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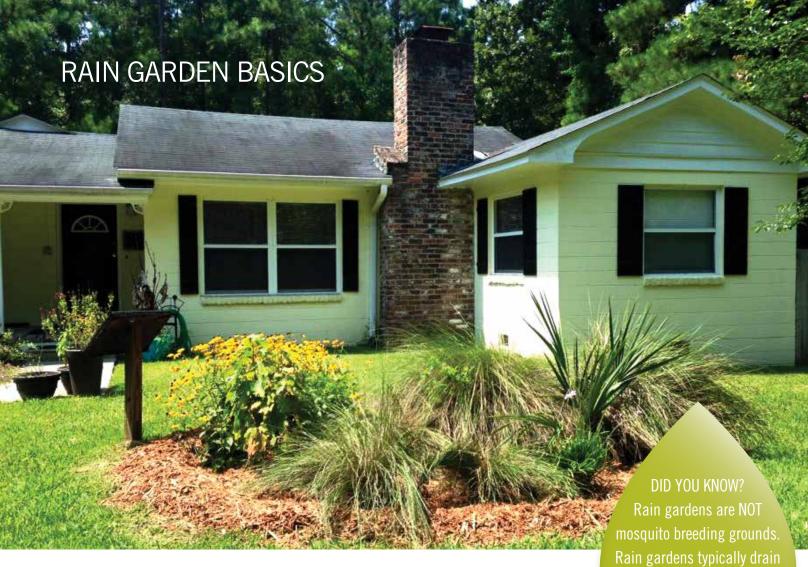
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#### **PHOTOS**

All photos are courtesy of Kim Counts Morganello unless otherwise noted





## What is a rain garden?

Rain gardens are depression gardens designed and located to receive water runoff from a roof, driveway, or lawn. They work with nature to collect, filter and infiltrate runoff, while showcasing a variety of colorful and low-maintenance plants. Rain gardens thrive when filled with native plants that don't mind getting their feet wet, but can also tolerate dry periods.

## Why are they important?

Impervious surfaces, such as rooftops, driveways, sidewalks, and roads prevent rainwater from soaking into the ground. When it rains on these hard surfaces, this water becomes stormwater runoff, which picks up pollutants that have been left on the ground — such as pet waste, excess fertilizers, litter, oil, and gasoline — and sweeps them downstream. Water that flows into storm drains empties into nearby waterways untreated; as a result, stormwater runoff is currently the greatest threat to water quality.

## How do they work?

Rain gardens are designed to mimic the natural water cycle. In an undeveloped landscape, rain falls on natural areas such as forests or fields, and soaks into the

soil, recharging groundwater for eventual uptake and use by plants. Developed landscapes in cities or neighborhoods increase the area of impervious surfaces and block rainfall from soaking into the soil. Rain gardens are a great solution to capture flow from impervious surfaces and allow it to infiltrate. Rain gardens not only reduce the quantity of stormwater and potential flooding, but they also preserve downstream water quality. Rain gardens trap sediment and associated contaminants, promote biological processes that remove pathogens, and store or remove excess nutrients. These low-maintenance landscape features prevent pollution from flowing downstream and contaminating local waterways.

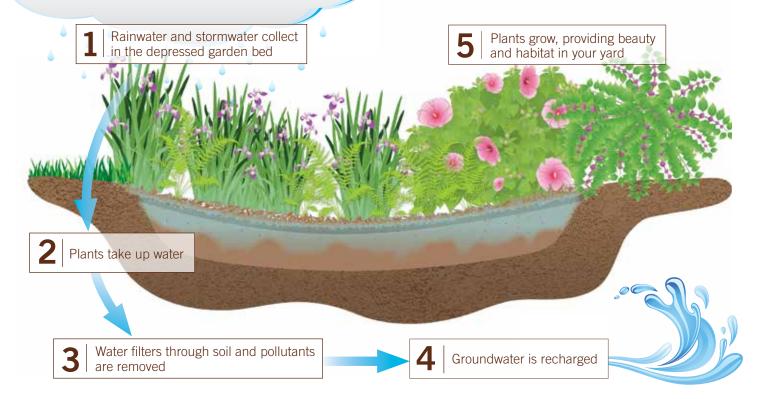
in under 24 hours, while

mosquitoes require 7 to 10

days of standing water to

lay and hatch eggs.

