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RAIN GARDENS FOR TENNESSEE: A HOMEOWNER'S GUIDE

Andrea Ludwig, Associate Professor, Biosystems Engineering and Soil Science Department
Michael Ross, Assistant Professor, Department of Plant Sciences
Mia Roark, Graduate Assistant, Landscape Architecture
Sue Choi, Landscape Designer

This publication provides an overview of how to site, design, construct and maintain a home rain garden. A worksheet is included that contains a flowchart which summarizes the process. Design examples and a plant list are also included.

WHAT IS A RAIN GARDEN?

Building a rain garden is one way to practice sustainable landscaping and environmental stewardship in your home landscape and may even help fix drainage issues. A rain garden is a planted depression that is positioned to capture runoff from **impervious surfaces** (like rooftops or driveways) and designed to infiltrate it into the ground. Rain gardens enhance natural elements of your yard and minimize impacts of runoff on local waterways.

As urbanization occurs, the amount of impervious surfaces in a **watershed** increases, causing more runoff and pollution than had previously occurred when the landscape was forest or meadows. Rain gardens help restore a natural water balance while replacing maintenance-intensive lawn with native plants. Rain gardens can easily be incorporated into a yard, neighborhoods, schoolyards or small-scale commercial landscaping.

BENEFITS OF RAIN GARDENS

Building a rain garden creates many benefits for private property owners as well as communities. Rain gardens help slow down rainwater runoff, decreasing the potential for soil erosion and improving soil quality over time. They can also increase property values by adding landscaping and aesthetic appeal to a yard. Using a rain garden to catch runoff may also decrease the need for costly irrigation. Native plants in a rain garden are also good sources of food and shelter for native birds, beneficial insects and other local wildlife. Using rain gardens may help improve water quality in drinking sources and recreational areas. Treating polluted water can be extremely expensive, but rain gardens can be cost effective strategies to protect water quality by using a landscape dominated with native plants as a natural sponge.Treating polluted water can be extremely expensive, but rain gardens can be cost effective strategies to protect water quality by using a landscape dominated with native plants as a natural sponge.

Figure 1. Native plants cover this rain garden at the University of Tennessee Arboretum in Oak Ridge, Tennessee, that catches rooftop runoff and protects Scarboro Creek below.

TABLE 1: Functions and benefits of a rain garden

FUNCTIONS OF A RAIN GARDEN:	BENEFITS OF A RAIN GARDEN:
Slows down and captures rainwater runoff	Decreases the potential for soil erosion
Adds landscaping and aesthetic appeal	Improves soil quality over time
Catches rainwater runoff. Reduces risk of local flooding or nuisance ponding in lawns	Increases the value of a property
Provides food and shelter for native wildlife (when native plants are used)	Decreases the need for costly irrigation
Reduces stormwater runoff in storm drainage systems	Increases songbird population and attracts beneficial insects
	Reduces strain on municipal infrastructure and decreases the risk of flooding

When it rains in developed areas, rainwater runs off impervious surfaces and into storm drainage systems, which are direct conduits to local streams and rivers. This runoff carries pollutants like sediment, nutrients (fertilizers), bacteria, metals, oils and gasoline. Stormwater runoff also runs quickly to streams and accumulates in large volumes, causing streambanks and channels to erode. Rain gardens can help slow this runoff and soak it into the ground. Rain gardens capture the **"first flush"** of runoff from impervious surfaces that often carries the most pollution. As the water percolates through soil, plants remove nutrients, oils are absorbed and other toxic chemicals are broken down by microorganisms in the soil.

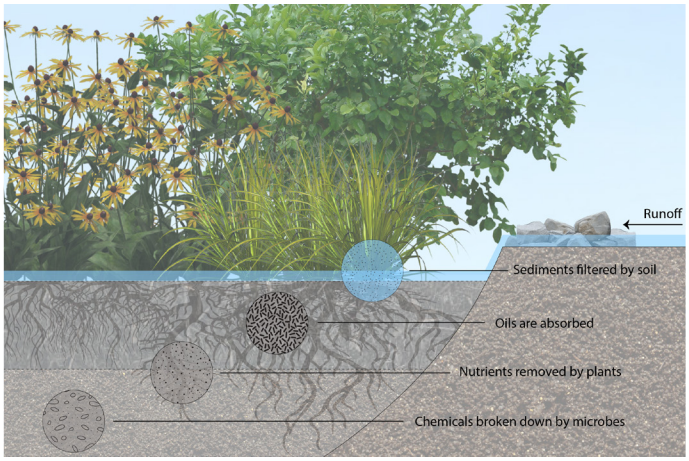


Figure 2: This figure depicts the runoff from a building or house entering a rain garden system and percolating downwards.

Rain gardens protect water quality while also enhancing the natural beauty of landscapes for you and your community. The cumulative effect of multiple rain gardens throughout a watershed decreases the potential for erosion of stream channels, which adversely impacts sensitive aquatic habitats at the stream bottom.

Rain gardens also create urban wildlife habitat and can be linked with other conservation landscaping to create habitat corridors to support pollinators, beneficial insects, songbirds and more.

DECIDING TO BUILD

Rain gardens can be adapted to fit in many spaces, but there are several key considerations to make before deciding to build. First, go outside when it rains and take an assessment of where runoff comes from, how it flows across the property and where it eventually goes. Some key features to note are the location and connection of gutter downspouts, drains, swales and ditches. Take note of spaces where runoff could be intercepted using a rain garden and make sure that overflow during large rain events can be diverted safely back into drainageways. Always call 8-1-1 to have underground utilities marked to be sure there are no lines running through. Be sure to account for electrical, water, sewer, cable, phone, gas and any other utilities you may have running through the property.

Rain gardens should not be placed in existing steam buffers, floodplains, forests or wetland. These areas are hydrologically sensitive and already perform an important natural function in the ecosystem. Preserve these areas on your property.

SELECTING A SITE

Rain gardens are ideally located near downspouts or along low-lying areas that already collect runoff, but aren't persistently soggy, as that shows that water is not moving through, or infiltrating through the soil. The topography (or slope) of your property will have the biggest influence on site selection. Look for flat areas with less slope. A good rule is less than 12 percent slope. This means that there is less than 6 feet in height difference over a span of 50 feet (or equivalent). Locate the garden at least 10 feet away from buildings, 15 feet from septic fields, as far as possible from trees and in as much sun exposure as possible.

