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Sustainable Landscapes: Designing a Rain Garden for Residential Property

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We all know traditional gardens can add beauty and aesthetic value to property. Rain gardens not only add visual beauty to the landscape, but they also provide significant environmental value by reducing rainwater runoff, mitigating flooding and improving water quality. Unlike conventional gardens that typically sit even or slightly higher than the adjacent landscapes, rain gardens are situated lower than their surrounding areas and serve as a basin for capturing, holding and filtering rainwater after a rainfall event.

What is a Rain Garden?

Definition of Rain Gardens

A rain garden is a planted shallow depression in the landscape that collects and soaks up rainwater runoff from paved areas, roofs and the surrounding landscapes. A rain garden is purposefully situated at a relatively lower spot on a property so it can receive runoff after it rains. Its soil and plants are selected to absorb water.

Typical Components of a Rain Garden

A typical rain garden has three main components: inflow, basin and overflow (see Figure 1). The inflow is where the rainwater runoff enters the rain garden. The basin is the shallow depression, which includes the plants and soil. The basin could be dry or might have standing water (also called ponding) during, or for a short period after, a rainfall event. The overflow is the location where water is released from the rain garden when there is a significant rainfall event, and the rain garden cannot hold all of the runoff. The overflow device can be as simple as a berm. The berm height should be set so the garden will hold the desired amount of water, but allow excess water to spill out.

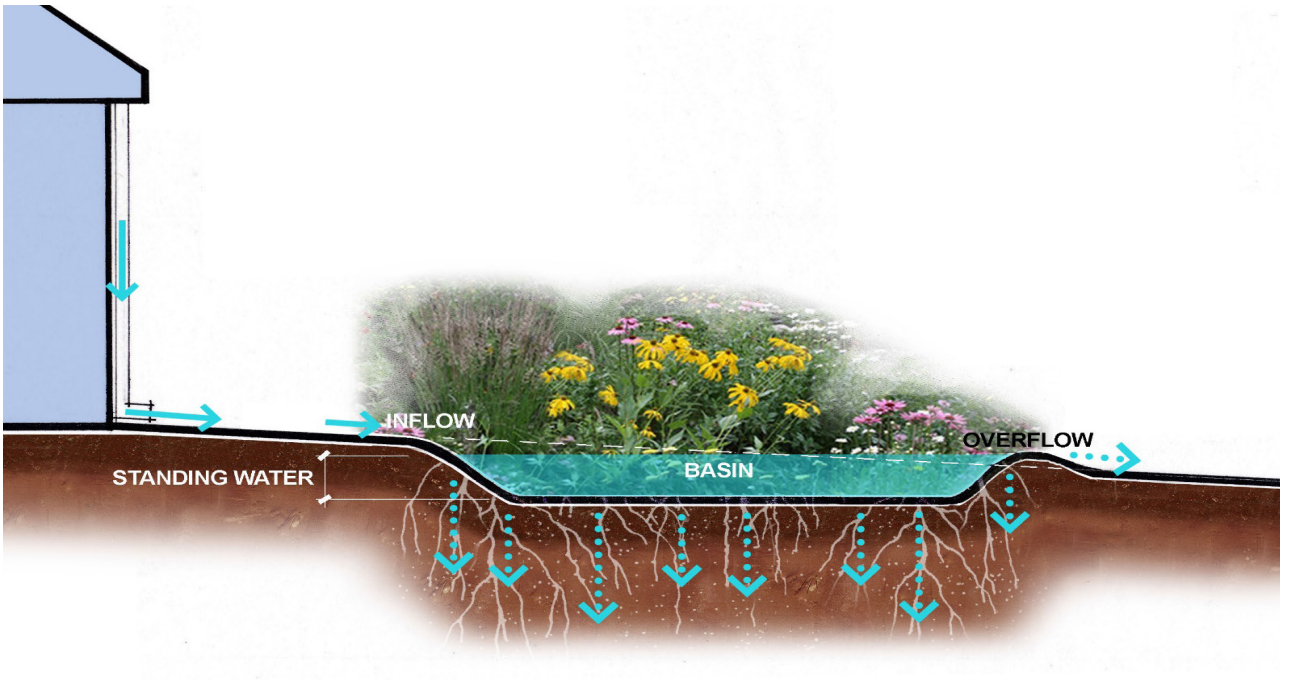


Figure 1. A typical rain garden section with three components: Inflow, Basin and Overflow.

Some rain gardens have more complicated components, such as underdrains, engineered soils and designated overflow devices. These rain gardens are officially considered bioretention cells, and require an engineer's involvement to work out the soil formula calculations. Complex bioretention cells are not discussed in depth here.