#### DIAGRAM OF A RAIN GARDEN



## Should I install one in my yard?

You will need to make sure your yard has the correct drainage conditions for a rain garden. Use a simple percolation (perc) test:

- Dig a hole at least 6 inches deep by 6 inches wide, and save the excavated soil for a soil test.
- Fill the hole to the top with water.
- Observe the hole periodically and note how many inches have drained each hour — ideally, the water will drop between 1-6 inches in the first hour. Consider an additional perc test to ensure proper site selection.
- If the water is gone in 24 hours or less, you have good soil for a rain garden.
- Place dry, excavated soil (from the hole you dug) in a paper or plastic bag and submit to your local Clemson Extension office for testing (\$6/sample).





TOP: Is this a good site for a rain garden?

**BOTTOM:** Find out by using a "perc" test to determine if the site has adequate drainage.

### SITING THE RAIN GARDEN

#### Go with the flow

When you select a location for your rain garden, it is very important to watch how water flows across the landscape during a storm event. Be sure to site the rain garden in the best location to intercept stormwater runoff.

#### PRO TIPS:

- Locate rain gardens at least 10 feet from building foundations.
- Keep rain gardens at least 25 feet away from septic system drain fields.
- Avoid areas when the water table is less than 18 inches deep. If you are unsure, contact the local Natural Resource Conservation Service office.
- Call #811 in S.C. before you dig to avoid buried cables and pipes.
- Full or part sun will give you more plant options, but shaded rain gardens can still be beautiful and functional.





## Getting rain to your rain garden

Rain gardens are typically installed to capture runoff from rooftops, lawns, and driveways. Water flowing off the roof via gutters and a downspout can be directed through a downspout extender into the rain garden. Downspouts can even be diverted into a rain barrel or cistern, and the overflow can be directed to the rain garden.

No gutters? A rain garden is still an option. Observe the flow of water during a rainstorm. Does water travel down the driveway or sidewalk? Does it sheet flow across your lawn? Does water tend to congregate in a certain area of your yard? After doing some basic detective work, this should help to identify an ideal rain garden location. A rain chain may be helpful for directing water

towards a rain garden.

DID YOU KNOW? Even shady rain gardens full of ferns and other shade-tolerant plants can provide erosion control and a pop of color.

TOP: Downspout extenders can be used either above or below ground to transport water to a rain garden.

BOTTOM: Overflow from rain barrels can be directed towards rain gardens.

## SIZING THE RAIN GARDEN

The size of the rain garden depends on three things: available space, total area of impervious surface, and soil type. First, measure all of the impervious surfaces that will contribute runoff to the garden. Generally, this will only include a portion of the rooftop and perhaps a sidewalk or driveway as well. Measuring impervious surface area is easy:

- 1. Measure the length and the width of the surface (feet).
- 2. Multiply the length by the width for the total area (square feet).
- 3. If measuring several surfaces, add each of the areas for a total impervious surface area (square feet) that you expect to be directed to the rain garden.

The size of your rain garden can be calculated as a percentage of this total, based on the results of the percolation test.

- For sandy, well-drained soils, the rain garden should be approximately 20% of the total impervious area.
- For loamy or poorly drained soils, rain garden should be at least 30% of the impervious area, but possibly up to 50%.

See Rain Garden Worksheet on page 11.

Rain garden plants are adapted to surviving both wet and dry periods, so the plants will thrive even if the rain garden doesn't fill up from every storm. Locate drought-tolerant plants closer to the perimenter of the rain garden.