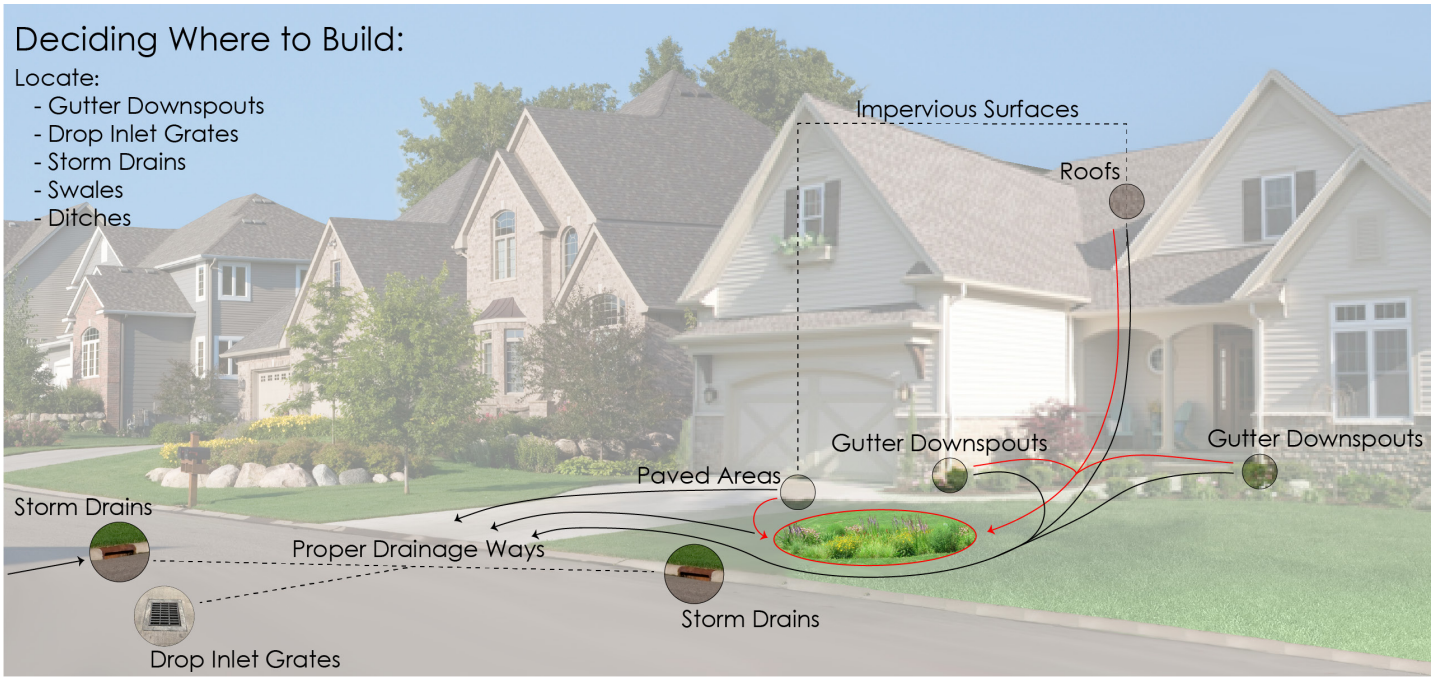


Figure 3: When determining where to build, consider the typical drainage patterns of your area, signified by the black lines above. If placed correctly, the runoff from your building will enter the rain garden system, depicted by the red lines.

Figure 4: When placing a rain garden, ensure that the slope of the lawn is equal to or less than 12 percent.

It may be necessary to divert or re-route roof downspouts from the storm drain system to capture the runoff in the rain garden. Downspout extensions and splash pads may be used to guide runoff away from structures and into rain gardens. Ensure that the area is sloped such that the runoff will flow away from structures. Some grading to create a shallow swale may be necessary to convey the water as needed.

Since rain gardens soak water into the ground, the selected site needs to have adequate infiltration. Perform a simple **infiltration test** by digging a hole that is one foot in diameter and about a foot deep. If you hit rock or the water table while digging this hole, then consider another location.

Scrape the sides of the hole to break up any slicking that may have been caused by the shovel (particularly important for clayey soils). Fill the hole with water and allow it to drain through gravity at least two consecutive times. This will saturate or "prime" the soils to simulate conditions of rainy weather. Fill the hole again and measure the depth of water. Now, monitor the water level over time to determine the infiltration rate, which is the depth of water moving into the soil (leaving the hole) over time.

For example, if the 12-inch-deep hole drains completely in 18 hours, then the infiltration rate is 12 inches per 18 hours, or 0.66 inches/ hour. Generally, if the hole drains in less than 24 hours, then the soils are fast draining and suitable for a rain garden. If the hole drains in 24-48 hours, then the soils are slow draining, and you will need to take extra steps during construction to amend the soils and increase infiltration. If the hole does not drain, there may be a confining layer that is impeding water movement. You may choose to dig down further and repeat the test or choose another site. If the deeper hole drains, then you could excavate down to that soil layer for your garden. This decision depends on the accessibility of excavation equipment and a place to dispose of the excess soil.

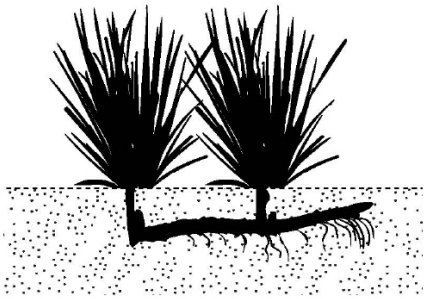
HOMEOWNER'S WORKSHEET

Rain garden for Tennessee: A homeowner's guide

Biosystems Engineering and Soil Science

Plant Sciences

Taproots



Rhizomes

Fibrous Roots

IS A RAIN GARDEN RIGHT FOR YOU?

Step 1. Pick a location			
Your chosen rain garden site should meet the following recommendations:		**IF NOT**, consider these options:	If the location meets all recommendations, proceed to step 2!
❑	The area is **NOT** a forest, a wetland or a floodplain.	Preserve the area as is.	
❑	There is a source of runoff, such as a roof or pavement.	Consider another location.	If the location does **NOT** meet the recommendations and the options are not desirable, then consider another location.
❑	Water drains in less than 72 hours.	Consider a bog garden.	
❑	The area is relatively flat.	Consider terracing.	
❑	The area is at least 10 feet away from infrastructure such as buildings and utility lines.	Use a liner to protect infostructure.	