Shapes of Rain Gardens

A rain garden can be designed into any shape – oval, rectangle or kidney bean shape, as long as it is positioned to receive rainwater runoff easily.

The Benefits of Rain Gardens

Rain gardens provide multi-facet benefits to your property, neighborhood and city.

1. Rain gardens can absorb 30 percent more rainwater than a regular lawn, thus they reduce chances of flooding on the property.
2. As EPA (Environmental Protection Agency) advocates, when there is a rainfall event, rain gardens can "slow it down, spread it out and soak it in."
3. Rain gardens are more cost-effective than traditional systems of pipes and drains to treat the same amount of stormwater.
4. Rain gardens can filter pollutants carried by rainwater and improve water quality before it reaches groundwater, rivers, streams and lakes.
5. Rain gardens can create a natural habitat for butterflies, birds and wildlife.
6. Rain gardens can add beauty to the landscape, resulting in an increase in property value.

Rain Garden Design Principles

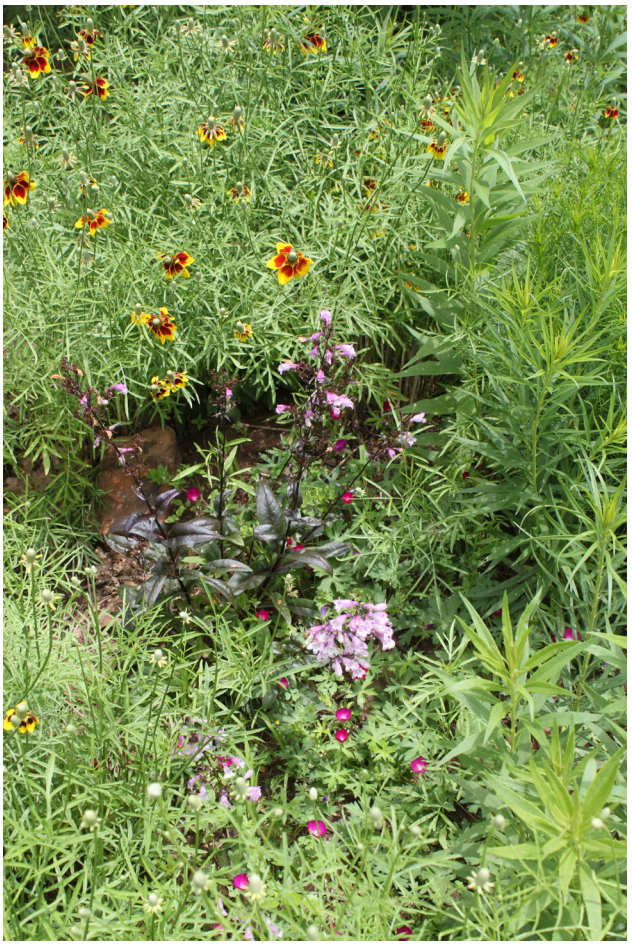
If you have designed or planted a traditional garden before, it will not be difficult to design and build a rain garden. Keep in mind that there are specific design principles to follow when creating a rain garden.

Locations

1. To protect your building's foundation, position a rain garden at least 10 feet (3 meters) away from any building.
2. The rain garden should be located at a relatively low area on the property where it can intercept runoff from the roof and paved areas.
3. Avoid areas with underground utilities, under existing trees or near a septic system. (Call Okie811 or 1-800-522-6543 before digging begins.)
4. Since rain gardens filter pollutants from runoff, place them at least 100 feet (30 meters) away from a wellhead to avoid polluting the clean water in the wellhead.
5. For the same reasons above, rain gardens should be avoided in areas that are always wet, or where groundwater is at a shallow depth.
6. Avoid locating rain gardens on steep slopes.

Sizing a Rain Garden

There are many ways to determine the size of a rain garden. Some are simple, while others are very scientific and complicated. This fact sheet introduces a simple method.



Step 1

Calculate the square footage of impervious surface areas that will contribute runoff to the rain garden. Impervious surface areas are paved or hardscape areas that cannot absorb rainwater. They typically include the roof area, patio, sidewalks and driveway.

Step 2

The rain garden size will be determined by using the impervious area calculated in step 1 and multiplying it by 5 to 10 percent.