**TOP:** Be sure to properly size the rain garden so it can handle the volume of water directed its way.

**BOTTOM:** Use a tiler or garden hoe to loosen the soil when digging and shaping the rain garden.

DID YOU KNOW? A 1000 square foot roof area can generate 600 gallons of water during a one-inch rain event!



# POP QUIE!

You want to install a rain garden to capture runoff from your 25ft. x 25ft. roof. You have sandy soils.

What size rain garden do you install?

Answer: With sandy, well-drained soils, the rain garden only needs to be around 20% of the size of the area draining to the rain garden, or 125 sq. ft.



## SHAPING THE RAIN GARDEN

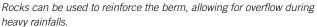
Rain gardens come in a variety of shapes and sizes. Kidney bean shaped rain gardens are a popular choice — the open area allows more surface for water to pool, lose

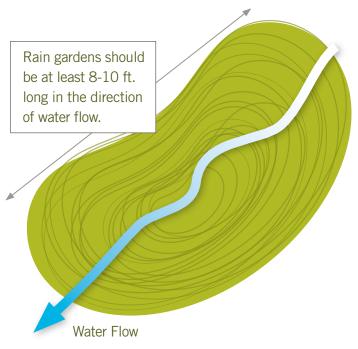


energy, and slowly infiltrate to groundwater. Since a rain garden is a "depression" garden, you will need to excavate the area, digging down approximately 10-12 inches. Use the removed soil to create a berm along the "downstream" edge. The berm will hold water in the rain garden, allowing time for infiltration. This is the most physical part of rain garden creation, so you may want to invite a few friends over to help.

Rain gardens are designed to capture one-inch of rainfall and infiltrate the water within three days. In the case of larger storms, rain gardens are designed to overflow through a simple dip in the berm on the downstream side of the garden (which can be reinforced with river rock to ensure stability of berm). The overflow can be directed toward another area that can infiltrate water, such as a landscaped bed or lawn.







## THE DIRT ON AMENDING SOILS

## Healthy soil

To give your rain garden plants an extra boost and promote infiltration, it is a good idea to amend soil with compost and sand. Sand will help with infiltration, and compost will help create a healthy soil environment for plants and beneficial microbes to grow and remove pollutants. Ideally, try for a mix of 20-30% existing soil, 20-30% compost, and 50-60% sand. Mix well for a "salt and pepper" look indicating a mix of soil, sand and compost.





Amending the soil creates the right mix to provide for healthy plant growth and stormwater infiltration.





## PLANTING THE RAIN GARDEN

Once the rain garden site has been prepared, the next step is to pick out and install plants. Choose from small trees, shrubs, perennials and grasses (especially native plants — which are particularly adapted to our local SC conditions) to add color, attract pollinators and beautify the landscape. Rain gardens will be dry most of the time, except for brief periods following storms, so it is important to pick hardy plants that can tolerate both dry and wet conditions. For ideas, check out the plant list at the end of this manual as well as these other resources from Clemson Extension:

#### 1. Carolina Yards Plant Database

clemson.edu/cy/plants | A searchable plant database that allows for selection of plants based on personal preferences, yard characteristics, and intended plant use — includes a specification for rain gardens.

#### 2. SC Waterways Fact Sheet Series

**clemson.edu/hgic/water** | Visit this site for more detailed information on a number of rain garden friendly plants.

DID YOU KNOW? Consider seasonality of The best times to plant plants when selecting your in South Carolina are plant palette, and try to select complementary plants spring and fall! that will bloom at different times, providing year-round appeal. Perhaps a dwarf palmetto (Sabal minor) will be the focal point in winter, while summer showcases a colorful beautyberry (Callicarpa americana). Create interest by including a mix of woody plants, grasses and perennials that provide a diverse array of textures and contrast.





Beautyberry and black-eyed Susans (Rudbeckia fulgida) add a pop of color to your rain garden.

