SIMPLE SOLUTIONS FOR YOUR ERODING BACKYARD STREAM
Is your stream getting deeper or wider? Are you losing some of your land every time it rains? Have you wondered why your streambanks are changing so rapidly and what you can do about that?

The changing landscape of Pennsylvania means more homes, commercial buildings, parking lots, and roads. We also have less forested land. Forests play a huge role in helping to slow down and absorb rainwater once it hits the ground. With fewer forests and more buildings comes more stormwater, the rainwater that isn’t absorbed. This increased volume of water rushes at great speeds directly into our streams, carrying pollutants off the land with it and frequently leading to local flooding (Neary et al. 2009).

When one inch of rain falls on a one-acre parking lot, it becomes 27,000 gallons of stormwater flowing into our streams. In Pennsylvania we average 41 inches of rain each year (PA State Climatologist). That adds up to a lot of water! All this extra water contributes to eroding our streambanks. That streambank soil becomes sediment pollution (Tangi-guchi and Briggs 2015), which is one of Pennsylvania’s biggest water quality problems. Sediment contributes to flooding and suffocates stream-bottom-dwelling animals (PA DEP 2012).

This publication is part of the Penn State Extension Backyard Stream Repair Program, which is implemented by the Penn State Extension Water Resources Team. You can find more information at extension.psu.edu/water.

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An Introduction to the Water’s Edge

Riparian buffers, streamside forests, and shoreline gardens all refer to the vegetated area along the water’s edge. There are many benefits to you, your downstream neighbors, and the surrounding environment when plants with deep roots grow on the creek bank (Sweeny and Newbold 2014; Bin et al. 2009).

- Improve bank stability and reduce erosion, saving property from washing away.
- Add aesthetic value to property.
- Create a sense of place and reduce noise.
- Cost less to maintain than turf—no need for mowing, watering, and fertilizing.
- Slow surface stormwater flow.
- Intercept pollution (fertilizer, pesticides, heavy metals, etc.).
- Allow sediment to settle out before clouding up a waterway.
- Cool stormwater runoff heated by sunlight on hard surfaces.
- Create shade that moderates water temperatures for aquatic species.
- Provide habitat for many types of wildlife (butterflies, hummingbirds, frogs, dragonflies).

Being around water brings a sense of calm and relaxation. Most people living near water want a clear view, and so they remove all the landscape. Why not? If you live near the water, you want to see it! But what if all your upstream neighbors want that too? Oftentimes we don't realize that by simply removing vegetation or keeping an area only in turf grass next to the creek we actually contribute to erosion, increase the likelihood for flood damage, and decrease the available habitat for wildlife. There is a compromise; utilize the right plant for the right place to create a shoreline garden (Bin et al. 2009; Hu et al. 2019).

Before you consider altering your streambanks, you need a clear image of what a healthy, stable stream looks like. It can be difficult to find healthy streams in urban areas to use as an example. Study the two photos on the right. Which one looks more stable with less erosion? Is there shade on either stream?

The top image has a stream with steep banks that could present a safety issue, especially if you were on a mower! The bottom image shows a stream with a more gentle slope and forest vegetation growing along the stream. It has much easier and safer access.

Streams that rise and fall quickly during and after rainfall events can saturate and loosen the soil (Taniguchi and Briggs 2015). Plant roots hold soil in place, but their effectiveness depends on their root depth (Arnold and Toran 2018). Turfgrass may only have 2-to-6-inch-deep roots (Landschoot 1997). Unanchored soil will continue to wash away until water finds a stable point that is difficult to erode, usually bedrock. It may take only a few storms or decades to see significant impact, but the damage is inevitable. Flooding and water quality degradation are another frequent consequence (Taniguchi and Briggs 2015).

A mix of native trees, shrubs, flowers, ferns, and grasses at varying heights provides a tangled mix of different root structures that help hold soil to the banks. These plants provide all kinds of other benefits to the environment as well (Sweeny and Newbold 2014).
Option 3: Grade banks to a gentle slope and add plants. A 3:1 slope is most ideal for a stable bank. Take time to plan whether you will do the work yourself or hire someone, select type of plants you want (or copy the design on page 12), and determine how you will maintain the appearance you want (tips on page 14).