IS A RAIN GARDEN RIGHT FOR YOU? (CONTINUED)

Step 2. Size the garden

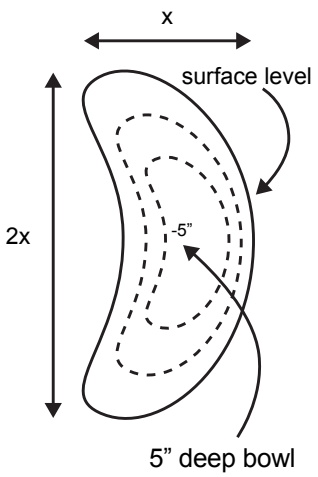
- Conduct a 12-inch percolation test at the location.
- If drain < 24 hours, then it is **fast-draining**.
- If drain takes 24-48 hours, then it is **slow-draining**.

To get the **area of the rain garden**, multiply

total area of impervious surfaces draining to the garden in sq. ft.	X	**slow-draining** 0.15
		or
		fast-draining 0.10

Impervious surface example: rooftop, driveway.

Step 3. Layout the garden



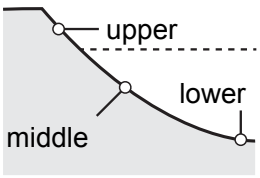
The garden should:

- Be a smooth natural shape
- Align on a natural contour
- Be about twice as long as it is wide
- Have a bowl depth of 5 inches deep from the overflow elevation
- Have an incline from existing ground surface to a flat bottom

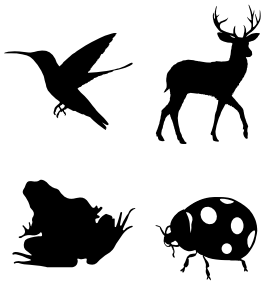
Step 4. Pick out plants

Consider the following characteristics to pick out the plants for your garden:

Moisture gradient

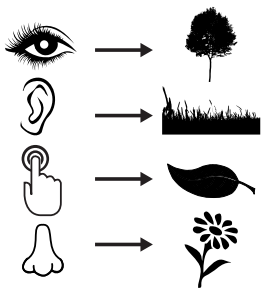


Wildlife



Light availability

Aesthetic needs



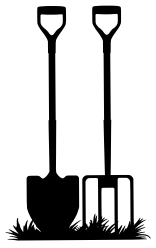
How many?

The number of plants for the garden depends on their mature size, the spacing between then and the root type and water collection strategy each plant has.

Step 5. Build the garden!

Here are some tips for building the garden:

- If the soils are tight or compacted, use a tiller down to 6 inches and amend with washed sand/or low-nutrient compost.
- If the area is sloped, build a berm on the lower end.
- If the side slopes are steep, use groundcover or dense grasses around the perimeter.
- Reduce overflow with stone and turf matting as necessary.
- Cover all bare soils with mulch or straw and seed.



Step 6. Maintain the garden!

Here are some tips for maintaining the garden:

- Add mulch as necessary.
- Remove weeds as needed.
- Watch for erosion and correct when needed.
- Replace or move plants based on success.
- Prune woody species in early spring.

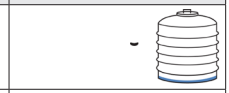
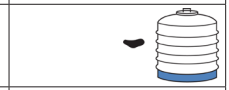
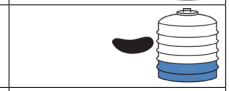
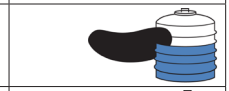
SIZING THE RAIN GARDEN

The size of the garden is guided by how much rainfall will be captured and soil infiltration rate. Rain gardens generally range from 100-250 square feet, with dimensions ranging from 8 to 12 by 10 to 20 feet. Determining a garden size for a 1-inch rain will catch the majority of rainstorms and meet requirements for local stormwater programs. Since the goal is to capture a volume of runoff, the garden surface area (or footprint) and the depth are important factors. The depth of water to be captured in the garden is called the bowl depth. A bowl depth of 4-5 inches is generally a good target for residential rain gardens to ensure that the garden area is reasonably small and that the captured water will infiltrate easily within a couple of days.

To find the garden size needed, first consider the **contributing drainage area** (CDA), which is the area that drains to the selected site. Take note of the impervious surfaces (rooftop, pavements, walkways, etc.) and the pervious areas (lawn, flowerbeds, etc). From your observations during rains, if portions of the yard shed water in relatively small storms, consider these areas in the CDA. The total area of the impervious surfaces and runoff-prone lawn areas that drain to the selected rain garden site comprise the CDA. Table 2 shows the relationship between impervious surface and generated runoff. For every 100 square feet of rooftop (or other impervious surface), about 60 gallons of runoff may be generated in a 1-inch rainfall.

"Building a rain garden for a 1-inch rain will catch the majority of rainfall and meets requirements for local stormwater programs."

TABLE 2: Amount of runoff generated by impervious surfaces

Impervious surface (sq.ft.)	Amount of runoff in 1-inch rainfall		Relative rain garden size
100	8 ft^3	60 gal	
200	21 ft^3	150 gal	
500	42 ft^3	310 gal	
750	63 ft^3	460 gal	
1000	83 ft^3	620 gal	
1500	125 ft^3	930 gal	
2000	167 ft^3	1240 gal	

GARDEN LAYOUT

Now that the garden size is set, the next step is to integrate the garden into the selected space in your yard. Use construction flags to mark out the perimeter of the garden, creating a jellybean shape that lies along a contour (or along the same elevation) with dimensions needed to get close to the target size. Determine where **concentrated flow and sheet flow** enters the garden and where the overflow needs to be in order to guide it to existing drainage infrastructure without causing erosion. For concentrated inflows, align the garden so that the inflow takes the longest path possible through the garden before it reaches the outlet. If the area is sloped, then use an earthen berm along the low side to create the cup-like depression.