RAIN GARDEN MANUAL I CAROLINA CLEAR

When designing a rain garden, consider how people will interact with it over time. Will the rain garden serve as a formal focal point in the front yard or more of an informal wildflower mix? Some rain gardens may feature a variety of plants to attract wildlife such as pollinators and birds, while others showcase a monoculture of a single grass or fern species. Get creative to design a rain garden that will be the envy of the neighborhood.



#### PRO TIP:

- Plant in groups of 1's, 3's, 5's, and 7's.
   Grouping similar plants in odd-numbered clusters creates a natural look and feel.
- Rain gardens typically need fewer total plants; give them time to grow before filling in gaps.

#### Mulch Matters

After the plants are installed, it's time to mulch. Mulch is an important feature of a rain garden because it:

- Helps to retain moisture in times of drought
- Moderates soil temperature
- Provides cover to the soil, creating a healthy balance of microbes to break down pollutants
- Serves as a weed barrier, helping to keep out unwanted plants

Spread a layer of mulch across the rain garden, aiming for a depth of 3-4 inches. Avoid piling mulch around the base of the plants, making sure to keep it several inches



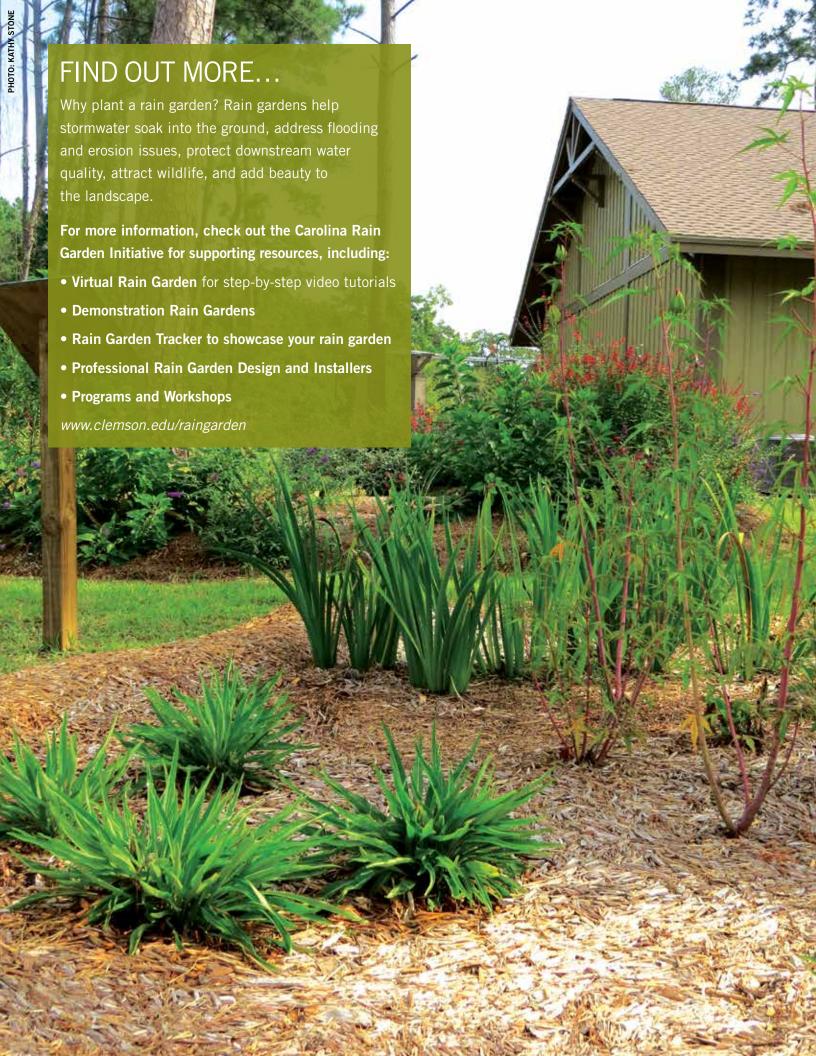
away from plant stems. Opt for hardwood mulches and avoid pinestraw or pine bark mulches. When possible, select cedar mulch, not cypress mulch, as cypress mulch can be harvested from cypress-tupelo swamps.

