper Birch, Beech, Ash, Common Elderberry) 2) homemade deer repellents 3) tree shelters.

Invasive Plants: Monitor the restoration site regularly for any signs of invasive plants. Consult the list of common invasive plants found in Additional Resources.

Special Maintenance Considerations: Riparian buffer restoration sites should be monitored to maximize wildlife habitat and water quality benefits, and to discover emerging threats to the project. During the first four years, the new buffer should be monitored four times annually (February, May, August, and November are recommended) and inspected after any severe storm. Repairs should be made as soon as possible. Survival rates of up to 70% area deemed to be successful. Calculate percent survival by the following equation:

(# of live plants / # of installed plants) * 100 = Percent Survival