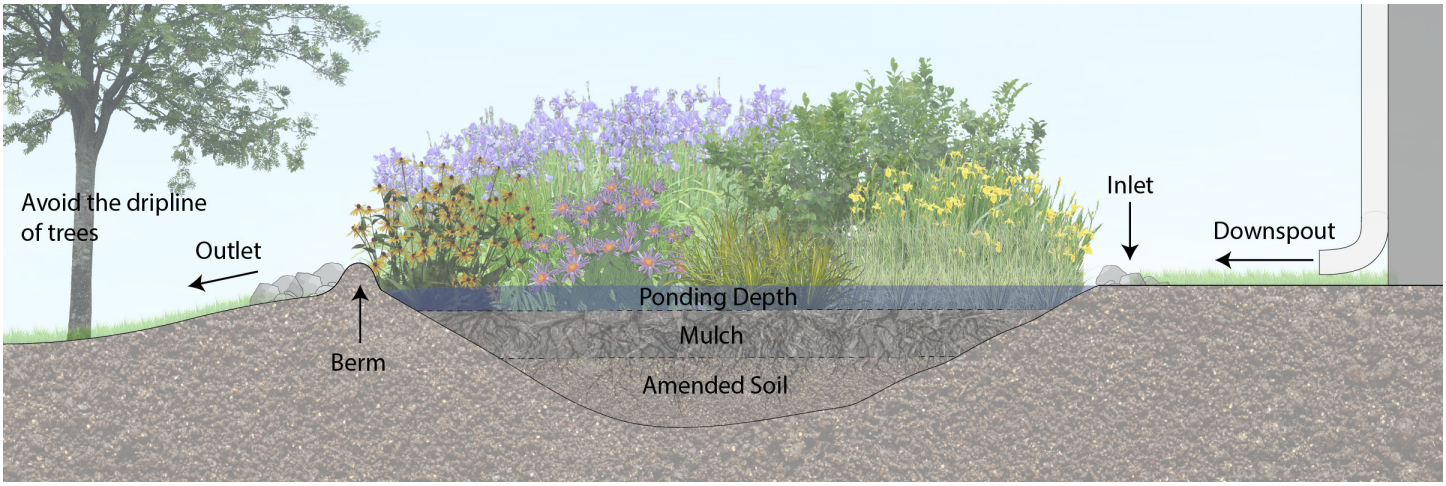


Figure 5: The layout of a rain garden should include both an inlet for runoff to enter the system and an outlet for water to exit. To protect against soil runoff, place a small berm prior to the outlet. The depression of the rain garden should be composed of amended soil and then a top layer of mulch.

PLANT SELECTION

Native perennial plants that are commonly found along streams and in floodplains will establish best in a rain garden because they are hardy, have extensive root systems, can survive in both wet and dry soil conditions, and are adapted to local climate conditions and the cycles of wet and dry soil conditions. Natives do not require fertilizers or supplemental irrigation once established. Create a plant palette with variable plant heights, shapes, color, bloom time, fall foliage and textures.

Envision the garden like a bull's-eye with three concentric rings: 1) the outside ring that lies at the highest elevation, which will stay the driest, 2) the middle ring that is the sloped or transitional area and 3) the center bull's-eye that lies lowest and stays wet the longest. Consider these soil moisture conditions in the planting design. Also consider the time of year the plants bloom or change color to maximize visual color appeal year-round. Specific perennials will attract pollinators and other beneficial insects. In addition to plants that provide pollen and nectar sources, host plants provide foliage for developing life stages of many insects, supporting the entire lifecycle of desired pollinators and beneficial insects you wish to attract. Berry-producing plants and dense, clumping grasses are good food and fiber resources for urban wildlife and birds. Remember, even fruit and seed eating birds need access to insect prey, your plant selections can support a robust community of interconnected organisms. Use the plant list at the back of this document and example gardens below to help guide your planting design.

Figure 6: The above images portray the progression of a rain garden overtime. From prior to installation (far left image) to multiple years of growth (far right image).

BUILDING THE GARDEN

The best time to build a rain garden is in dry weather in early spring or late fall. Springtime will have relatively looser, moister soils for digging and ensure there is enough rainfall after planting to get your plants established before the dry, stressful summer. Late fall is preferable because water tables are generally low, and plants have entered their dormant phase. This means that they will not feel as much stress during planting and come out of dormancy in the natural spring cycle.

The first step in building is to dig the rain garden bowl. Determine the needed depth of excavation by adding 4-5 inches to the 8 or 4 factor determined through the percolation test. This will account for the mulch that will be added to the garden later and a small "freeboard" that will ensure excess water will only flow out of the intended overflow area (and not erode other areas). It will be beneficial to use existing topographic change or slope. You may set up a level using two wooden stakes (one at each end of the garden) and either a bubble or picture-handing level. Use this fall over the area to reduce the amount of digging necessary.

Follow these steps to build the rain garden:

1. Dig or excavate the bowl. Place good topsoil on a tarp and clay subsoils on a separate tarp. The topsoil may be spread back in the bottom of the bowl if needed for planting. Dig to a depth of 8 inches — 5 inches to accommodate the ponded runoff and 3 inches for the mulch. If topsoil needs to be replaced into the garden after excavation, then account for this depth as well.
2. Build an earthen berm from the excavated clay subsoil to the needed height in order to pond the needed depth. Tie the clay berm into the existing ground around the garden, to ensure a smooth transition and so there is a relatively level rim around the entire bowl.
3. Till the bottom 3-6 inches of the bowl to aid in easy planting and encourage infiltration.
4. Replace a layer of clean topsoil (no weed seeds or turfgrass) or leaf litter compost to promote plant establishment.
5. Create an overflow spillway in the berm, about 1 foot wide and about 1 inch sunk into the berm. Use flat flag stone or seeded natural fiber matting here to protect from erosion.
6. Use stones to armor the inflow areas and slow down water if there is high concentrated inflow.
7. Layout and place plants in their desired location. Plant them shallow to allow for the additional mulch.
8. Cover all exposed soil with 3-inch triple-shredded hardwood mulch (or sod around the edges).
9. Water the plants immediately and as needed until plants are well established.

Document the plant placement with photos and flags so that after the dormant season you have a reference to help you remember where plants should be coming up. Over time, perennials may migrate into spaces that best suit their light and soil moisture adaptations. Keep a log of plant health and make changes to the design as you observe the garden through multiple seasons.

