Rain Gardens (RG)

Entrance to Benjamin Russel High School; Alexander City, AL

Synonyms: There are no synonyms for this practice.

A rain garden is a shallow depression in a landscape that captures water and holds it for a short period of time to allow for infiltration, filtration of pollutants, habitat for native plants, and effective stormwater treatment for small-scale residential or commercial drainage areas. Rain gardens use native plants, mulch, and soil to clean up runoff.

As urbanization increases and pervious surfaces decrease, rain gardens are an excellent practice to promote infiltration of up to 30% more stormwater than traditional lawns. Residential stormwater management can often help homeowners save money on lawn irrigation when lawns are converted to rain gardens. These areas are designed to capture 3 to 6" of runoff after a storm, which allows water to infiltrate and return to groundwater, rather than being discharged to a stormwater conveyance system.

Site Selection

Quantity Control	---
Drainage Area	small
Space Required	small
Works with:	
Steep Slopes	✔
Shallow Water Table	✔
Poorly Drained Soils	✔

General Significance

Construction Cost	low
Maintenance	low
Community Acceptance	high
Habitat	med-high
Sun / Shade	sun to p. shade

Site Selection

Potential Rain Garden Locations: Rain gardens can be located throughout the landscape to disconnect impervious surfaces and treat runoff from rooftops, driveways, sidewalks, existing landscapes, or a combination of these surfaces. Rain gardens are most effective at reducing stormwater runoff when disconnecting two impervious surfaces such as a rooftop and a street.

Practice Pairing: Rain gardens can also be connected to other residential stormwater control measures (SCMs) for more effective stormwater treatment. For example, rain barrels can be used to capture rooftop runoff and overflow from these barrels can be directed to rain gardens and used as a water source. A landscape designer or other professional should be consulted for projects that incorporate curbing or curb cuts, storm drains, any type of under drain, or when drainage areas are larger than 2000 ft^2.

Pinch Point: The rain garden should be located between the runoff source (rooftop, driveway, etc.) and the destination of runoff, also known as the "pinch point." A "pinch point" is an area in which water is already converging, moving through, or exiting a property.

Observe the Site: It is often helpful to watch water flow patterns throughout the landscape on a rainy day. Snapping a few photos will also help note problem areas. Look for eroded areas and sediment accumulation both in the landscape and at curbs. Check where gutters, downspouts, or roof valleys deposit roof runoff as potential rain garden locations.

Collecting From a Rooftop: A good rule of thumb is to place rain gardens approximately 10' downslope of the

Example of Infiltration Testing.

In./Hr.	Drain Time	Rain Garden Type
≥ 1”	<12 Hours	*Standard Rain Garden*
0.25 to 0.9”	12 - 36 Hours	*Zoned Rain Garden*
< 0.25”	>36 Hours	*Wet Rain Garden*

downspout. A simple swale or rock-lined ditch can be used at the roof drip line as the inlet to the rain garden to direct stormwater if gutters or downspouts are not available.

Planning for Overflow: Consider how runoff will enter the garden, how it will be captured and held, and how it will exit the rain garden during heavy rain events. Alabama frequently experiences high intensity storms rather than slow, soaking rain events and because of this, overflow of the rain garden should be expected. Overflow should be directed to grassed or vegetated areas and never to the home foundation or a neighbor’s property.

Infiltration Test: An infiltration test is performed to determine the optimal rain garden location. Using a post-hole digger, auger, or other tool, dig at least two 4 - 6” diameter, approximately 1’ deep holes in each potential rain garden location. Fill each hole with water and let drain completely to prime the hole for more accurate results; this is especially important during drought conditions. Next, fill the hole so that water is within 1” of the top of the hole. Use a ruler or other measuring tool to monitor the depth of the water. Record the start time in order to calculate the drain time. Monitor the amount of time required for water to infiltrate completely. Check the hole once an hour for at least 4 hours. The rate of drain time will determine the most appropriate type of rain garden for the landscape (see table below).

Follow Up Infiltration Test: Once a specific location and rain garden type have been determined, an additional deeper infiltration test can be performed if there are any concerns about hard pans, bed rock, or other constraints that may limit stormwater percolation. Dig two to three holes at a depth of 2’ and fill with water, similarly to the standard infiltration test described above. These holes should drain within 48 hours to ensure that the rain garden will not create a mosquito breeding ground.

Soil Test: Perform a soil test using the soils from the holes dug for the infiltration test. Soil sample boxes, information sheets, and other supplies for soil testing are available from the local County Extension Office. A soil test should be performed to determine lime and

For more information on soil test protocols, go to the Alabama Cooperative Extension System website at www.aces.edu/pubs/docs/A/ANR-0006-A/ANR-0006-A.pdf. Soil samples can be sent to the Auburn University Soil Testing Lab (www.aces.edu/anr/soillab/) or to other soil testing facilities to be analyzed.

Table 5.1.1
Site Selection: Constraints and Limitations for Rain Gardens

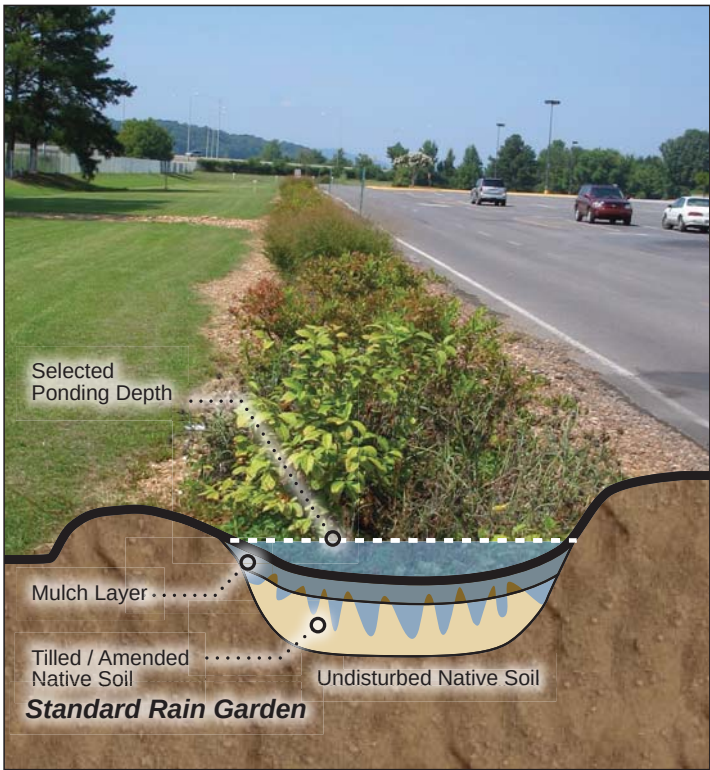
House Foundation	Do not locate within 15' of building foundations with basements; otherwise 5' from the foundation is acceptable.
Slope	Rain gardens should not be located on slopes > 12% due to the inability to hold runoff in the rain garden without a really steep berm. Flatter slopes will also require less digging.
Septic System and Drain Field	Should be located > 25' from septic system and upslope of the drain field.
Utilities	Call 811 when selecting a site for the rain garden and before construction to locate utilities (for more information, visit: www.al1call.com). Rain gardens should not be placed within 5' horizontally or 1' vertically from utilities.
Seasonally High Water Table	If the seasonally high water table is within 2' of the bottom of the rain garden, a different location should be chosen for a standard rain garden or a wet rain garden should be considered.
Large Flow Volumes	Decrease percentage of impervious area for treatment.
Wellhead	Should be located at least 10' from wellhead.
Shaded areas	Locate in full sun to part shade if possible; dense shade will cause the rain garden to remain wet longer than intended and can promote mosquito breeding.
Soggy Areas in the Landscape	These areas are not good locations for a rain garden. Instead, consider capturing runoff before it settles in these spots of the yard.
Existing Trees	Rain gardens should not be located within the drip line of existing trees so that tree roots are left undisturbed and water they uptake will not affect runoff the rain garden should capture.
Existing Retaining Wall	Do not locate a rain garden upslope of a functional retaining wall. Encouraging water to collect in these areas could damage the retaining wall structure.
Heavy Foot Traffic	Foot traffic compacts soil and may damage plants. Consider locating the rain garden in areas where pedestrians do not frequent or incorporate footpaths around the rain garden.

nutrient recommendations for initial plant establishment and quality. Many plants prefer specific pH ranges and the soil test will recommend lime requirements if an increase in pH is necessary for optimal plant growth.