#### Maintenance

Established rain gardens are low maintenance, but they still require attention. Follow these tips for an easy maintenance regime:

- Irrigation: Water plants in times of drought.

  Even though rain garden plants are droughttolerant, they may need a boost when establishing
  and during hot, dry periods. Learn to recognize
  signs of plant stress and monitor local rainfall
  with a rain gauge. Be sure that a water source is
  available before siting the rain garden.
- Plants: It is not necessary to fertilize rain garden plants. These plants will get all the nutrients they need from runoff. Be sure to maintain the plants by regularly pruning and trimming, and remove weeds.
- **Debris:** Clear any litter, leaves, sticks or other plant material from rain garden inlets and overflows to prevent clogging. If the rain garden fills in to the point that it is no longer a depression, remove the upper layer of material and reshape. If water does not appear to be infiltrating, aerate using a pitchfork to poke small hoes in the surface.
- **Mulch:** Add fresh mulch as necessary to maintain appropriate depth.



## RAIN GARDEN WORKSHEET

1. Did your soil drain in under 24 hours during the percolation test? YES NO If no, consider a wetland or bog garden.
If yes, how fast did it drain?  • Less than 6 hours: quick draining soil.  • 6 to 12 hour range: standard draining soil.  • Closer to 24 hours: slow draining soil.
2. Is your soil quick, standard or slow draining (may fall between categories)?
3. Indicate the type impervious surface draining into your rain garden (this is your catchment area).  Circle all that apply:
• Roof
Driveway/Sidewalk
Lawn (semi-impervious/sheet flow)
• Other
<ol> <li>Estimate your total catchment area in square feet.         (Find this by multiplying length x width).         Reminder: If your rain garden will receive water from multiple impervious surfaces (e.g. roof, driveway and sidewalk), add the estimated area for each surface to determine total catchment area.</li> </ol>
Size your rain garden based on drainage characteristics of your site's soils (quick, standard, or slow).
NOTE: Recommendations suggest minimum sizes — you can always make a bigger rain garden.
Quick draining soil should be at least as large as 20% of the catchment area
Standard draining soil should be at least as large as 20-40% of the catchment area
• Slow draining soil should be at least as large as 30-50% of the catchment area

Slow draining son should be at least as large as 30-30 % of the catefillient area

**EXAMPLE:** An individual has a 1200 square foot roof, but only directs half of their roof towards their rain garden; therefore, the catchment area is 600 square feet. When they performed a percolation test, the water drained in less than an hour at a rate of 6 inches per hour. They have quickly draining sandy soils.

#### How should they size their rain garden?

Based on soil type, the rain garden only needs to be 20% of the total catchment area.

600 square feet of catchment area x 0.20=120 square feet

The rain garden should be around 120 square feet, which could be accomplished by a 10' x 12' footprint.