- Optimal time of year: Dormant season to allow for live staking and additional plantings soon after grading.
- Pros: Safer, stable banks; not losing land; and more attractive.
- Cons: Financial investment and potential soil compaction from heavy equipment. Requires a preapproved permit regardless of project size in Pennsylvania.
- Next steps: Skip to grading section on pages 15–17. Pay special attention to permit requirements.

Option 2: Plant diverse, native flora without changing the grade (above left illustration). Above right photo shows live stakes installed every 1 foot on the existing slope to create a snag and quick root mass.

Option 3: A repaired stream site where the landowner’s home is less than 20 feet from the water with 2-to-3-foot vertical banks (above left photo). Above right photo shows the now graded, stabilized, and planted bank.

Pennsylvania Permit Requirements

Small Docks and Boat Launches
Credit: Jennifer Fetter, Penn State

Intakes and Outfalls
Credit: Jennifer Fetter, Penn State

Bank Rehab and Stabilization
Credit: Kristen Koch, Penn State

Construction in Wetlands
Credit: U.S. Fish and Wildlife Service Northeast Region

All of these things and more are regulated by 25 PA Code Chapter 105. A General Permit 3 (GP3) is required for grading work on less than 500 feet of continuous streambanks and/or adding rock or other nonpolluting structures to the streambank or channel.
Wet Zone: Herbaceous (Nonwoody) Plants

Below is a sampling of herbaceous plants that can bend with the stream flow at the water's edge.

<table>
<thead>
<tr>
<th>Type</th>
<th>Common Name</th>
<th>Botanical Name</th>
<th>Sun</th>
<th>Height (feet)</th>
<th>Wetland Code</th>
<th>Bloom Time</th>
<th>Bloom Color</th>
<th>D/E</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>FERN</td>
<td>Chain fern</td>
<td>Woodwardia areolata</td>
<td>P–S</td>
<td>1–2</td>
<td>OBL</td>
<td>N/A</td>
<td>N/A</td>
<td>D</td>
<td>Amphibian shelter</td>
</tr>
<tr>
<td>GRASS</td>
<td>Sweet flag</td>
<td>Acorus calamus</td>
<td>F–P</td>
<td>2–4</td>
<td>OBL</td>
<td>N/A</td>
<td>N/A</td>
<td>D</td>
<td>Iris-like leaves, waterfowl habitat</td>
</tr>
<tr>
<td>GRASS</td>
<td>Fringed sedge</td>
<td>Carex crinita</td>
<td>P–S</td>
<td>2–3</td>
<td>OBL</td>
<td>May–June</td>
<td>CRM</td>
<td>E</td>
<td>Drooping seed heads</td>
</tr>
<tr>
<td>GRASS</td>
<td>Common spikerush</td>
<td>Eleocharis palustris</td>
<td>P</td>
<td>1–3</td>
<td>OBL</td>
<td>July–Sept.</td>
<td>N/A</td>
<td>E</td>
<td>Dark yellow/brown fruits more notable than flowers</td>
</tr>
<tr>
<td>GRASS</td>
<td>Soft rush</td>
<td>Juncus effusus</td>
<td>All</td>
<td>2–4</td>
<td>OBL</td>
<td>July–Sept.</td>
<td>GRN</td>
<td>E</td>
<td>Clump forming</td>
</tr>
<tr>
<td>PERENNIAL</td>
<td>Swamp milkweed</td>
<td>Asclepias incarnata</td>
<td>F–P</td>
<td>2–5</td>
<td>OBL</td>
<td>July–Aug.</td>
<td>PNK</td>
<td>D</td>
<td>Pollinator</td>
</tr>
<tr>
<td>PERENNIAL</td>
<td>Hardy hibiscus</td>
<td>Hibiscus moscheutos</td>
<td>F</td>
<td>3–7</td>
<td>OBL</td>
<td>July–Sept.</td>
<td>RED</td>
<td>D</td>
<td>Showy flowers, attracts butterflies</td>
</tr>
<tr>
<td>PERENNIAL</td>
<td>Blue Flag iris</td>
<td>Iris virginica</td>
<td>F</td>
<td>2–3</td>
<td>OBL</td>
<td>May–June</td>
<td>BLU, WHT</td>
<td>D</td>
<td>Attracts birds and pollinators</td>
</tr>
<tr>
<td>PERENNIAL</td>
<td>Cardinal flower</td>
<td>Lobelia cardinalis</td>
<td>F–P</td>
<td>2–5</td>
<td>OBL</td>
<td>July–Sept.</td>
<td>RED</td>
<td>D</td>
<td>Hummingbird, pollinator</td>
</tr>
<tr>
<td>PERENNIAL</td>
<td>Pickeralweed</td>
<td>Pontederia cordata</td>
<td>F</td>
<td>3–4</td>
<td>OBL</td>
<td>June–Oct.</td>
<td>BLU, PUR</td>
<td>D</td>
<td>Mat forming, wildlife food, fish habitat, attracts butterflies</td>
</tr>
<tr>
<td>PERENNIAL</td>
<td>New York ironweed</td>
<td>Vernonia noveboracensis</td>
<td>F–P</td>
<td>3–6</td>
<td>FACW</td>
<td>July–Sept.</td>
<td>PUR</td>
<td>D</td>
<td>Pollinator, tolerates deer</td>
</tr>
</tbody>
</table>