In-situ Soil: Ponding depth is also a function of in-situ soil. Slower draining soils should be designed with decreased ponding depths compared to well-drained soils. The time required to draw down or infiltrate this volume of water will also directly affect vegetation selection.

Types of Rain Gardens

Rain gardens can be designed in a variety of ways and may use different shapes, vegetation, and sizes to meet the needs of a particular site. All rain gardens should hold water after a rain event and infiltrate collected water within 36 to 48 hours. The primary differences in rain garden type refer to the time required for the rain garden to draw down the volume of stored water after a rain event, which is determined by the infiltration test.



Standard Rain Garden

Standard Rain Garden: A standard rain garden uses a uniform ponding depth (3” or 6”) of water across the entire base of the rain garden. Native soils are used and can be amended if necessary based on the infiltration rate found by the infiltration test. In these systems, the bottom of the rain garden area is raked level with no variation in elevation within the rain garden footprint.

Wet Rain Garden: If existing soils are more clayey and an infiltration test confirms that a particular site within the landscape does not draw down in 36 hours, a wet rain garden may be necessary. Poorly drained soils do not limit the use of a rain garden in the landscape, but may require a more specific vegetation plan to ensure plant survival, aesthetics, and mosquito prevention. Wet rain gardens can have standard (flat across the bottom) or zoned (variable) topography.

Zoned Topography: Zoned topography provides changes in elevation so that some areas within the rain garden pond more or less, thus requiring a more diverse plant community with aquatic plants occupying deep pools and vegetation that prefers drier conditions in higher areas.

Design Steps

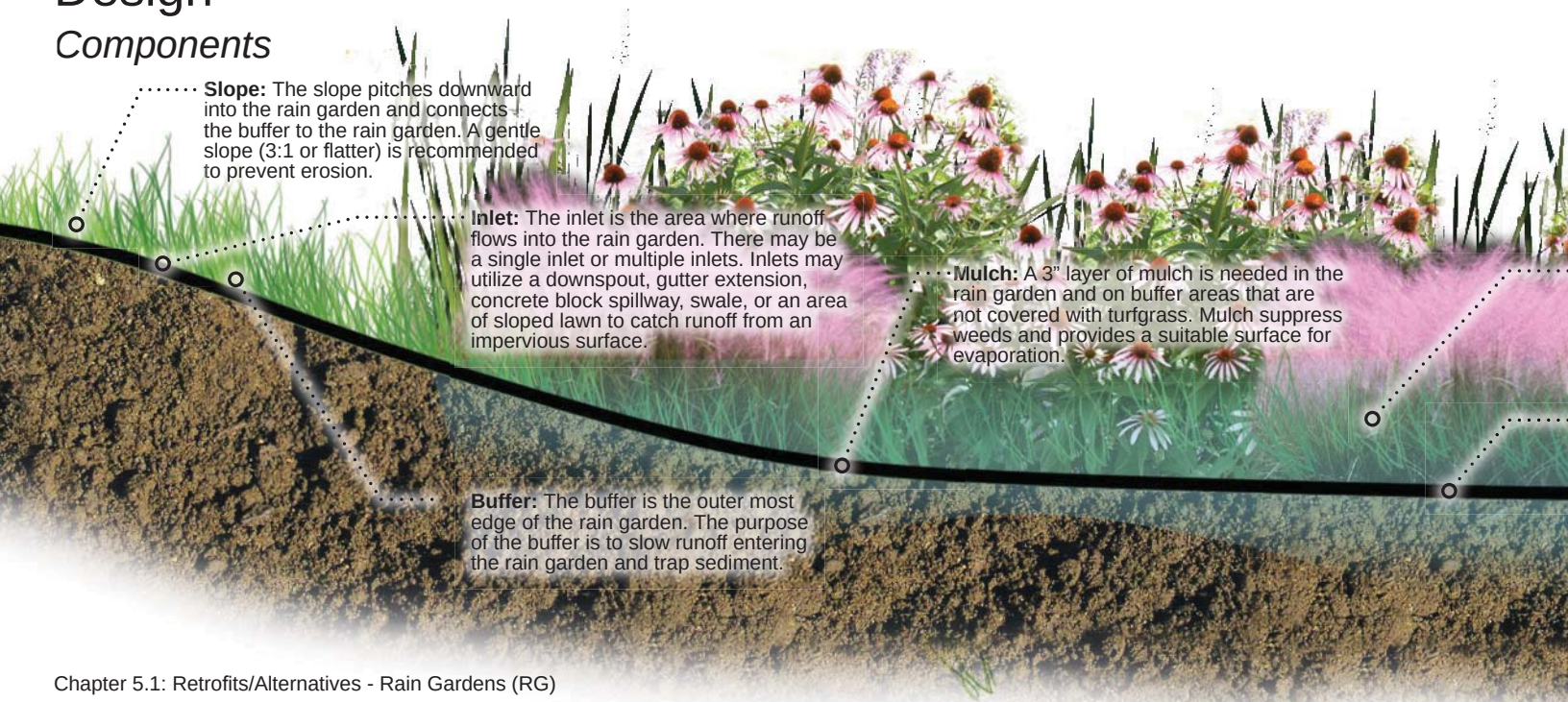
1. ***Determine Sub-watershed Boundaries***

   Consider your property and the source(s) of runoff for the rain garden.

   - How does rainwater move on your property?
   - Do you receive runoff from your neighbor’s property?
   - Are there areas that stay wet for long periods of time following a rain event?
   - Examine pinch points on site (see Chapter 2 on Site Selection for more information). Treating the entire area may require the use of multiple rain gardens especially if you receive runoff from neighboring properties as well as your own.

Design

Components



2. Estimate the Amount of Impervious Area (IA)

Calculate the square footage of impervious surfaces (IA) within the boundaries you have established. Include all portions of rooftops, driveways, sidewalks, roadways, etc. that will be draining to the rain garden. If two roof areas drain to a single downspout that will be used to direct flow, these roof areas are added together.

Curb Cuts: If the rain garden will collect roadway runoff, determine the flow pattern and in areas where curb is present, a curb cut will be needed. Contact the local Municipal or County office if a curb cut is needed but not already in place.

Grassed Filter Strip: When there are no curbs, a 2' minimum grassed filter strip and optional 1' wide notch filled with rock is recommended to help slow runoff, trap sediment, and prevent erosion into the rain garden.

3. Choose a Runoff Capture Depth and Ponding Depth

The amount of rainfall to be treated by the rain garden is the **runoff capture depth.** Typically, the rain garden should treat the "first flush" or the first inch of rainfall, which has higher concentrations of pollutants in comparison with runoff later in the storm. See Appendix A on Stormwater Hydrology for more information on stormwater runoff calculations.

Ponding Depth: The rain garden ponding depth refers to the depth at which water will pond in the rain garden before overflowing. Typically ponding depths are 3 or 6" and either of these depths can be used in sandy soils, but a 3" ponding depth is appropriate for clayey soils as these will drain more slowly.

4. Determine the Size of the Rain Garden

A good rule of thumb is to design the rain garden so that it is twice as long as it is wide, perpendicular to the flow into the garden. Using the desired ponding depth and the total **impervious area (IA)**, the size of the rain garden can be determined with the following equations.

