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Rain Gardens and Stormwater

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What is stormwater?

When precipitation falls to the ground or snow melts, it either percolates into the soil or moves across the land or an impervious surface as **stormwater** until it reaches a creek or stream, eventually flowing to a natural storage area such as a pond, a lake or a reservoir. In some cases, stormwater is stored temporarily in small depressions until it can infiltrate or evaporate.

Stormwater runoff is a natural process, but it can be greatly altered by development, which creates large areas of impervious surfaces such as parking lots, roofs, buildings, roads, sidewalks and driveways. Impervious surfaces prevent infiltration and create greater volumes and flow velocities of stormwater runoff for a given area. This, in turn, increases the potential for stormwater to collect and transport pollutants such as sediment, nutrients, bacteria and petroleum-based products to streams and ultimately to lakes and oceans. It also creates greater potential for flooding in urban areas when small natural drainage areas can no longer accommodate stormwater flows due to increased runoff volume and flow velocities.

To protect our waterways from polluted stormwater, the United States Environmental Protection Agency now has laws in place that require certain municipalities to manage and control stormwater runoff through measures such as bio-retention basins, bioswales, constructed wetlands, open space conservation and land development ordinances. Homeowners and property managers can also manage stormwater in a manner that is relatively inexpensive, pleasing to the eye and beneficial to the environment through the use of rain gardens.

What is a rain garden?

As their name implies, rain gardens are cultivated areas created to collect stormwater runoff. A rain garden is a landscaped depression that collects rainfall from impervious areas such as roofs, driveways or parking lots and blends in seamlessly with other landscaping. Thus, they are really smaller-scale bio-retention basins that fit perfectly around houses and lawns. The garden's flat bottom and porous soil help distribute rain water evenly across the planted area, allowing the water to slowly soak into the ground within 48 hours after the rain stops. Appropriately designed rain gardens will not increase mosquito populations since mosquitoes cannot complete their breeding cycle in this length of time.

While they are beautiful, low-maintenance additions to your yard, rain gardens also provide important environmental benefits. Landscaped with native plants, rain gardens provide habitat that attracts local wildlife, including butterflies and birds. By catching and allowing rainwater to slowly percolate into the soil, rain gardens recharge groundwater supplies and decrease stormwater

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runoff. Rain gardens are designed and constructed in such a way that the soil in the garden can filter and remove any pollutants from the captured stormwater, thereby protecting the quality of our groundwater.

Rain gardens can vary in size and shape and contain an infinite arrangement of plants and colors to fit into any landscape. Rain gardens have been used at businesses, in neighborhoods, schools and parks. They can be placed virtually anywhere where runoff can be collected.

How do rain gardens work?

Rain gardens are designed to capture stormwater and to hold it long enough to allow interaction with soil but not long enough to create habitat for mosquitoes. Rain gardens capture stormwater by being placed downslope of drainages from impervious surfaces. Once stormwater is collected, it is stored temporarily in the rain garden where it interacts with plants and soil before draining to groundwater or evaporating. In this manner, rain gardens can function like temporary, miniature wetlands. Wetlands can remove pollutants by slowing the flow of stormwater to allow soil to filter pollutants via adsorption and entrapment, while plants can uptake some pollutants such as nutrients and metals in a process known as phyto-remediation. Also, oxygen imported into the soil by wetland plants can help microbes transform and degrade pollutants before the water drains to groundwater or is released to natural drains. In this manner, rain gardens become more than a beautiful landscape feature, they become an effective way of capturing, reducing and remediating stormwater runoff.

What are the environmental benefits of rain gardens?

Rain gardens provide a number of relatively low-cost benefits to the environment including:

- Removing pollutants including sediment, fertilizers, pesticides, automotive fluids and metals from stormwater.
- Increasing water infiltration and recharging groundwater supplies.
- Enhancing the beauty of yards, neighborhoods and businesses through beautiful landscaped areas.
- Providing habitat for birds, butterflies and beneficial insects.
- Reducing flooding and drainage problems in yards and communities.
- Sustaining creek flows during dry periods.
- Reducing the flow intensity of creeks during storm events.