Look for them in plugs or small containers. You may find some available in seed as well. Seeds will need to be held in place with straw mulch and/or fabric to prevent them from washing away. These nonwoody plants may also readily transplant.
Common Nonnative Invasive Plants Along Pennsylvania’s Streams
Avoid planting and spreading these harmful plants.

Trees and Shrubs
- Autumn olive (*Elaeagnus umbellate*)
- Burning bush (*Euonymus alata*)
- Common privet (*Ligustrum vulgare*)
- Exotic bush honeysuckle (*Lonicera* sp.)
- Glossy buckthorn (*Rhamnus frangula*)
- Japanese barberry (*Berberis thunbergii*)
- Multiflora rose (*Rosa multiflora*)
- Norway maple (*Acer platanoides*)
- Princess tree (*Paulownia tomentosa*)
- Tree-of-heaven (*Ailanthus altissima*)

Grasses and Grasslike Plants
- Common reed (*Phragmites australis*)
- Japanese stiltgrass (*Microstegium vimineum*)
- Reed canary grass (*Phalaris arundinacea*)

Nonwoody Flowering Plants
- Bull thistle (*Cirsium vulgare*)
- Canada thistle (*Cirsium arvense*)
- Garlic mustard (*Alliaria petiolata*)
- Giant hogweed (*Heracleum mantegazzianum*)
- Japanese knotweed (*Fallopia japonica*)
- Lesser celandine (*Ranunculus ficaria*)
- Poison hemlock (*Conium maculatum*)
- Purple loosestrife (*Lythrum salicaria*)
- Spotted knapweed (*Centaurea maculosa*)

Vines
- English ivy (*Hedera helix*)
- Japanese honeysuckle (*Lonicera japonica*)
- Japanese hops (*Humulus japonicus*)
- Mile-a-minute (*Polygonum perfoliatum*)
- Oriental bittersweet (*Celastrus orbiculatus*)

Optimal Stream Repair Planting Schedule

**LATE WINTER/EARLY SPRING**
Live stakes: plant while dormant when the soil is not frozen

**EARLY TO MID-SPRING**
Bareroot tree and shrub seedlings

**PLANT AFTER LAST SPRING FROST**
Stream edge herbaceous (nonwoody) transplants or plugs

**SPRING AND FALL**
Trees and shrubs in containers

**SUMMER**
Avoid planting—new plantings require 1 inch of water or rainfall per week
Familiarize yourself with the USDA hardiness zone and the average first and last frost dates in your area. Spring weather comes earlier in the southeastern part of Pennsylvania than it does in northern counties. Therefore, ideal planting dates will also vary.