Sizing Rain Gardens

EQN 5.1.1

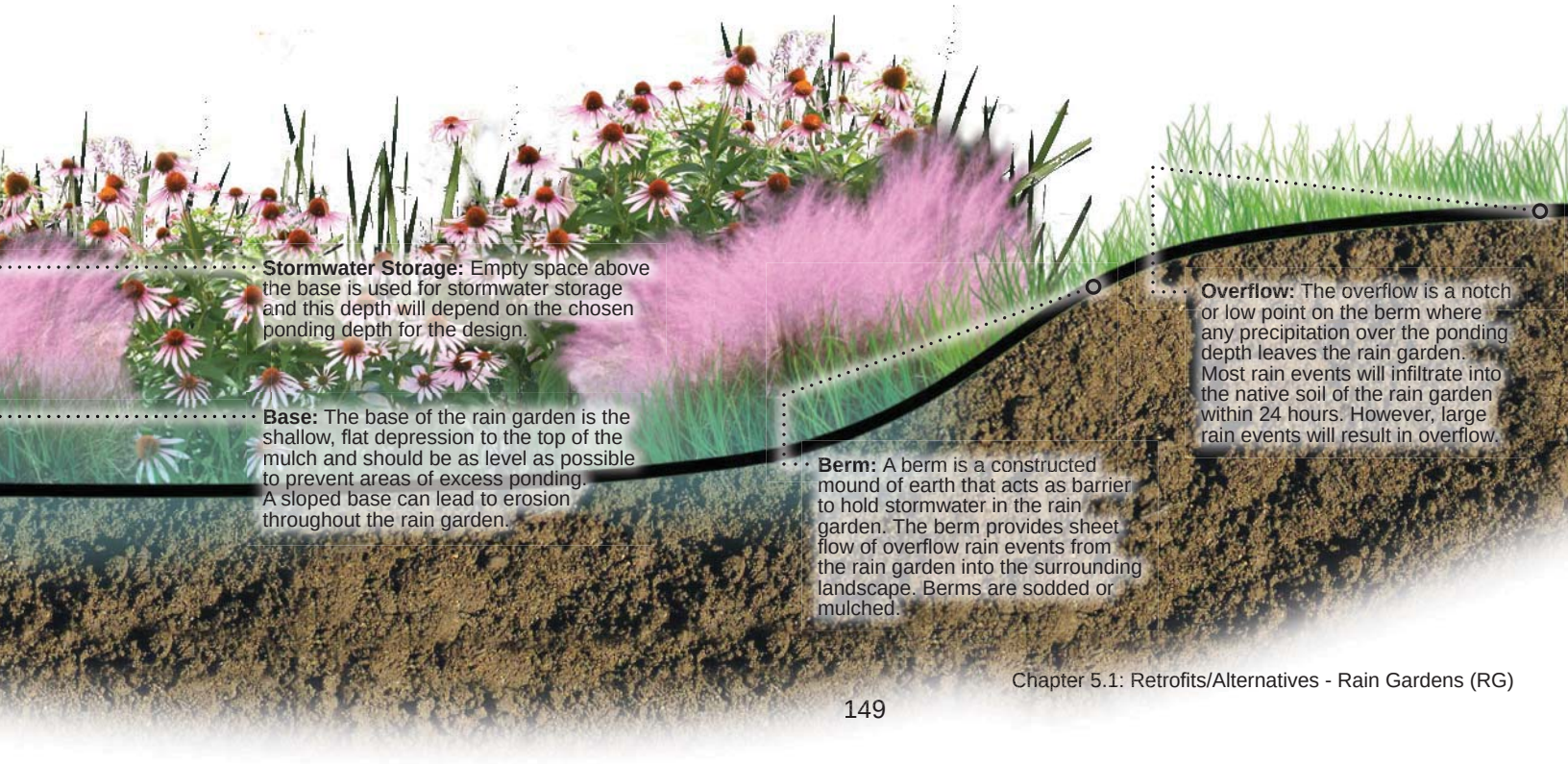
For a 3" Ponding Depth:

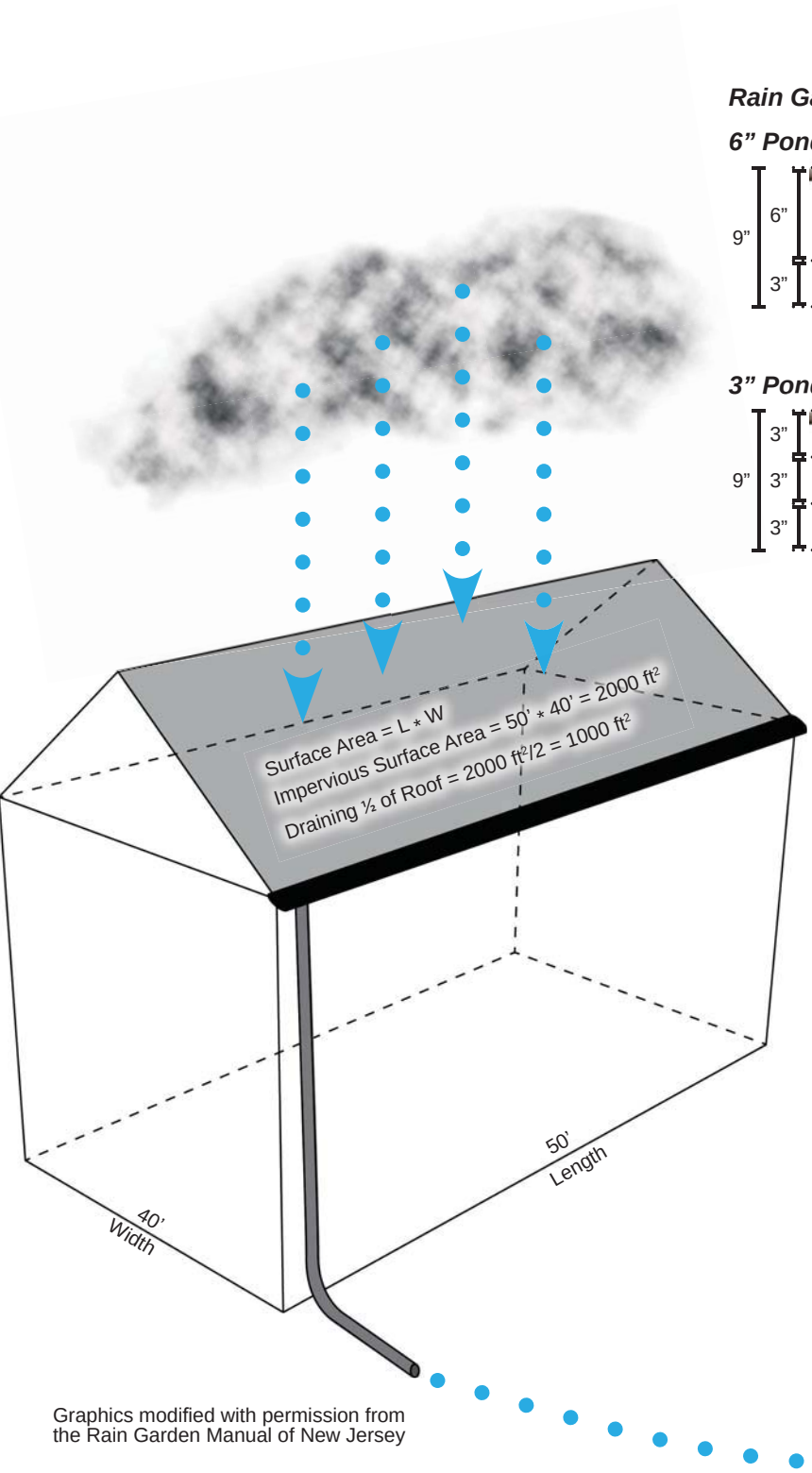
$$\text{Rain Garden Size} = \frac{IA}{10}$$

EQN 5.1.2

For a 6" Ponding Depth:

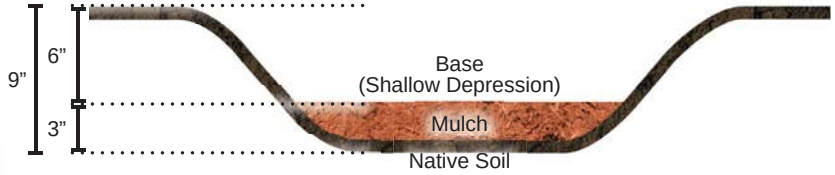
$$\text{Rain Garden Size} = \frac{IA}{20}$$



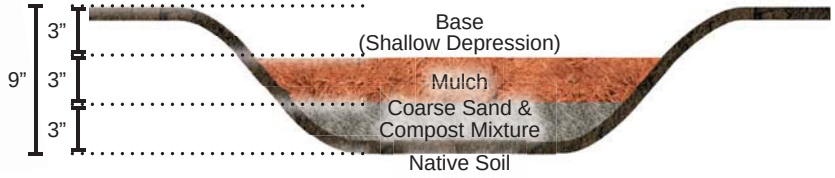


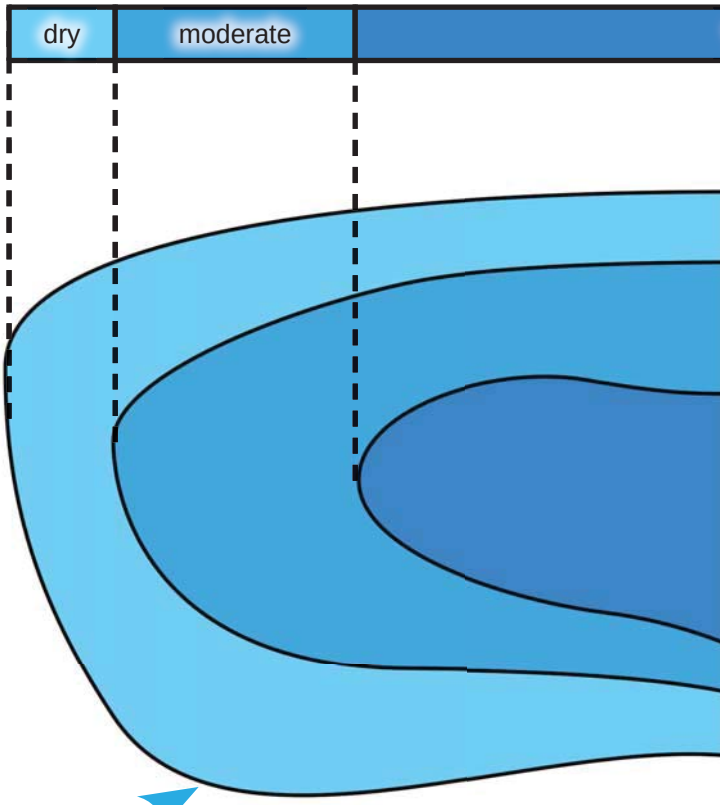
Rain Garden Excavation Depths

6" Ponding Rain Garden - no soil amendments



3" Ponding Rain Garden - with soil amendments





Graphics modified with permission from the Rain Garden Manual of New Jersey

5. Design a Berm and/or Overflow Weir.

A berm is sufficient for rain gardens that are treating less than 2,000 ft² of IA.

Call a Professional: If designing a rain garden with a drainage area greater than 2000 ft², it is recommended to consult an engineer or professional landscape architect (PLA) for weir or overflow design options. The **length of the overflow weir** can be determined by the following equation.

Sizing Over-flow Weir

EQN 5.1.3

For a raingarden over 2000 ft²:

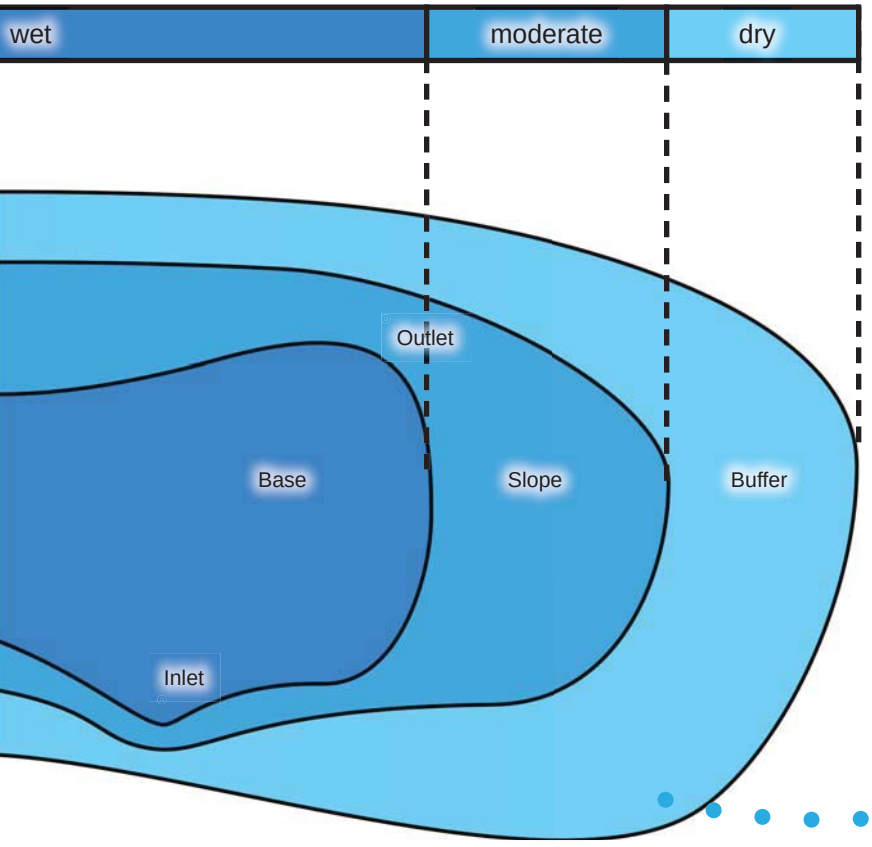
$$\text{Length of Overflow Weir} = \frac{IA}{2000}$$

Design Example

A residential rooftop is 50' by 40', for a total of 2,000 ft² of IA. Half of the runoff from the rooftop will be directed to the rain garden. The owner prefers 3" of ponding due to clayey soils on site.

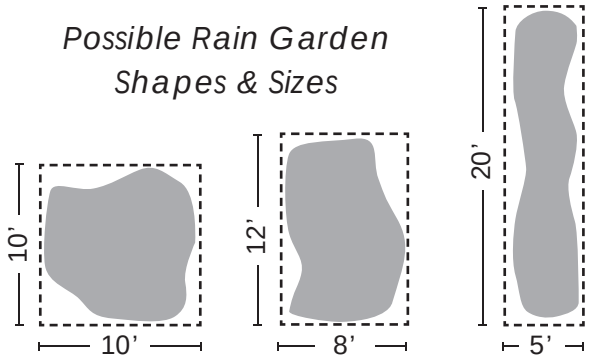
Roof Area = 2,000 ft², treating ½ of the rooftop
Impervious Area (IA) to be treated = 1,000 ft²
Ponding depth = 3"

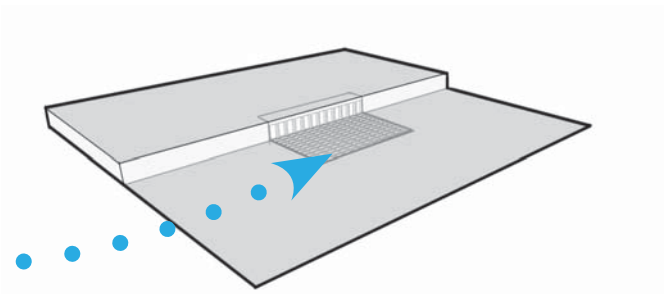
Using the rain garden sizing EQN 5.1.1. The rain garden is sized to be approximately 100 ft², optional dimensions include a 8' x 12' and 5' x 20'.



$$RG\ Size = \frac{1000}{10} = 100\ ft^2$$

Possible Rain Garden Shapes & Sizes





Construction

Below are construction steps for a standard rain garden.