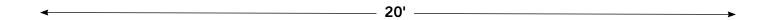
# RECOMMENDED NATIVE PLANTS FOR SC RAIN GARDENS

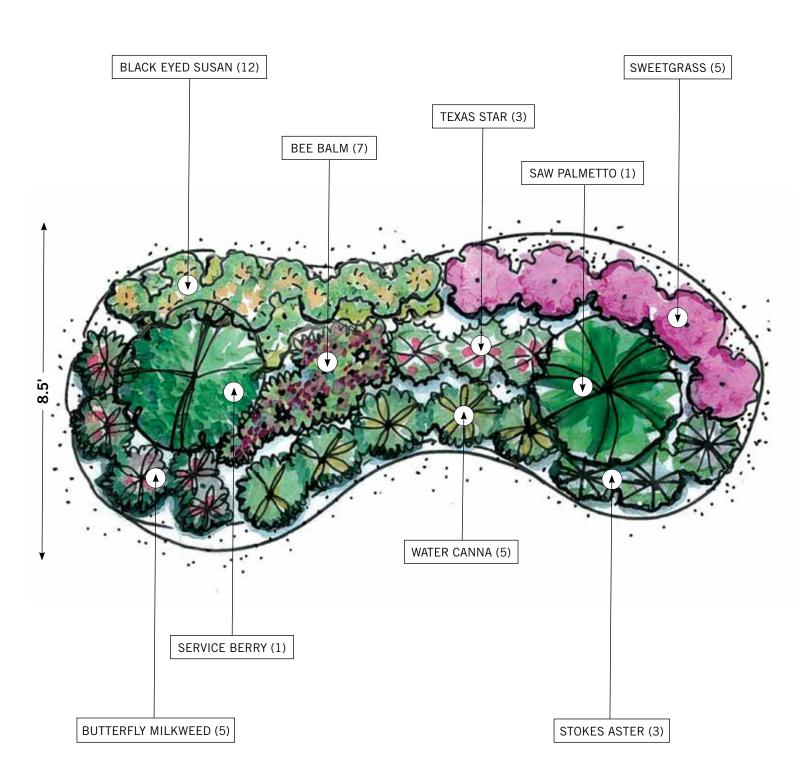
Plant list adapted by Kim Counts Morganello, Terasa Lott and Dr. Sarah White from the Rain Gardens, A Rain Garden Manual for South Carolina, 2012 publication.

GRASSES					
SC Region	Common Name	Scientific Name	Plant Characteristics		
All	Big Bluestem	Andropogon gerardii	Blue-green color; deep roots; drought-resistant; full sun; tall grass reaching 6 to 8 feet		
All	Little Bluestem	Schizachyrium scoparium	Attracts birds and mammals; clumping warm-season grass, full sun; slender blue-green stems turn red with white seed tufts in fall; color remains in winter; grows 2 to 3 feet in height		
All	River Oats	Chasmanthium latifolium	Tolerates dry soils, dangling oats are ornamental and copper in fall; clump forming, shade, 2 to 3 feet in height		
All	Switch Grass	Panicium virgatum	Tolerant of flooding; good erosion control; sun; add texture and contrast to the garden; grows 2 to 5 feet in height		
All	Sweetgrass, Muhly Grass	Muhlenbergia capillaris	Attracts birds and beneficial insects; drought tolerant once established; requires good drainage; sun; fluffy pink to purple flower stalks in the fall; grows 3-4 feet in height		
PERENNIAL	.S				
SC Region	Common Name	Scientific Name	Plant Characteristics		
All	Columbine	Aquilegia canadensis	Erect branching perennial; showy flowers; best in shade and well-drained soils; 3-5 year lifespan and re-seeds easily; grows up to 2 feet tall		
All	Swamp Milkweed	Asclepias incarnata	Valuable to butterflies; small rose/purple flowers bloom in mid-summer; sun; grows 2 to 4 feet tall		
All	Butterfly Milkweed	Asclepias tuberosa	Attracts butterflies; slow to establish; easy to grow from seed; hardy plant with orange flowers; full sun; 2 to 3 feet tall		
All	Water Canna, Louisiana Canna	Canna glauca	Tropical looking plant that blooms from April-October; sun to part shade, moist to wet soils; grows approximately 3 to 6 feet tall		
All	Joe Pye Weed	Eutrochium purpureum	Attracts butterflies; showy flower heads of pink to purple flowers; can grow up to 6 feet tall		
All	Narrowleaf Sunflower, Swamp Sunflower	Helianthus angustifolius	Wet to dry conditions; salt-tolerant; yellow daisy blooms that bloom profusely in the fall; will spread; tall sunflower-like height reaching 6 to 8 feet tall		
Coastal Plain	Dune Sunflower, Beach Sunflower	Helianthus debilis	Dry, sandy conditions; yellow daisies bloom profusely from spring to fall; more shrub-like than the narrowleaf sunflower; will spread; 2 to 3 feet tall		
Coastal Plain	Texas Star, Scarlet Hibiscus	Hibiscus coccineus	Full sun; clumping; deciduous; striking scarlet-colored blooms 6 inches in width from July through September; grows 4 to 7 feet tall		
All	Rose Mallow; Marsh Mallow Hibiscus	Hibiscus moscheutos	Tolerates wet conditions; can grow near water or in seasonally wet places; salt-tolerant; shrubby with large white to pink flowers; grows 3 to 8 feet tall		
Coastal Plain	Virginia Iris, Southern Blue Flag	Iris virginica	Best in wet, acidic, sandy soils; sun; violet blue flowers with yellow and white crested falls; grows up to 3 feet tall		
All	Blazing Star	Liatris spicata	Good source of nectar and seeds for wildlife; straight and slender perennial; tall spike of purple flower heads; grows 3 to 4 feet tall		
All	Cardinal Flower	Lobelia cardinalis	Attracts butterflies and hummingbirds; part sun to shade; can tolerate wet conditions; showy red flower spikes; grows 1 to 3 feet tall		
All	Blue Lobelia	Lobelia siphilitica	Attracts butterflies and hummingbirds; part sun to shade; can tolerate wet conditions; bright blue flowers; grows 1 to 3 feet tall		