Rain garden size = Area of Impervious Surfaces x (5 percent ~ 10 percent)

Example

For example, if a house has a roof of 2,400 square feet and a driveway that is 20 feet by 30 feet, both of which slope toward the proposed rain garden, use the above method to determine the size of the garden:

Step 1)

Add up all impervious areas. For this instance, both roof and driveway contribute runoff to the rain garden. Then Total Area of Impervious Surfaces = roof square footage + driveway square footage. The detailed calculation is:

2,400 square feet + (20 feet x 30 feet) = 3,000 square feet

Step 2)

Rain garden size is calculated:

3,000 square feet x 10 percent = 300 square feet (this example is 10 percent, but you can choose to use anywhere between 5 percent and 10 percent)

Mark the outline of a 300-square-foot area on the ground in the desired position and shape to receive runoff. For example, it could be a 30 feet by 10 feet rectangular shape.

Note: Each property is different and has its own constraints with regard to the proper size and location of a rain garden. Keep in mind – the size of a rain garden does not need to be exact. If your garden ends up a little smaller than the results of the calculations, the extra water will spill through the runoff overflow mechanism. If your garden turns out to be bigger than the calculations, the rain garden will simply capture and filter more rainwater.

Soil Infiltration Rate

One important rule for picking a site for a rain garden is there must be a positive soil infiltration rate (also called percolation rate). A slow soil infiltration rate means the soil will not have the ability to absorb water and result in water standing in the rain garden for long periods. The acceptable rate needs to be at least 0.5 inch per hour. If the soil drains slower than that, look for another location or amend the soil. Submit a soil sample to SWFAL (Soiltesting.okstate.edu) to determine your soil's properties.

There are several ways to test the soil infiltration rate. This fact sheet introduces a simple infiltration rate test method. Visually observe the soil. If it is high in clay, its infiltration rate is probably very slow. If it is silty or sandy soil, it should have a good infiltration rate. The steps to perform a simple soil infiltration rate test are:

Step 1

Clear out a small area where the future rain garden will be located.

Step 2

Dig an 8-inch deep hole. Fill the hole with water and let it completely percolate into the soil. This pre-wets the soil in the hole area.

Step 3

Fill the hole with water again. Measure how much time it takes the water to completely drain into the soil.

Step 4

Calculation: the infiltration rate = 8 inches/number of hours it took the water to drain.

Example

For example: if it took the water four hours to drain fully, the infiltration rate would be 8 inches ÷ 4 hours = 2 inches per hour. In this example, it is an ideal soil to build a rain garden. Remember that the water needs to drain at a rate of 0.5 inch per hour or faster.

For another example, if it takes 22 hours to drain fully, the infiltration rate would be 8 inches ÷ 22 hours = 0.37 inch per hour, which is not an ideal soil to build a rain garden.

Soil Amendments

If the soil has a very slow infiltration rate, the soil must be amended. Typically, after digging out 6 to 8 inches of soil to create the depression, another 6 inches of soil needs to be removed and replaced for an improved infiltration rate. The amended soil should be a blend of 50 percent sand, 25 percent compost and 25 percent topsoil. After amending the soil, rerun the soil infiltration rate test to determine if the amended soil's properties are adequate for building a rain garden.

Plant Selection

Rain gardens can be as colorful and beautiful as the rest of the landscape. There are numerous plants that work in rain gardens. Plants for the rain garden should: tolerate wet roots for short periods, usually 24 to 48 hours, compliment the rest of the landscape and thrive in the area. As with all gardens, proper soil preparation and mulching will help the plants grow and thrive. Provide irrigation and fertilizer for the rain garden as required. Using largely native plants will serve as a source for butterflies, hummingbirds and other nectar, seed and berry feeders. Once plants are established, they should be able to thrive on their own. However, Oklahoma is prone to severe drought conditions and supplemental water may be needed to keep even native plants alive during these extreme conditions.

Below are suggestions of native and other suitable plants for the areas in the rain garden that are periodically wet. Dry-tolerant plants can be planted on the upper edges of the rain garden.

Perennials (S = Full Sun; Sh = Part Shade)

Adiantum capillus-veneris, Southern Maidenhair (Sh)
Amorpha fruticosa, False Indigo (S)
Amsonia tabernaemontana, Blue Star (S)
Aquilegia hinckleyana, Texas Columbine (S or Sh)
Asclepias incarnata, Swamp milkweed (S)
Athyrium filix-femina, Lady Fern (Sh)
Baptisia australis, Blue False Indigo (S)
Canna x *generalis*, Canna (S)
Chelone glabra, Rose Turtlehead (S or Sh)
Coreopsis verticillata 'Moonbeam', Moonbean Coreopsis (S)
Crinum americanum, Crinum Lily (S or Sh)
Echinacea purpurea, Purple Cone Flower (S)
Eutrochium purpureum, Joe-Pye Weed (S or Sh)
Helenium autumnale, Sneezeweed (S)
Helianthus angustifolius, Swamp Sunflower (S)
Heliopsis helianthoides, Ox-eyed Sunflower (S)
Hemerocallis spp., Daylilies (S or Sh)
Hibiscus coccineus, Red Star Hibiscus (S or Sh)