1. **Preparation**

Cost: A do-it-yourself (DIY) rain garden typically ranges from $3 – 5 per square foot depending on soil conditions, plant species and size, and planting density. Plant costs are the major expense associated with a DIY hand-dug rain garden. The installer can save on plant costs if a neighbor or friend already has a rain garden or flowerbed with suitable plants that require division. However, depending on the size of transplants, usually at least one growing season is required before a plant size is reached that rivals one purchased.

Utilities: Utilities should be located before digging the rain garden. Call 811 at least two working days prior to any construction. The area of disturbance, including the rain garden and some allowance outside of the rain garden should be outlined using white landscape marking paint to help 811 determine whether the rain garden installation will encroach on any existing underground utilities. In general, rain gardens should not be placed within 5' horizontally or 1' vertically from underground utilities.

Erosion and Sediment Control: Active construction activities can increase sediment loading in runoff that will clog the rain garden rendering it ineffective. Rain gardens should be designed to fit into the landscape, but should not be constructed until all on-going construction and land disturbance are complete in the drainage area.

Construction Timeline: Rain garden construction is generally more efficient in early spring because digging will be easier due to seasonal rainfall. Plants will also benefit from an early spring planting due to less stress, milder temperatures, and a better chance for establishment. Summer and fall installations can work but may require more frequent irrigation and care until establishment. Most container sizes can be installed at any time of year as long as adequate irrigation is provided. For more information on plant sizes see Appendix D on Vegetation.

2. Excavation

Excavation Depth: The rain garden excavation is based on the chosen ponding depth of 3 or 6" for the design and whether or not your soil requires soil texture amendments. It should be noted that when construction is complete and mulch has been placed in the rain garden, there will be 3 or 6" of empty space in the rain garden that is used for storage of the rain that is captured. Without the ponding depth, or water storage space, the rain garden is not able to capture the desired amount of runoff and will overflow more often than intended. See Rain Garden Excavation Depth graphics on previous page.

Topsoil: Topsoil is the first 4 to 6" of soil that is removed and set to the side to be incorporated with any necessary soil texture and quality amendments before placing plants in the rain garden. Topsoil is usually darker than deeper soil layers and contains high organic matter content that is great for plant establishment and nutrient availability.

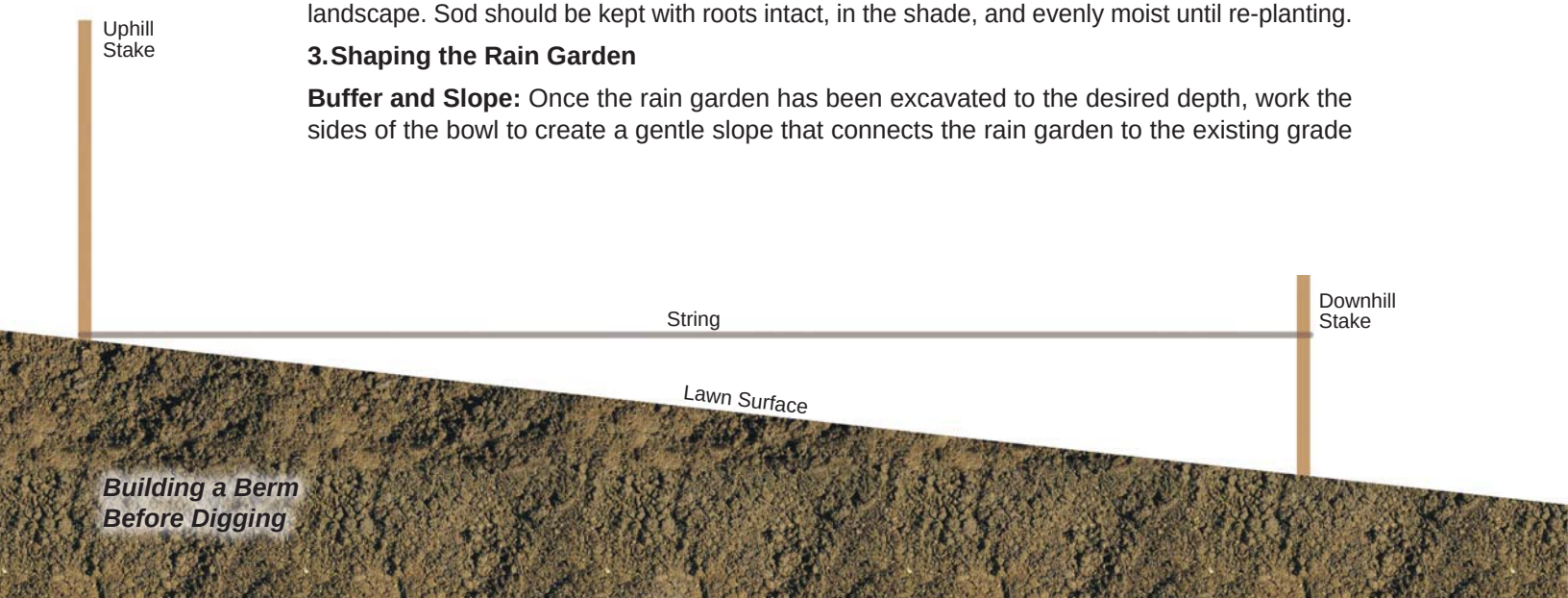
Excavated Soil: Soil that is removed can be stockpiled and placed in other parts of the landscape or can be used make a berm when excavation is complete.

Compacted Soils: If native soils are compacted or a hard pan is reached when digging, up to 8" of soil (including topsoil) may need to be removed or tilled from the soil layer of the rain garden so that plant roots can grow.

Sod Removal: To remove sod, a shovel, sod cutter (rented from local hardware store), or a backhoe can be used. Turfgrass sod should be set to the side for use on the rain garden buffer, berm, or other bare areas of the landscape. Sod should be kept with roots intact, in the shade, and evenly moist until re-planting.

3. Shaping the Rain Garden

Buffer and Slope: Once the rain garden has been excavated to the desired depth, work the sides of the bowl to create a gentle slope that connects the rain garden to the existing grade



Building a Berm Before Digging

or ground level of the landscape. A 3:1 slope works well to provide a gradual change in grade between the rain garden and the buffer.

Soil Texture Amendments: Soil texture amendments may be necessary to improve the soil's ability to infiltrate water in the rain garden. Amendments are generally a combination of yard compost or other organic matter and coarse sand. Infiltration rates of 1.5"/hr or greater do not require any soil amendments. For every 100 ft^2 of rain garden, a cubic yard or a 3" layer of soil texture amendments is recommended.

Soil Quality Amendments: Soil quality amendments such as any lime or fertilizer (indicated by soil test results) should be incorporated into topsoil. Animal waste compost is not recommended as an amendment due to typical high nutrient content.

Backfill: Next, use a rake, shovel, or rototiller to break up topsoil that was set aside. This topsoil is mixed with soil amendments (if necessary) and placed back in the rain garden. Begin by mixing in 1" of soil texture amendments and soil quality amendments with some topsoil to create a mix that is about 50/50 topsoil and amendments. If topsoil is poor quality on site, reduce the amount of topsoil added to the amendments for rain garden backfill. Work this soil mixture back into the existing soil in the rain garden until approximately 2 to 3" have been added. Check the depth with a yard stick or ruler to make sure it has not been overfilled. Rake and smooth out the soil so the bottom is level. This will prevent ponding in lower areas. At this point, the empty space should equal to the desired ponding depth plus a mulch depth of 3".