PICKING YOUR EXCAVATION EQUIPMENT:

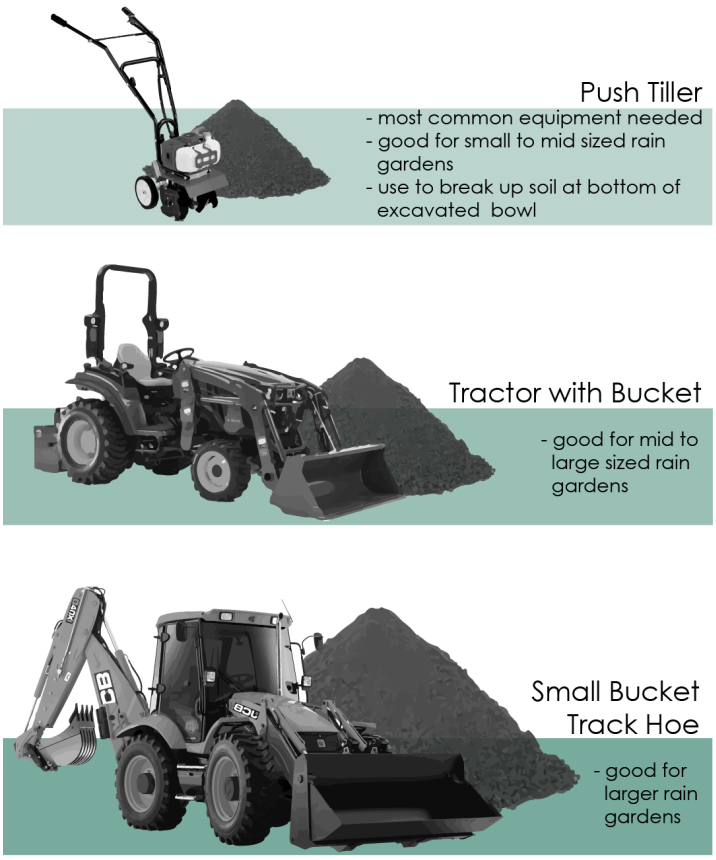


Figure 7: Excavation equipment should be chosen based of size of rain garden.

ENJOYING YOUR RAIN GARDEN

Keep in mind that once your rain garden is built, it is considered "in line" and will catch runoff during the next rain. Be prepared by ensuring all bare soil is covered and erosion-prone areas are armored as needed. Plants may take several months to become well established, depending on the time of year and climate pattern. If plants appear ill suited for the saturation or sun exposure of their initial planting location, move them around the garden until they take hold in a different location. Once established, the plants should be relatively low maintenance. Replace mulch as needed after large rains. During the first 1-2 years, plants will grow, and some will spread to fill the available space. After about 3-4 years, the garden will likely be filled with plant material, and the underlying mulch will be covered completely. This will provide natural weed suppression.

In summary, we use rain gardens to take advantage of natural rainfall to grow healthy plant communities and help prevent erosion and pollution downstream. The use of rain gardens lessens the burden on municipal stormwater systems saving taxpayer money and reducing the risk of local flooding. Sizing a rain garden requires knowing the contributing drainage area and soil infiltration rates. The average home size in the United States is 2,700 square feet. If we assume the average home is two levels, then the average home rooftop is approximately 1,400 sq. ft. If a rain garden is designed to catch half of the rooftop runoff during a 1-inch storm, then that rain garden will capture up to 430 gallons during that one storm. If every house in a 30-home neighborhood had a similar rain garden, then that would amount to almost 13,000 gallons of runoff soaked into the ground every time it rains an inch.

The environment is where we all meet, where we all have a mutual interest; it is the one thing all of us share. It is not only a mirror of ourselves, but a focusing lens on what we can become."

— Lady Bird Johnson

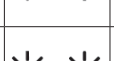
Legend

COMMON NAME	SCIENTIFIC NAME	BLOOM TIME AND COLOR	LOCATION	HEIGHT (FT.)	SPACING (FT.)	LIGHT	ROOT	BENEFITS
Local name given to a certain genus or species, varies across place and communities.	Local name given to a certain genus or species, varies across place and communities.	Bloom time is the general time of year that a specific species flowers. The color of the each is represented in the box. A qbox means the color-ation is white.	Location is where each plant can be placed within the rain garden.L- Lower ElevationM-Middle ElevationU- Upper Elevation	Average height that a mature species can reach over time.	Average space that a mature individual will need and, therefore, should be placed that far from other plants.	Full Sun Full Shade Part Sun/ Part Shade	Fibrous Taproot Rhizome	Attracts: Birds Bees Butterflies Humminbirds

Rain Garden Allstars

COMMON NAME	SCIENTIFIC NAME	BLOOM TIME AND COLOR												LOCATION	HEIGHT (FT.)	SPACING (FT.)	LIGHT	ROOT	BENEFITS
		J	F	M	A	M	J	J	A	S	O	N	D						
Blue Star	*Amsonia tabernaemontana*													M/U	3'	3'			
Swamp Milkweed	*Asclepias incamata*													L/M/U	3-4'	3'			
New England Aster	*Aster novae angliae*													L/M/U	4'	4'			
Blue Wild Indigo	*Baptisia australis*													L/M/U	4'	3'			
Dwarf Joe Pye Weed	*Eupatorium maculatum*													L/M/U	up to 6'	4'			
Rose Mallow	*Hibiscus mocheutos*													L/M/U	3-8'	4'			
Brown-eyed Susan	*Rudbeckia fulgida*													M/U	3-5'	3-4'			
Blue Flag Iris	*Iris versicolor*													L/M	1-3'	2'			
Rough-Leaf Goldenrod	*Solidago rugosa*													L/M/U	5'	3-4'			
White Star Sedge	*Rhynchospora colorata*													L/M/U	2'	2'			

Perennials

COMMON NAME	SCIENTIFIC NAME	BLOOM TIME AND COLOR												LOCATION	HEIGHT (FT.)	SPACING (FT.)	LIGHT	ROOT	BENEFITS
		J	F	M	A	M	J	J	A	S	O	N	D						
White Baneberry	*Actaea pachypoda*													M/U	2'	2'			
Blue Star	*Amsonia tabernaemontana*													M/U	3'	3'			
Columbine	*Aquilegia canadensis*													M/U	2-3'	1'			
Swamp Milkweed	*Asclepias incarnata*													L/M/U	3-4'	3'			
New England Aster	*Aster novae angliae*													L/M/U	4'	4'			
Blue Wild Indigo	*Baptisia australis*													L/M/U	4'	3'			
Pink Beauty/False Aster	*Boltonia asteroides*													M/U	4'	4'			
Marsh Marigold	*Catha palustris*													L/M	1-1.5'	1'			
White Turtlehead	*Chelone glabra*													L/M	3'	2.5'			
Pink Turtlehead	*Chelone lyonii*													L/M	3'	2.5'			
Mistflower	*Conoclinium coelestinum*													L/M/U	2'	2'			
Purple Coneflower	*Echinacea purpurea*													U	2'				
Joe Pye Weed	*Eupatorium maculatum*													L/M/U	up3-t5o'6'	4'			
Dwarf Joe Pye Weed	*Eupatorium maculatum*													L/M/U	4-5'	4'			
Wild Geranium	*Geranium maculatum*													M/U	1-2'	1'			
Swamp Sunflower	*Helianthus angustifolius*													L/M/U	5-8'	3'			
Scarlet Rose Mallow	*Hibiscus coccineus*													L/M/U	6'	6'			
Rose Mallow	*Hibiscus moscheutos*													L/M/U	3-8'	4'			
Crested Iris	*Iris cristata*													M/U	6-9"	1'			
Copper Iris	*Iris fulva*													L/M	2-4'	1-2'			