Hibiscus militaris or *H. laevis*, Swamp Hibiscus (S)
Hibiscus moscheutos, Rose Mallow (S)
Hymenocallis liriosme, Spider Lily (S or Sh)
Iris brevicaulis and hybrids, Louisiana Iris (S or Sh)
Iris versicolor, Blue Flag Iris (S or Sh)
Liatris spicata, Gayfeather (S)
Lobelia cardinalis, Cardinal Flower (S or Sh)
Lobelia siphilitica, Great Blue lobelia (S or Sh)
Malvaviscus arboreus var. *drummondii*, Tuck's Cap (S or Sh)
Monarda didyma, Bee Balm (S or Sh)
Oenothera speciosa, Pink Evening Primrose (S)
Onoclea sensibilis, Sensitive Fern (Sh)
Osmundastrum cinnamomeum, Cinnamon Fern (Sh)
Phlox divaricata, Woodland Phlox (Sh)
Phyla incisa, Frogfruit (S or Sh)
Physotegia spp., Obedient Plant (S)
Polygonatum biflorum, Solomon's Seal (Sh)
Polystichum acrostichoides, Christmas Fern (Sh)
Rudbeckia fulgida, Orange Coneflower (S)
Rudbeckia hirta, Black-eyed Susan (S)
Ruellia spp., Mexican Petunia (S or Sh)
Sisyrinchium angustifolium, Blue-eyed grass (S)
Solidago spp., Goldenrod (S)
Spigelia marilandica, Indian Pink (Sh)
Symphyotrichum novae-angliae, New England Aster (S)
Symphyotrichum oblongifolius, Aromatic Aster (S)
Thelypteris kunthii, Wood Fern (Sh)
Tradescantia occidentalis, Spiderwort (S or Sh)
Tradescantia pallida, Purple Heart (S or Sh)
Vernonia spp., Ironweed (S)
Veronicastrum virginicum, Culver's Root (S)
Zephyranthes spp., Rain Lily (S or Sh)

Grasses, rushes, and sedges

Acorus calamus, Sweet Flag (S or Sh)
Carex spp., Sedges (S or Sh)
Chasmanthium latifolium, Inland Seaoats (S or Sh)
Muhlenbergia reverchoni, Seep Muhly (S or Sh)
Panicum virgatum, Switch Grass (S or Sh)
Sorghastrum nutans, Indian Grass (S)
Tripsacum dactyloides, Eastern Gama Grass (S or Sh)

Shrubs

Aronia spp., Chokeberry (S or Sh)
Callicarpa americana, American Beauty Berry (S or Sh)
Cephalanthus occidentalis, Buttonbush (S or Sh)
Clethra alnifolia, Sweet Pepperbush (S or Sh)
Cornus stolonifera, Redtwig Dogwood (S or Sh)
Ilex decidua, Possumhaw Holly (S or Sh)
Ilex vomitoria, Yaupon (S or Sh)
Itea virginica, Sweetspire (S or Sh)
Lindera benzoin, Spice Bush (S or Sh)
Morella cerifera, Southern Wax Myrtle (S or Sh)
Physocarpus opulifolius, Ninebark (S or Sh)
Rhus aromatic, Fragrant Sumac (S or Sh)
Sabal minor, Dwarf Palmetto (S or Sh)

Steps to Construct a Rain Garden

Step 1. Mark the outlines of the rain garden.

Use a long string or white spray paint to mark the area that you have decided for the rain garden. Make sure you plan out where the runoff will flow into the garden and where the overflow can spill out.

Step 2. Dig the depression.

Dig out soils up to 6 to 8 inches deep for the basin. Amend soils if infiltration rate is less than 0.5 inches per hour. The depth of the depression should be no deeper than 8 inches. Deeper depth means deeper standing water, which attracts mosquitos. Use the overflow berm to control potential ponding height.

Step 3. Planting.

Plant the most drought tolerant plants at the higher part of the basin. Install plants that can endure both drought and inundation of water at the bottom of the basin.

Step 4. Maintenance.

Before the plants are established, you will need to water and weed them. Maintain a good layer of mulch in the rain garden. Observe the inflow and overflow, and make sure that the runoff flows as you have designed.

Summary

Once plants are established, you will discover that the rain garden can take in a considerable amount of rainwater. You will also notice that the runoff at the downstream of your rain garden has been dramatically reduced. Now you have a beautiful garden in your yard as a sustainable landscape, which contributes to the protection of the environment.

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