Mulch quantity in cubic feet = 0.25'* x length of rain garden (ft) x width of rain garden (ft)
**** 0.25' = 3" of mulch***

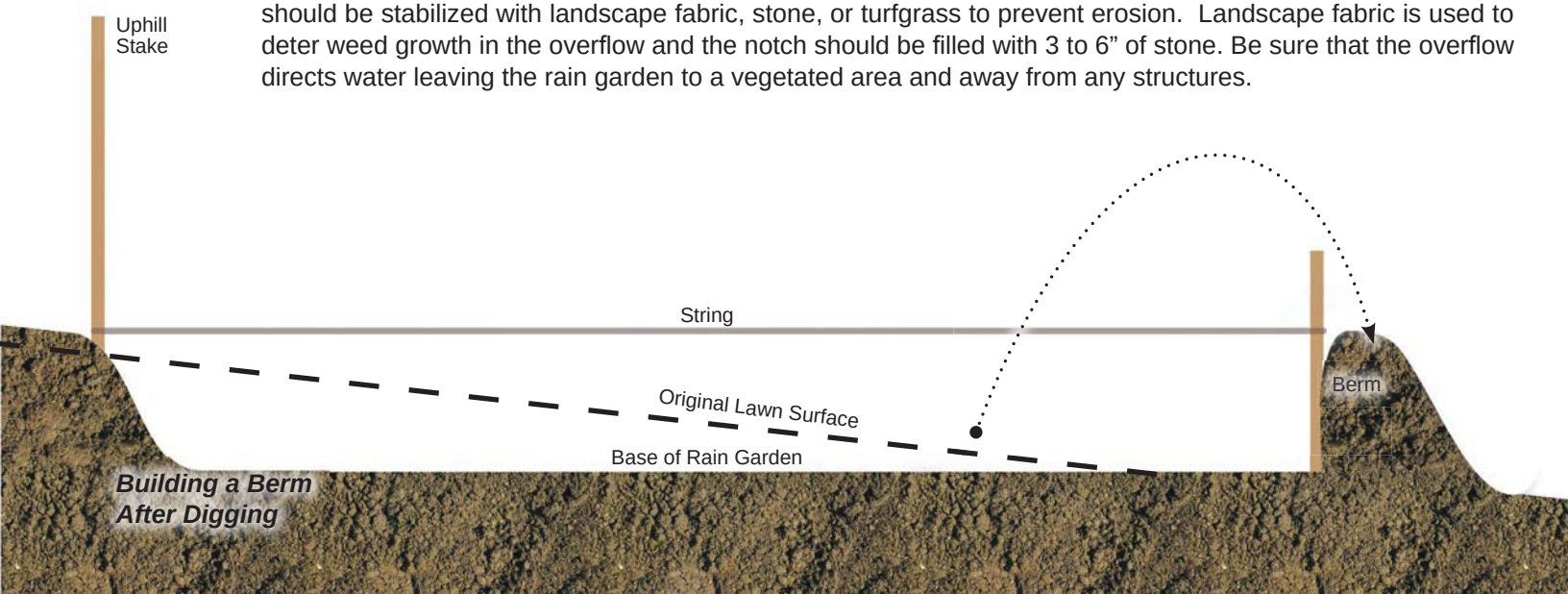
Mulch: A general rule of thumb is 0.5 yd^3 of mulch for every 50 ft^2 of rain garden. Bagged mulch is usually sold in cubic feet; however, if ordering a large quantity, keep in mind that it is sold by cubic yards and will need to be converted accordingly. Small, tender perennial plants can be protected during mulch placement by placing containers over plants to ensure that the mulch layer does not unintentionally cover plants. Mulch should be aged at least six months so it does not rob nitrogen from plants trying to establish. Triple or double shredded hardwood mulch is recommended for rain gardens because it has a decreased tendency to float away. However, hardwood mulch can be difficult to find in Alabama, especially when large quantities are needed. Pine bark or straw has been used successfully, but may require more frequent replacement to maintain a 3" mulch layer. Cypress mulch is not recommended as it is harvested from cypress wetlands and is not sustainable.

4. Prepare Inlet, Berm, and Overflow

Inlet: To prevent erosion at the inlet, a 1' wide strip of gravel, rocks, or concrete splash pad can be added to slow down and evenly disperse the flow of water into the rain garden. This is especially helpful when there are not any gutters or a gutter extension cannot be incorporated. More rocks can always be added later if erosion occurs.

Berm: The berm should be mounded on the downhill side of the rain garden where the overflow will exit the rain garden. A berm is not usually necessary when a rain garden is installed on a level landscape. The berm should be mounded as high as the uphill grade of the rain garden (see diagram below). Native grasses or turfgrass sod can be grown (or re-purposed) on the berm to provide cover and stabilize berm soil.

Overflow: A low spot or notch can be created on the berm to serve as the overflow. The overflow area of berm should be stabilized with landscape fabric, stone, or turfgrass to prevent erosion. Landscape fabric is used to deter weed growth in the overflow and the notch should be filled with 3 to 6" of stone. Be sure that the overflow directs water leaving the rain garden to a vegetated area and away from any structures.



Building a Berm After Digging

Vegetation

Plant Characteristics: Rain garden type will determine which vegetation should be used. Generally, plants for rain gardens should be able to withstand periodic wet and dry periods. Most standing water in a standard rain garden should infiltrate within 24 hours, but during extended periods of rainfall, plants that are unaccustomed to these conditions may suffer. Likewise, periods of extreme drought may also injure plants that are not drought tolerant. Plants selected for all types of rain gardens should be evergreen or perennial and have sturdy root systems at planting.

Native Plants: Native plants are adapted to local environmental conditions and are considered to be low maintenance since they require less fertilizer, water, and pest control inputs, and are usually able to persist during periods of low rainfall or drought once established. Using native plants can also help meet ecological site goals such as providing wildlife habitat, food sources, or breeding sites.

Butterfly Attractors: Many rain garden plants attract butterflies and a combination rain garden and butterfly garden can be created with appropriate plant selection.

Edible Plants: When using edible plants, “eat at your own risk” because rain gardens capture pollutants from impervious surfaces and many of these may be absorbed by plants and held in the tissues.

Standard Rain Garden: A standard rain garden will include plants that prefer moist and dry conditions that have a facultative (FAC or FACW) wetland indicator status, indicating that they are found in both wetland and non-wetland areas.

For more information regarding wetland indicator status, see Appendix D on Vegetation

Wet Rain Garden: A wet rain garden will utilize wetland plants that are better suited to mostly wet conditions with facultative (FACW) and obligate (OBL) wetland indicator status.

Zoned Wet Rain Garden: A wet rain garden with zoned topography should have a mixture of plants for dry, moist, and wet conditions based on the topography of the rain garden.

Right Plant, Right Place: Plants more suited for wet conditions should be placed in the center of the rain garden, as this is the area that will typically remain wet the longest. In general, plants that prefer drier conditions should be placed on the slope, or perimeter of the rain garden. Be sure to plant accordingly based on preferred sunlight and water requirements .

Plant Spacing: The plant budget will often drive plant spacing. Dense planting or using larger containers will be more expensive. Perennials may be spaced two or more feet apart to lower plant costs. However, some property owners may prefer an instant landscaped look, and in this case, herbaceous perennial plants are usually spaced more closely. This is not only more expensive, but may lead to additional maintenance in the future as plants spread to colonize an area and encroach on one another’s space. Plants can compete for moisture, nutrients, and sunlight, so it’s best to resist the urge to over plant.

Seasonal Interest: Plan for seasonal interest by including plants that bloom at various times of year. Consider including species that are evergreen or have showy fall color. A seasonal interest calendar can be created to show times of year when plants are most visually interesting to ensure year round aesthetic value.

Botanical Name	Spring	Summer	Fall	Winter
Conoclinium coelestinum				
Clethra alnifolia				
Fothergilla gardenii				
Ilex verticillata				
Itea virginica				
Lindera benzoin				
Morella cerifera				
Muhlenbergia capillaris				
Rudbeckia fulgida				
Stokesia laevis				
Vernonia gigantea				
Viburnum nudum				

Rain Garden Plant List

The following plant list contains plants native to Alabama that are appropriate for standard and wet rain gardens.

Botanical name – This column indicates the genus and species assigned to each plant. Botanical or scientific names should always be used to prevent confusion because only one plant has been assigned that particular name; many plants share the same common name which causes confusion. (For example, the common name possumhaw could indicate *Ilex decidua* or *Viburnum nudum*). For more information, see Botanical Names in Appendix D on Vegetation.