PERENNIALS, CON'T.					
SC Region	Common Name	Scientific Name	Plant Characteristics		
All	Beebalm	Monarda didyma	Attracts butterflies and hummingbirds; sun to part sun; red to purple flowers; fragrant leaves have minty aroma; vigorously colonizes; 3 feet tall		
All	Black-eyed Susan, Orange Coneflower	Rudbeckia fulgida	Attracts birds and beneficial insects; sun, tolerates dry and moist soil; yellow-orange flowers; blooms late summer through early fall; grows 1-3 feet tall		
All	Cutleaf Coneflower	Rudbeckia laciniata	Large yellow coneflower-like flowers with green center; attractive to pollinators and good seed source for wildlife; grows 1 to 4 feet tall		
All	Goldenrod	Solidago spp.	Attracts pollinators; falsely accused of fall allergies; blooms tight clusters of small yellow flowers; blooms in fall; sun; height ranges dependent upon species from 2 to 8 feet tall		
All	Stoke's Aster	Stokesia laevis	Attracts butterflies; prefers moist, well-drained soil but adapts to many conditions; produces numerous, solitary flower heads with blue rays and blue florets from the disk; sun to part shade; 12 to 30 inches tall		
All	Ironweed	Vernonia noveboracensis	Attracts butterflies; tolerates water inundation; deep green leaves and small red-purple flowers occur in loosely branched clusters, grows 5 to 8 feet tall		
FERNS					
SC Region	Common Name	Scientific Name	Plant Characteristics		
All	Lady Fern	Athyrium filix-femina	Yellow-green to green fronds; clump forming; part to full shade, prefers moist areas of rain garden, should be watered in dry conditions; 18 to 36 inches tall		
All	Cinnamon Fern	Osmunda cinnamomea	Part sun to shade. Ideal for back drop and moist areas of the rain garden; 3 to 4 feet tall		
All	Sensitive Fern	Onoclea sensibilis	Lush green; rusty-gold in fall; part shade to shade; spreads easily; 3 to 4 feet tall		
All	Royal Fern	Osmunda regalis	Delicate, bright-green fronds; part shade to shade; tolerates a variety of wet soils; 2 to 3 feet tall		
All	Christmas Fern	Polystichum acrostichoides	Robust, leathery, evergreen fern; requires at least partial shade; prefers moist but well-drained soils, will not tolerate clay; grows 1.5 to 3 feet tall		
SHRUBS AND SMALL TREES					
SC Region	Common Name	Scientific Name	Plant Characteristics		
All	American Beautyberry	Callicarpa americana	Striking purple berries on new growth; yellow fall color; deciduous; sun to part shade; up to 6 feet tall		
All	Buttonbush	Cephalanthus occidentalis	Attracts hummingbirds; white button flower; salt-tolerant; tolerates flooding; grows up to 8 feet tall		
All	Virginia Sweetspire	Itea virginica	Fragrant white tassel flowers; deep red or purple fall foliage; sun to shade; deciduous; medium sized shrub growing up to 6 feet tall and 4 feet wide		
All	Swamp Azalea	Rhododendron viscosum	Sweet fragrant flowers in summer; part shade; one of South Carolina's native azaleas; deciduous; grows up to 6 feet tall		
Sandhills to Coastal Plain	Dwarf Palmetto	Sabal minor	Native palm that slowly spreads; black berries; drought-tolerant; suitable for coast; evergreen; grows up to 10 feet tall and 6 feet wide		
Sandhills to Coastal Plain	Saw Palmetto	Serenoa repens	Native palm; provides design contrast in the rain garden with triangular shape; evergreen; sun to part shade; 5 to 12 feet tall		
All	Spicebush	Lindera benzoin	Attracts birds and butterflied; fragrant leaves; chartreuse flowers; deciduous; part shade to shade; grows up to 8 feet tall		