How do you build a rain garden?

The first step to constructing a rain garden is to develop a plan that includes location, size and shape (layout), porous media selection, mulch selection and plant selection.

Site Selection

Rain gardens can be placed just about anywhere but must be placed at a lower elevation than the runoff entrance and the surrounding land. The installation of a rain garden will most likely require some shallow excavation. To avoid damage to underground utility lines and serious injury, contact

Figure 1. Examples of rain gardens.

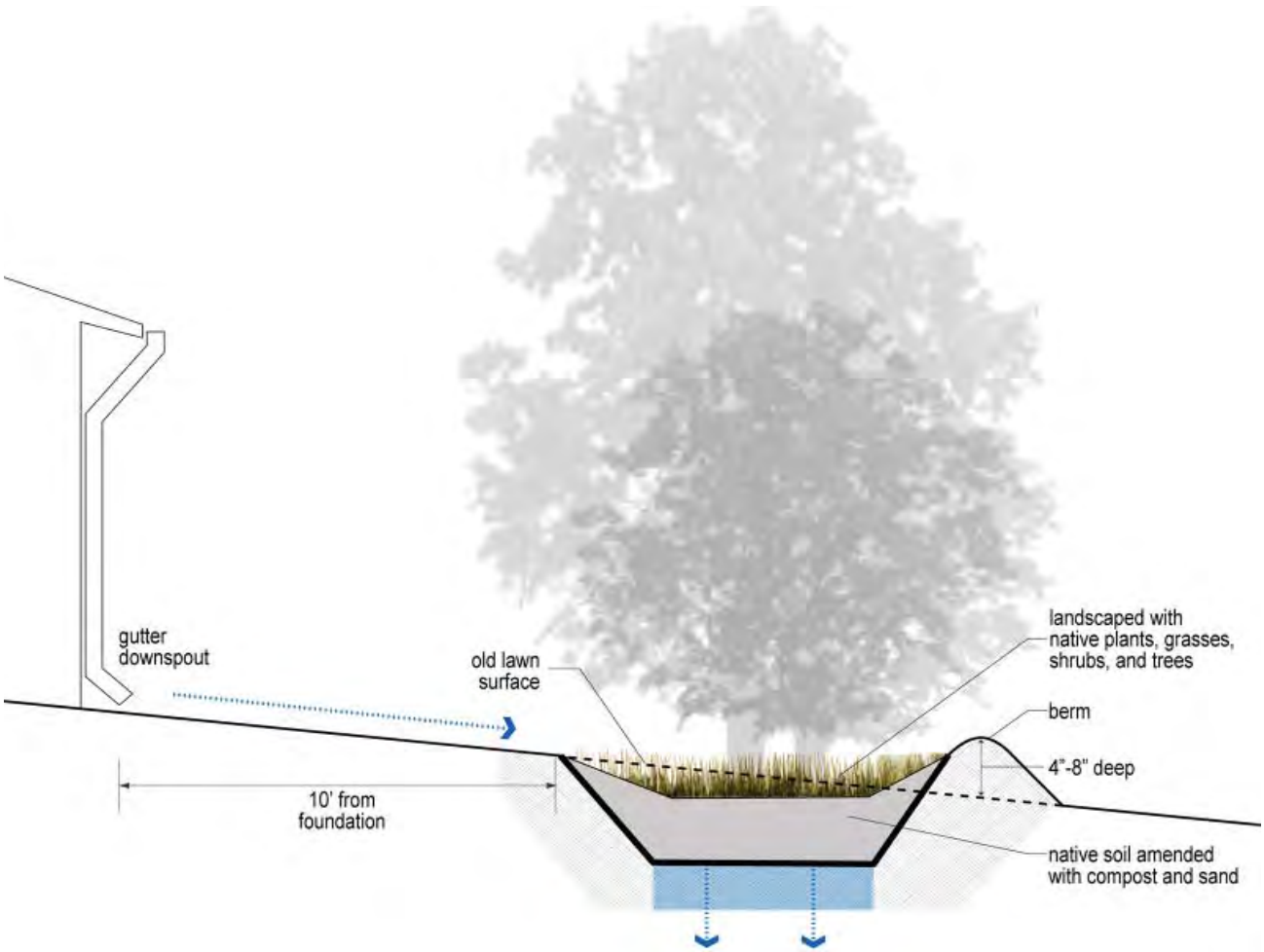

Figure 2. Schematic cross section of a typical rain garden (Rain garden detail created by Jeff Huber, University of Arkansas Community Design Center).

your local utilities to ensure your location does not coincide. Other tips for locating rain gardens include:

- The rain garden should be at least 10 feet from the house to avoid interaction with the foundation.
- Do not place rain gardens directly over septic systems or lateral lines.
- Avoid areas where water already ponds as this indicates poor infiltration.
- Place rain gardens in full or partial sun.
- Selecting gently sloping land will reduce excavation efforts.

An extremely important consideration for determining the suitability of your site is to ensure that you have adequate infiltration and water movement through the soil. You can do a simple percolation test to determine how quickly water moves through your soil. Dig a hole about 12 inches deep and about 6 inches in diameter. A post-hole digger is good for this. Fill the hole with water three times and allow it to thoroughly saturate the surrounding soil. Fill the hole with water a fourth time and observe how long it takes the water to soak out of the hole. If the soil is already saturated from rain, you may not have to fill it three times. Use the following guidelines to determine suitability:

- Rapid percolation: Water drains out of the hole within an hour; soil may not hold water long enough for establishment of vegetation. Organic matter amendments such as compost or peat moss needed.
- Moderate percolation: Water drains out of the hole within eight hours; ideal for effective rain garden establishment.
- Slow percolation: Water does not completely drain within 24 hours; site may be too wet, clayey or low for effective rain garden. Additional digging and soil amendments necessary.