<table>
<thead>
<tr>
<th>Area</th>
<th>Spring Frost Dates</th>
<th>Autumn Frost Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10% Chance</td>
<td>50% Chance</td>
</tr>
<tr>
<td>Selinsgrove, PA (Snyder County)</td>
<td>May 14</td>
<td>April 29</td>
</tr>
<tr>
<td>Norristown, PA (Montgomery County)</td>
<td>April 26</td>
<td>April 17</td>
</tr>
<tr>
<td>Slippery Rock, PA (Butler County)</td>
<td>June 9</td>
<td>May 21</td>
</tr>
<tr>
<td>Hawley, PA (Wayne County)</td>
<td>May 24</td>
<td>May 11</td>
</tr>
</tbody>
</table>

Source: NOAA National Centers for Environmental Information (January 2020).
Streamside Maintenance Checklist

The best care is the least care when it comes to a stream buffer. Resist the urge to tidy up. Here are some typical maintenance suggestions.

- Install tree shelters to protect plants from wildlife browsing for the first couple of years.
- Initial fertilization/liming: Get a soil test to determine what the soil needs are.
- Visit streambank at least seasonally.
  - Spring
  - Summer
  - Fall
  - Winter
- Pick up litter and trash, as it will most likely wash down from upstream.
- Observe plant survival rates to determine what needs to be replanted (remember to be patient). Succession happens, so eventually perennials will thin out due to shade from trees and shrubs. Consider replanting with shade-tolerant species when this happens.
- Observe and ID invasive plants to determine your eradication management plan. If you keep up with what is supposed to be there, and get rid of what’s not on your list, it will make for much easier maintenance in the future.
- Prune only as needed for future health of the trees. The object is to build a strong belowground root system to protect bank integrity and allow a dense canopy to shade the stream. If a large tree threatens to fall from a steep bank, you can cut the tree 10 feet above the ground surface and leave the root system in place. The “snag” that remains on the streambank will provide a great home for wildlife. In Pennsylvania, you need a permit to remove a tree’s root mass from a streambank.
- Mowing: While not always needed or required, herbaceous plants could occasionally be mowed to 6 inches once plants are established. This should be done in late fall or early spring, but watch for trees and shrubs. Mowing and weeding tools can damage your planted vegetation and open the door to future disease and early plant death. This is a good reason to space your newly planted trees far enough to allow your mower to fit between them.
- Inspect after large rain events or flooding. Repair small eroded spots before they get worse. If large woody debris is going to dam the creek and cause inundation, remove a 2-foot piece out of the log so water can flow through, but leave the rest for fish habitat. No permit is needed to remove that log portion from the stream.

Helpful tip: Search online for pictures of what was planted by season so you know what you’ve got and don’t accidentally cut down good vegetation!

Step 4: Maintaining Your Streamside Garden

In the first year, expect additional volunteer plants and invasive weeds to grow. Learn to identify and decide whether to pull out or manage these plants. Waiting too long to start weed management can make the job very difficult.

Some plants can die back but may sprout from the base of the plant; give plants a season before giving up and replacing them. It may take more than a year for seed to germinate and begin to grow.

It may take a few seasons to a few years for plants to establish (grow beyond their root ball and not need 1 inch of water per week), depending on the plant.

Throughout the year, sediment and debris may deposit in your planting area. It is okay to leave some deposits in place, but you may need to remove debris that is straining your plants or covering them completely.

Helpful Plant Identification Guides

- Invasive Plants in Pennsylvania: https://www.dcnr.pa.gov/Conservation/WildPlants/InvasivePlants/Pages/default.aspx
- Pennsylvania Native Plant Society: http://www.panativeplantsociety.org/

Soft rush (Juncus effusus) and jewelweed (Impatiens capensis, pictured above) will often come up along creek banks without planting. These two plants bend with river flows and stabilize the water’s edge.

Credit: © North Carolina Cooperative Extension

Unmaintained, this invasive bindweed is overtaking an oak tree planted along a stream.

Credit: Ryan Hill, Penn State

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