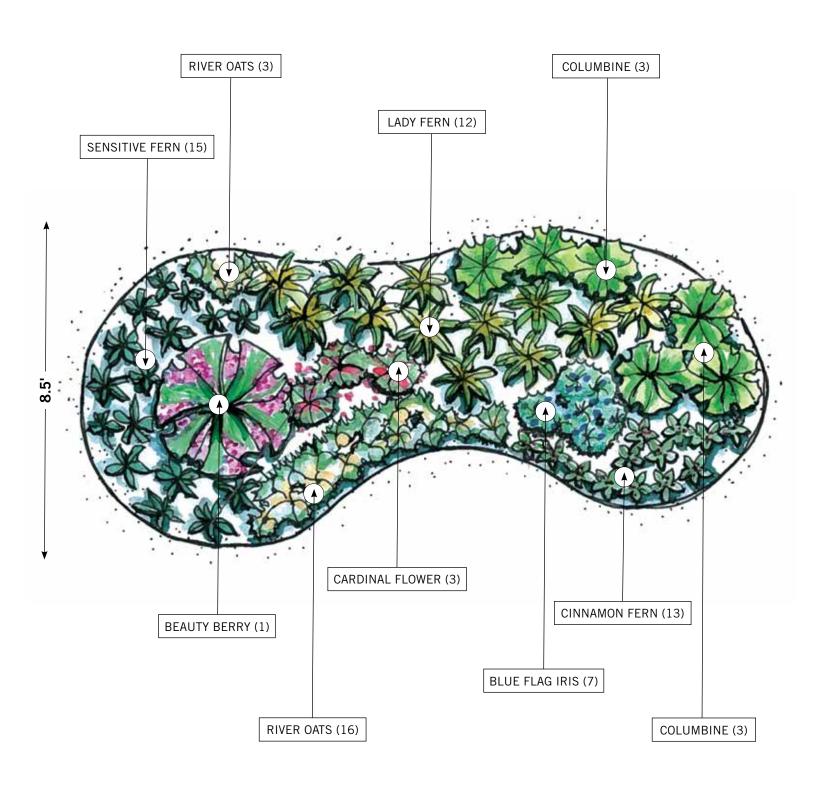
# RAIN GARDEN SAMPLE DESIGNS: FULL SUN RAIN GARDEN





# SHADE RAIN GARDEN





# LINEAR BUTTERFLY RAIN GARDEN