Size and Shape

Once you have determined a location that is free of utility lines, then determining the size and shape should follow. Rain gardens can be any size and

shape, but here are a few guidelines that can improve performance:

- Total area should be at least 10% the size of the impervious area from which runoff is being collected, such as a roof or driveway, with 30% being optimum.
- The depression area of the garden should be excavated to six to eight inches below the original soil surface or deeper with greater slope. The bottom of the garden should be flat. If the percolation test indicated slow water movement, then dig four to six inches deeper and remove that soil and save for berm construction. Break up the soils on the bottom of the bed with a rototiller, shovel or pitchfork. Backfill with soil mixture described below.
- A berm four to eight inches above the top of the planting bed should be constructed around the perimeter of the garden.

As far as shape, rain gardens can be any shape including kidney, crescent, rectangular, circular or square. Its shape can be constructed to uniquely fit your landscape and be pleasing to your eye.

Soil Mixture

The results of your percolation test can help guide you on how to amend the soil that is used as backfill. For rapid infiltration, mix removed soil with equal mixture of an organic amendment such as compost or peat moss. For moderate percolation, you may not have to amend for water movement. However, adding 25% to 40% compost or peat moss may be advantageous to the long-term soil fertility and plant life. For slow percolating soils, remove and use the soil collected from the additional digging for the berm. Mix equal parts sand, organic material and original topsoil (four to six inches) and backfill to desired garden depth.

Plants

Rain gardens can be as colorful, beautiful and unique as your creativity allows. Hundreds of plants can work in rain gardens. However, native perennial flowers, grasses and shrubs that can tolerate both drought or moist soil conditions should thrive in your garden. They'll also entice butterflies, hummingbirds and other nectar and berry feeders to visit and provide better disease resistance. These local plants tend to be well-adapted to a range of regional conditions and will flourish without chemical fertilizers and pesticides. A list of select native plants for Arkansas is listed in Table 1.