Common name – This column is the name applied to a plant based on its botanical name, appearance, or some other characteristic of the plant.

Type – This column indicates the plant's growth habit (shrub, tree, herbaceous perennial or grass, fern, etc.).

Soil Comments – Many plants have a pH range or type of soil they will perform best in and this column shows any soil preferences each plant may have.

Prefers – This column shows moisture and light requirements for each plant. See Table below for moisture and light requirement definitions.

Determining plant spacing for a small rain garden.
Pioneer Museum; Troy, AL

Table 5.1.3
Rain Garden Plant List

Botanical Name	Common Name	Type	*Soil Comments*	Prefers
Acorus calamus	sweetflag	herbaceous grass	acidic, wet	2,3 Sun to Part Shade
*Asceplias incarnata**	swamp milkweed	herbaceous perennial	any	3 Sun or Part Shade
Amsonia tabernaemontana	Eastern bluestar	herbaceous perennial	sandy	3 Part Shade
Baptisia alba	white wild indigo	herbaceous perennial	sandy to rocky, tolerates clay	1,2 Sun
Carex crinita	fringed sedge	grass like	any	2,3 Part Shade to Shade
Carex comosa	bottle brush sedge	grass like	any	3 Part Shade
Carex lurida	lurid sedge	grass like	any	3 Part Shade
Carex tribuloides	bristlebract sedge	grass like	any	2,3 Part Shade
Chasmanthium latifolium	river oats	herbaceous perennial	any	2 Part Shade
*Conoclinium coelestinum**	blue mistflower	herbaceous perennial	any	2 Sun to Part Shade
*Clethra alnifolia**	summersweet	shrub	any	2,3 Sun or Part Shade
*Coreopsis auriculata**	lobed tickseed	herbaceous perennial	rich, acidic	2 Part Shade
*Coreopsis lanceolata**	tickseed	herbaceous perennial	any	1,2 Sun
Coreopsis nudata	Georgia tickseed	herbaceous perennial	rich, acidic	2,3 Part Shade
*Echinacea pupurea**	coneflower	herbaceous perennial	sandy	1,2 Sun or Part Shade
*Eupatoriadelphus fistulosus**	Joe Pye weed	herbaceous perennial	acidic, moist, or wet	2,3 Sun
Helianthus angustifolius	swamp sunflower	herbaceous perennial	any	2,3 Sun to Part Shade
Hibiscus coccineus	scarlet rose mallow	herbaceous perennial	any wet	3 Sun
*Hibiscus moscheutos**	crimson eyed rose mallow	herbaceous perennial	moist, alkaline	2,3 Sun to Part Shade
Ilex glabra	inkberry	shrub	sandy, acidic, peaty	1,2 Sun or Part Shade
*Ilex verticillata**	winterberry	small tree	any, acidic	1,2 Sun or Part Shade
Itea virginica	sweetspire	shrub	any, acidic	1,2,3 Sun or Part Shade
Juncus effusus	common rush	grass like	any, wet	2,3 Sun or Part Shade

Botanical Name	Common Name	Type	*Soil Comments*	Prefers
*Lobelia cardinalis**	cardinal flower	herbaceous perennial	any, will tolerant limestone based soils	2,3 Sun to Part Shade
Muhlenbergia capillaris	muhly grass	herbaceous grass	sandy or sandy loam	1,2 Sun or Part Shade
*Phlox carolina**	Carolina phlox	herbaceous perennial	sandy, loam, acid, will tolerate some lime	2 Sun to Part Shade
*Phlox divaritica**	blue woodland phlox	herbaceous perennial	any	2 Part Shade
*Physostegia virginiana**	obedient plant	herbaceous perennial	humus rich soils	1,2,3 Sun to Shade
Pontederia cordata	pickerelweed	herbaceous perennial	any	3 Sun to Part Shade
Rudbeckia fulgida	orange coneflower	herbaceous perennial	sandy	1,2 Sun or Part Shade
Sisyrinchium angustifolium	blue eyed grass	grass	poor to average moist soils	2,3 Sun to Part Shade
*Stokesia laevis**	Stoke's aster	herbaceous perennial	well drained acid sand preferred	1,2 Sun or Part Shade
*Vernonia novenboracensis**	Ironweed	herbaceous perennial	tolerates clay and acidic soils	1,2 Sun
Viburnum nudum	possumhaw	shrub	prefers acid mucky soils, but is adaptable	1,2,3

*Attracts butterflies, hummingbirds, or both

1. prefers dry conditions and can tolerate drought conditions; to be used on buffer, slope, or berm of standard rain garden and wet rain gardens with zoned topography.

2. prefers moderate or moist conditions and can tolerate occasional inundation. Plants labeled 2 are appropriate for the center of standard rain garden designs or wet rain gardens with zoned topography.

3. prefers wet conditions and are appropriate for wet rain gardens and deep pools of wet rain gardens zoned topography.

Sun – at least 6 hours of full sun per day.

Part Shade – 3 to 5 hours without direct sun per day.

Shade – less than 2 hours of direct sun per day.

Vegetation Design Guidelines

- Mature plant sizes should be considered, particularly if the rain garden is sited where visibility is a concern.
- The design plan should reflect mature plant sizes. Every square foot of the rain garden will not be covered at planting, but over time, the area will naturally fill.
- Large trees are generally not recommended due to the size and canopy cover, which can outcompete and shade out other plants. If you desire the size contrast offered by trees, consider training a shrub such as wax myrtle (*Morella cerifera*) into a tree form.
- Consider the direction a rain garden will be viewed. If it will be viewed from one side, i.e., the rain garden is located in the back of the yard, it may be appropriate to place taller plants in the back. If the rain garden will be viewed from two or more sides, i.e., the rain garden is sited in the front yard, taller plants should be placed in the center of the rain garden.

Create a Landscape Design

Sketch It Out: The rain garden area can be sketched out to help visualize how it will look after planting. A circle template (purchased from the school supply section) can be used to create a bird's eye or plan view of the rain garden sketched to scale. You will need to establish an appropriate scale to use (often decided by your available paper size), such as 1"= 1'. Start by sketching out the footprint of the rain garden. If using a 1"= 1' scale, a 10'x20' rain garden would be sketched on paper to an actual size of 10"x20". See Chapter 4.1 on Bioretention for examples of sketched out landscape designs.

Grouping Plants: Plants are usually grouped in clumps of three, five, or seven to avoid monocultures (plantings with only one plant species).

Extra Space: Be sure to include space between different plantings for maintenance access as well as any reseeding of perennial plants.

For more information on creating a landscape design, contact the local County Extension Office.

Calculating Plant Quantity

Another design option (used in Design Examples 1 and 2 in this handbook) is to calculate a plant quantity. Creating a landscape drawing is best, but a plant quantity can also be calculated so plants can be ordered and placed on the day of planting. Calculating plant quantity will help to avoid over or under purchasing of plants and overcrowding plants. When plants are purchased, nursery tags will denote preferred plant spacing for each species as well as plant height, soil characteristics, and light requirements. Species-specific spacing should always be used when that information is available, but the suggested spacing based on plant type in this handbook provides good general recommendations.

Divide the Space: It is sometimes easiest to divide the area into a mixture of smaller shapes that have easily calculated areas. For example, a rectangular rain garden can be divided into smaller squares, circles, or rectangles. This will make it easier to calculate the quantity of each plant for each part of the rain garden.

Spacing Guidelines: Plants can be spaced based on plant type and a plant quantity for each section of the rain garden can be calculated. This is especially helpful if the rain garden will consist mostly of grasses and perennials because 2' spacing is appropriate for most species of both plant types. By using this method, the total amount of plants needed is known and the rain garden plant selection can be based on what is available at the local nursery.

As a general rule of thumb for rain gardens, plant spacing guidelines based on plant types can be used as seen in Table 5.1.4.