Perennials (continued)

COMMON NAME	SCIENTIFIC NAME	BLOOM TIME AND COLOR	LOCATION	HEIGHT (FT.)	SPACING (FT.)	LIGHT	ROOT	BENEFITS
Blue Flag Iris	*Iris versicolor*		L/M	1-3''	2'			
Dense Blazing Star	*Liatris spicata*		M/U	2-6'	2'			
Cardinal Flower	*Lobelia cardinalis*		L/M	1-4'	2'			
Great Blue Lobelia	*Lobelia siphilitica*		L/M	1-4'	2'			
Beebalm	*Monarda didyma*		L/M	2-4'	2'			
Wild Bergamont	*IMonarda fistulosa*		M/U	2-4'	2'			
Meadow Phlox	*Phlox maculata*		M/U	2-4'	3'			
Grey Headed Coneflower	*Ratibida pinnata*		L/M	2-4'	1-2'			
Brown-Eyed Susan	*Rudbeckia fulgida*		M/U	3-5'	3-4'			
Rough-Leaf Goldenrod	*Solidago rugosa*		L/M/U	5'	3-4'			
Fireworks Goldenrod	*Solidago rugosa*		L/M/U	4'	3-4'			
Foam Flower	*Tiarella cordifolia*		M/U	1'	1'			
Ironweed	*Vernonia gigantea*		L/M/U	4-7'	3'			

Shrubs

COMMON NAME	SCIENTIFIC NAME	BLOOM TIME AND COLOR	LOCATION	HEIGHT (FT.)	SPACING (FT.)	LIGHT	ROOT	BENEFITS
Red Chokeberry	*Aronia arbutifolia*		L/M/U	6-10'	8'			
Black Chokeberry	*Aronia melanocarpa*		L/M/U	5-9'	5'			
American Beauty Berry	*Callicarpa americana*		M/U	5-7'	5'			
Buttonbush	*Cephalanthus occidentalis*		L/M/U	8-12'	10'			
Summersweet "HB"	*Clethra alnifolia*		M/U	3'	3'			

Shrubs (continued)

COMMON NAME	SCIENTIFIC NAME	BLOOM TIME AND COLOR	LOCATION	HEIGHT (FT.)	SPACING (FT.)	LIGHT	ROOT	BENEFITS
Summersweet "RS"	*Clethra alnifolia*		M/U	6''	5'			
Red/Yellow Twig Dogwood	*Cornus stolonifera*		L/M/U	6-9'	6'			
Hearts-a-burstin	*Euonymus americanus*		L/M/U	4-6'	5'			
Dwarf Fothergilla	*Fothergilla gardenii*		M/U	3-5'	4-5'			
Vernal Witchhazel	*Hamamelis vernalis*		L/M/U	6-10'	8'			
Oakleaf Hydrangea	*Hydrangea quercifolia*		M/U	5-10'	6'			
Inkberry	*Ilex glabra*		M/U	6-10'	8'			
Common Winterberry	*Ilex verticillata*		L/M/U	6-10'	8'			
Virginia Sweetspice	*Itea virginica*		L/M/U	3-5'	4'			
Spicebush	*Lindera benzoin*		M/U	6-12'	6'			
Ninebark	*Physocarpus opulifolius*		L/M/U	5-10'	8'			
Swamp Azalea	*Rhododendron viscosum*		L/M/U	3-8'	5-7'			
Swamp Rose	*Rosa palustris*		L/M/U	6-7'	6'			
Arrowhead Possumhaw	*Viburnum dentatum*		M/U	6-12'	6-12'			
Smooth Witherod Viburnum	*Viburnum nudum*		L/M/U	6'	7-8'			

Ferns

COMMON NAME	SCIENTIFIC NAME	HEIGHT (FT.)	SPACING (FT.)	LIGHT	ROOT	BENEFITS
Lady Fern	*Athyrium filix-femina*	2-3'	1'			
Ostrich Fern	*Matteucia struthiopteris*	2-3'	2'			
Cinnamon Fern	*Osmunda cinnamomea*	4'	2'			
Royal Fern	*Osmunda regalis*	2-5'	2'			
Christmas Fern	*Polystichum acrostichoides*	2-4'	1'			

Grasses and Sedges

COMMON NAME	SCIENTIFIC NAME	HEIGHT (FT.)	SPACING (FT.)	LIGHT	ROOT	BENEFITS
Big Blue Stem	*Andropogon gerardii*	4-8'	2'			
Bushy Blue Stem	*Andropogon glomeratus*	3-4'	2'			
Tussock Sudge	*Carex stricta*	2-3'	1.5'			
River Oats	*Chasmanthium latifolium*	3'	2'			
Soft Rush	*Juncus effuses*	4'	1'			
Swithchgrass	*Panicum virgatum*	3-5'	3'			
White Star Sedge	*Rhynchospora colorata*	2'	2'			
Little Bluestem	*Schizachyrium scoparium*	3'	2'			
Woolgrass	*Scirpus cyperinus*	6'	1'			
Indian Grass	*Sorghastrum nutans*	3-6'	2-3'			
Cedar Sedge	*Carex eburnea*	0.5'	1'			
Oak Sedge	*Carex albicans*	3-4'	2'			

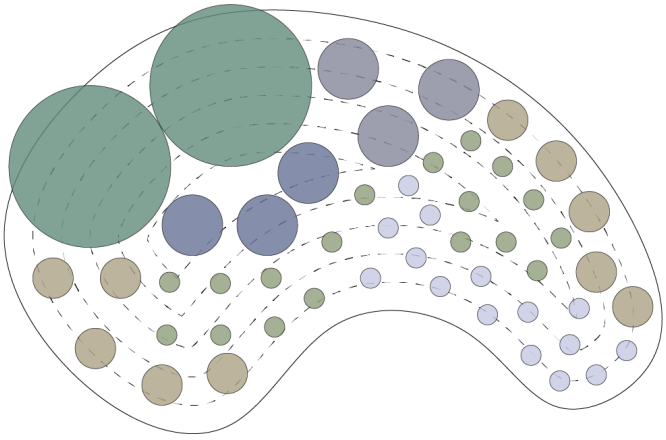
Grasses and Sedges (continued)