Table 1. Native Arkansas plants for rain gardens. Plants shown in gray either can take a good amount of shade or need afternoon shade.

Perennials and Grasses	
Allium cernuum	Nodding onion
Amsonia tabernaemontana	Willow leaf blue star
Andropogon geradii	Big bluestem
Andropogon glomeratus	Bushy bluestem
Asclepias incarnata	Swamp milkweed
Aster oblongifolius	Fragrant aster
Aster paludosus	Prairie aster
Aster sagittifolius	Arrow leafed aster
Aster turbinellus	Violet prairie aster
Baptisia sphaerocarpa	Yellow wild indigo
Carex species	Many sedges
Chasmanthium latifolium	Northern sea oats or Indian woodoats
Chelone species	Turtle head
Eupatorium species	Joe Pye weed
Gelsemium sempervirens	Carolina jessamine
Helianthus angustifolius	Narrowleaf sunflower
Hibiscus coccineus	Texas star hibiscus
Hibiscus mos. v. lasiocarpus	Red eye mallow
Ilex verticillata	Winterberry holly
Iris fulva	Copper iris
Iris virginica	Blue flag
Liatris pycnostachya	Gayfeather
Lobelia cardinalis	Cardinal flower
Lobelia siphilitica	Blue cardinal flower
Malvaviscus arb. v. drummondii	Turk's turban
Muhlenbergia capillaris	Pink muhly grass
Osmunda cinnamomea	Cinnamon fern
Osmunda regalis v. speciosa	Royal fern
Panicum virgatum	Switchgrass
Parthenium integrifolium	Wild quinine
Penstemon digitalis	Beardtongue
Penstemon tenuis	Gulf Coast penstemon
Physostegia species	Obedient plant
Polemonium reptens	Jacob's ladder
Polygonatum biflorum	Solomon's seal
Rudbeckia maxima	Giant coneflower
Schizachyrium scoparium	Little bluestem
Silphium species	Rosinweed
Sisyrinchium angustifolium	Blue eyed grass
Solidago species	Goldenrod
Tripsacum dactyloides	Eastern gamma grass
Vernonia arkansana	Arkansas ironweed
Vernonia lettermanii	Letterman's ironweed
Vernonia missurica	Missouri ironweed
Veronicastrum virginicum	Culver's root

Woody Plants	
Alnus serrulata	River alder
Amorpha fruticosa	Evening primrose
Aronia arbutifolia	Red chokeberry
Aronia melanocarpa	Black chokeberry
Asimina triloba	PawPaw
Betula nigra	River birch
Callicarpa americana	Purple beauty berry
Cephalanthus occidentalis	Buttonbush
Chionanthus virginicus	Fringe tree
Cornus drummondii	Rough leaf dogwood
Cornus racemosa	Gray dogwood
Itea virginica	Virginia sweet spire
Leitneria floridanum	Corkwood
Lindera benzoin	Spicebush
Magnolia virginiana	Sweet bay magnolia
Myrica cerifera	Southern wax myrtle
Nyssa sylvatica	Black gum
Quercus michauxii	Swamp white oak
Rosa palustris	Swamp rose
Salix species	Willows
Sambucus canadensis	American elderberry
Taxodium distichum	Bald cypress
Viburnum dentatum	Arrowwood
Viburnum nudum	Shonny haw
Viburnum prunifolium	Blackhaw viburnum

Summary

Rain gardens are becoming a popular landscape feature in Arkansas because they are relatively inexpensive, beautiful and provide many environmental benefits. They are a great way for homeowners, businesses, neighborhoods and communities to address stormwater runoff and ensure that our surrounding creeks and streams are clean, healthy and functional.

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