COMMON NAME	SCIENTIFIC NAME	HEIGHT (FT.)	SPACING (FT.)	LIGHT	ROOT	BENEFITS
Palm Sedge	*Carex muskingumensis*	2-3’	1.5’			
Fox Sedge	*Carex vulpinoidea*	3’	2’			
Gold Sedge	*Carex aureolensis*	10”	1’			
Pennsylvania Sedge	*Carex pensylvanica*	0.5-1’	0.5-1’			

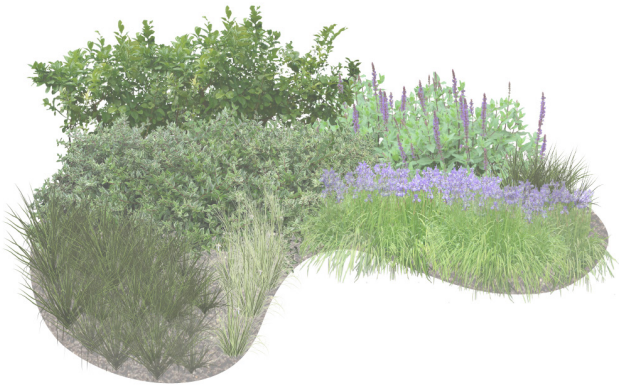
SUNNY LOCATION

320 sq. ft. garden

SCIENTIFIC NAME	PLANT	DIAMETER	SYMBOL
Iris versicolor	Blue Flag Iris	1’	
Rhynchospora colarata	White Star Sedge	1’	
Rudbeckia fulgida	Brown-eyed Susan	2’	
Bapfisia ausfralis	Wild Blue Indigo	3’	
Aster novae-angliae	New England Aster	3’	
Ilex verticillata	Common Winterberry	8’	



Spring Blooms

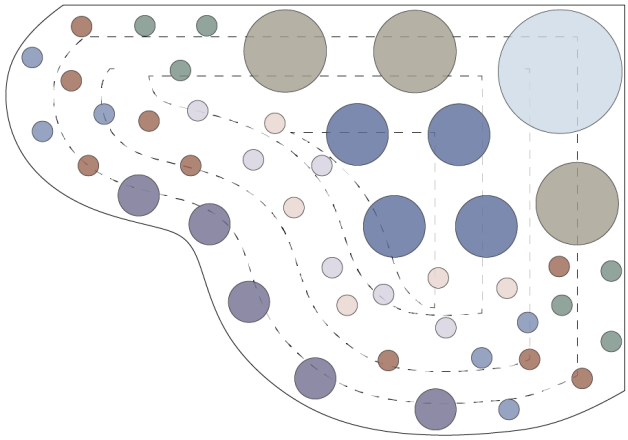


Fall Blooms

SUNNY WITH SHADE IN BACK CORNER OF GARDEN

180 sq. ft. garden

SCIENTIFIC NAME	PLANT	DIAMETER	SYMBOL
Tiarella cordifolia	Foam Flower	1’	
Phlox divaricata	Woodland Phlox	1’	
Lobelia cardinalis	Cardinal Flower	1’	
Lobelia siohilifica	Blue Lobelia	1’	
Polvstichum acrosfichoides	Christmas Fern	1’	
Stokesia laevis	Stokes Aster	2’	
Amsonia fabernaemonfana	Blue Star Amsonia	3’	
Fofhergilla gardenii	Fothergilla	4’	
Hydrangea quercifolia	Oak Leaf Hydrangea	6’	



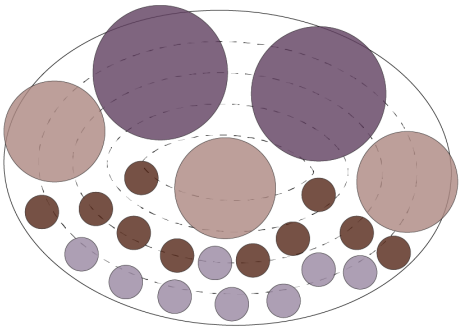
Spring Blooms

Fall Blooms

SUNNY LOCATION

320 sq. ft. garden

SCIENTIFIC NAME	PLANT	DIAMETER	SYMBOL
Conoclinium coelestinum	Purple Mist Flower	2’	
Monarda didyma	Scarlet Bee Balm	2’	
Hibiscus coccineus	Scarlet Rose Mallow	6’	
Callicarpa americana	Beauty Berry	8’	



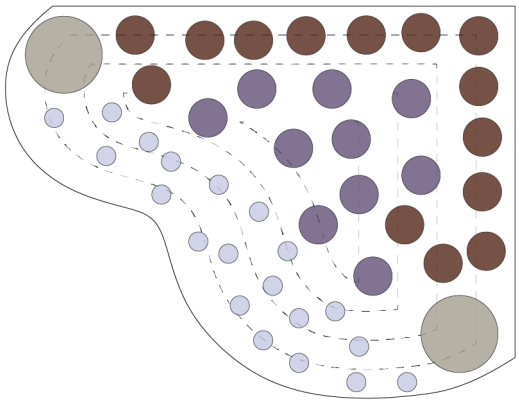
Spring Blooms

Fall Blooms

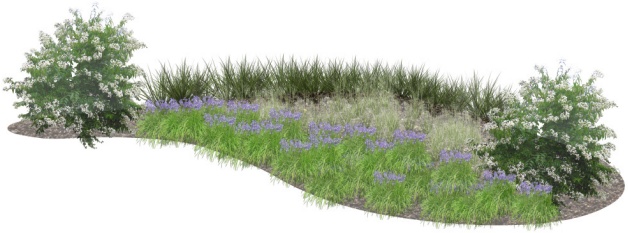
SUNNY LOCATION

125 sq. ft. garden

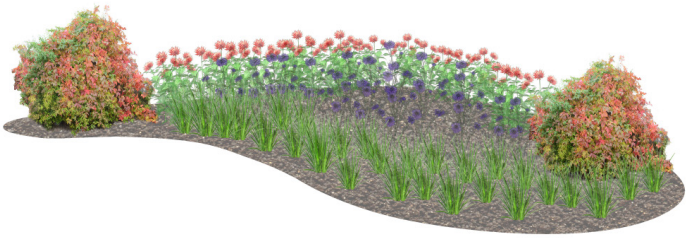
SCIENTIFIC NAME	PLANT	DIAMETER	SYMBOL
Iris versicolor	Blue Flag Isis	1’	
Conoclinium coelestinum	Purple Mist Flower	2’	
Monarda didyma	Scarlet Bee Balm	2’	
Fothergilla	Fothergilla	4’	



Spring Blooms



Fall Blooms



GLOSSARY

Berm

A barrier constructed of compacted earth or other material and intended to restrict, hold or direct the flow of water. Berms are often used along the lower end of a rain garden to create an even elevation around the perimeter of the rain garden needed to capture water in the bowl of the garden.

Best management practice

In regard to stormwater management, a best management practice (BMP) is a practice that captures stormwater runoff and treats it for pollutant removal using natural processes like infiltration and sedimentation, microbial remediation or plant uptake. An interchangeable term is Green Stormwater Infrastructure, or GSI.

Bioretention

The process of collecting stormwater in a treatment area consisting of soil and plant materials to facilitate infiltration and remove sediment and other pollutants through physical, chemical and biological processes.

Concentrated flow

Water flow that gains speed and increases in depth, forming small channels. There are two types of concentrated flow: shallow concentrated flow and channelized flow.

Contributing drainage area

The land area that will contribute runoff during a storm. For rain garden design, a rain garden is sized to be 10-15 percent of the impervious surfaces contained within the contributing drainage area for the selected site.

Drop inlet

Any inlet or drain that conveys stormwater from the surface to the storm sewer system.

Ecosystem services

The benefits people obtain from ecosystems that fall into four general categories: provisioning, regulating, supporting and cultural.

Engineered soil

A growing media that has been formulated or designed with specific components for specific purpose or application, which is generally related to infiltrating water and removing potential pollutants in rain gardens.

Erosion

The process of moving soil from one location to another caused by the action of wind, water or other forces working on the earth's surface.

First flush

A phenomenon where runoff water from the first half to one inch of rainfall in a storm is the most contaminated with pollutants. This is especially true during a rain preceded by a long dry period.

Floodplain

An area of low-lying ground around adjacent to a river or stream, formed mainly of sediments and subject to flooding.

Freeboard

The distance between the water level when the rain garden is full and the top of the berm or rim.

Grading

In reference to construction, grading is the changing of the existing ground surface to desired slopes, elevation or forms. Grading is used to direct stormwater runoff flow and enhance the use of space.

Habitat

A natural home or environment of an animal, plant or other living organism.

Habitat corridor

A natural or planned strip of land that connects two habitats that connects wildlife populations otherwise separated by human activities or structures.

Impervious surface

Any surface or ground cover that has very limited or no capacity to absorb and/or infiltrate water. Examples include asphalt, concrete, mortared brick or highly compacted soils.

Infiltration

The process of water moving into the soil profile from the soil surface.

Inlet (rain garden)

Area where concentrated flow of stormwater runoff enter the rain garden, sometimes by means of a pipe or conveyance channel and usually containing some sort of erosion matting or stone to prevent erosion and in a manner to dissipate flow energy as it spreads into the rain garden footprint.

GLOSSARY

Native plants

Plants that occurred in an area before disturbance by humans. When matched to the right conditions, native plants can readily establish because they are adapted to the climate, soil, insects and other conditions of the region and can provide habitat and genetic diversity to their specific ecoregion. Native plants commonly have desirable characteristics for use in rain gardens, such as deep roots, adaptability to variable soil moisture conditions, and growth habits that readily assemble into plant communities.

Neutral fiber matting

A woven product made of raw materials directly obtainable for an animal, vegetable or mineral source that will readily degrade in the environment within a short timeframe (within a few years). Natural fiber matting is used to reduce soil erosion and encourage good seed to soil contact needed for germination and vegetation establishment.

Nonpoint source pollution

Pollution that comes from the landscape, a diffuse source, rather than a pipe or other singular point of origin. It is one of the leading causes of water quality impairments in Tennessee and the U.S.

Nutrients

Elements essential for plant growth. The nutrients most critical for management as relates to water quality issues are nitrogen (N) and phosphorus (P).

Outlet (rain garden)

Area where overflow water spills from the rain garden during storms that exceed design capacity. Usually consisting of an armored surface, the outlet is at an elevation that dictates the ponded depth in the rain garden and directs water safely towards drainage infrastructure that carries large storm flows.

Percolation

The process of water moving within the soil profile once it has moved through the soil surface through infiltration.

Percolation test

A standard method for measuring percolation rate of soil at a site of interest, commonly used to determine suitability for infrastructure that relies on losses of water through infiltration and percolation.

Perennial plants

Plants that live year after year.

Pollutants

A substance that is present in concentrations that may harm organisms (human, plants or animals) or exceed an environmental quality standard.

Ponded depth/bowl depth

The depth of water retained in the rain garden in a design storm event, measured from the deepest/lowest point in the rain garden footprint to the outlet/area where overflow water spills out of the garden.

Rain garden

A planted depression positioned in the landscape to capture runoff from impervious surfaces (like rooftops or driveways) and designed to infiltrate it into the ground. Rain gardens are used to enhance natural elements of your yard and minimize impacts of runoff on local waterways.

Sediment

Soil particles that have been detached from the land by the process of erosion. Excess sediment is a pollutant of concern and the leading cause of impairment in surface waters in Tennessee and many other states.

Sheet flow

Water flow over a surface at a uniform depth, also referred to as overland flow.

Soil amendments

Any material added to soil to improve its physical, chemical, biological or structural properties or to provide enhanced plant growth.

Storm drain/storm sewer

A series of inlets and pipes used to collect and convey stormwater runoff to a discharge point such as a stream, river, lake, or other waterbody. Generally, storm drainage is not treated for pollution before it is discharged into a waterbody.

Stormwater runoff

Excess rainfall, snowmelt or other storm-derived water that flows over the surface of the land.

Stream buffer

A vegetated area between a waterbody and adjacent land use such as farming or urban/suburban development used to slow the flow of runoff and protect the water quality and aquatic habitat of the waterbody.

GLOSSARY

Swale

A broad, shallow, gently sloped channel for collecting, directing and conveying stormwater runoff in such a way to minimize erosion. Swales may be lined with vegetation, erosion matting, compost and/or stone/riprap.

Water table

An underground boundary between the soil surface and the area where groundwater saturates spaces between sediments and cracks.

Watershed

The land area from which water drains to a particular point, usually associated with a waterbody such as a stream, river or lake.

Wetland

Complex ecosystems that occur in the transition zone between land-based ecosystems and water-based ecosystems. A wetland has plants that are adapted to water, soils that have formed under saturated conditions and wetland hydrology.

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