Table 5.1.4
Plant Spacing Guidelines

Plant Type	Spacing
Herbaceous perennials	*1.5 - 2'*
Grasses	*2 - 3'*
Shrubs	*4 - 5'*

*Note: These spacing guidelines are meant to create masses of each plant type with sweeps of color. For more space between each plant, the spacing should be increased.

Spacing Patterns: Plant quantity is calculated based on the square feet needed per plant, which is based on whether you plan to arrange plants on a rectangular or triangular grid pattern. For rectangular spacing, the space between plants and between rows is the same. Triangular spacing is generally more visually appealing as it creates a mass-planting look and plants are equally spaced within rows, but the rows are staggered.

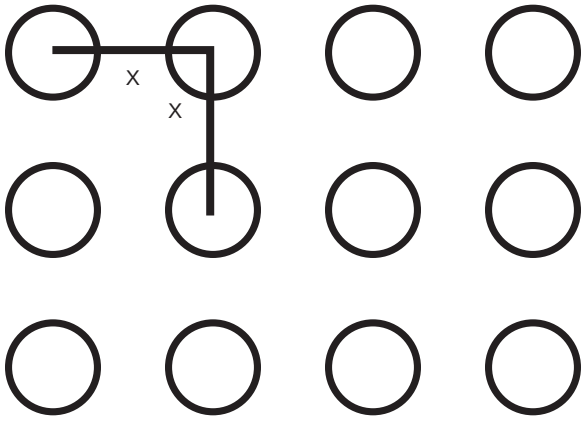


Fig. 1 - Rectangular Spacing

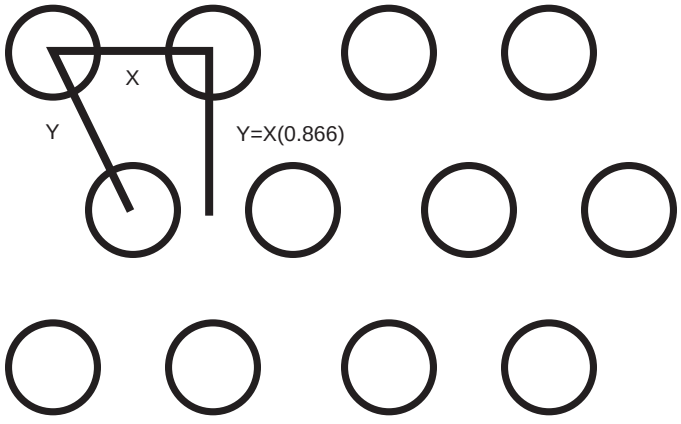


Fig. 2 - Triangular Spacing

An equation can be used to calculate plant quantity based on the selected spacing pattern.

Quantity = Area (ft^2) ÷ square feet needed per plant

So for a 100 ft^2 rain garden planted with herbaceous perennials on 2' spacing in a rectangular spacing pattern, how

Rectangular Spacing Equation

$$ft^2/plant = (X)(X) = X^2$$

$$Quantity = \frac{Area\ (ft^2)}{ft^2\ /\ plant}$$

$$Quantity = \frac{100\ ft^2}{4\ ft^2/plant} = 25\ plants$$

Triangular Spacing Equation

$$ft^2/plant = YX$$

$$ft^2/plant = [(X * 0.866(X)]$$

$$Quantity = \frac{Area\ (ft^2)}{ft^2\ /\ plant}$$

$$Quantity = \frac{100\ ft^2}{3.4\ ft^2/plant} = 29\ plants$$

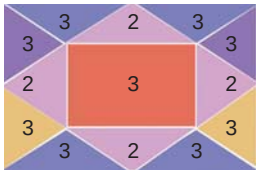
many plants would be needed?

When using this equation, recall that you will almost never come up with a whole number and since half of a plant cannot be installed, you must decide whether to round up or down. Units of Area should be consistent, so if your

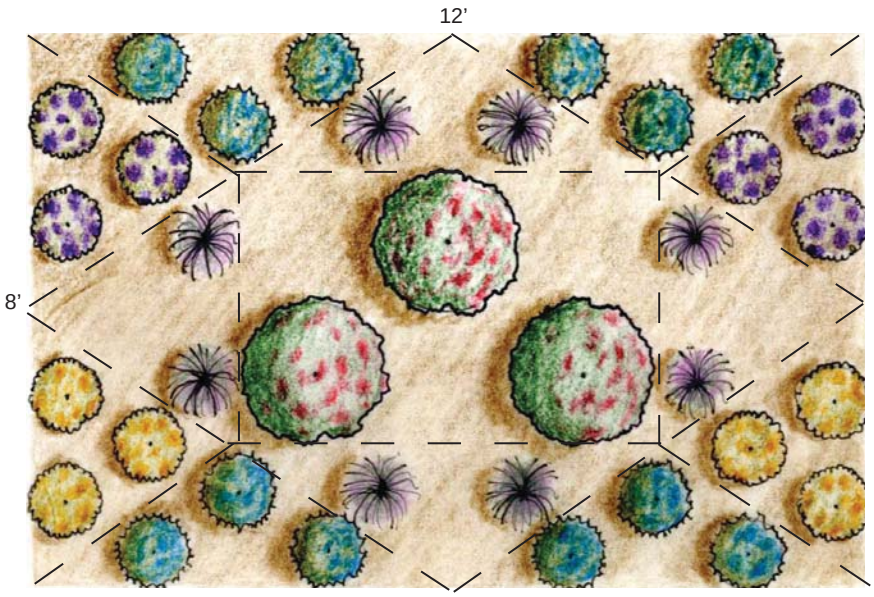
Rain Garden at Pioneer Museum; Troy, AL

Vegetation Design Example 1
Standard Rain Garden

This rain garden vegetation plan was designed for a front yard with showy plants and seasonal interest. The design calls for a 3" ponding depth and is an 8' x 12' (96 ft²) rectangle on a triangular spacing pattern. The slope and buffer are planted with repurposed turfgrass.



Planting Diagram (ft²)

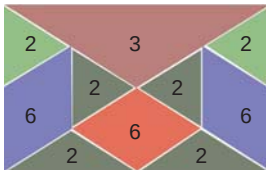


Plant List

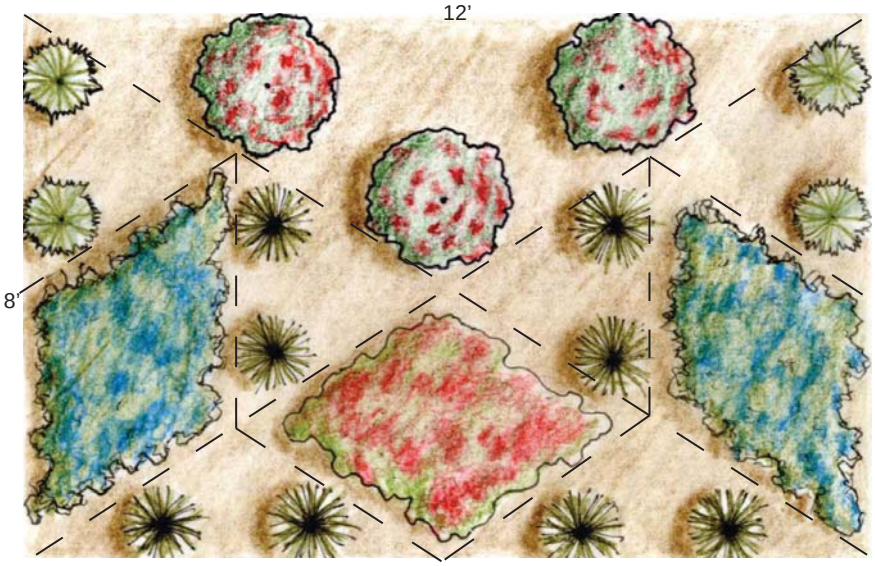
Plant Common Name	Spacing (ft)	Area (ft²)	ft²/plant	Quantity
crimsoneyed rose mallow	3	24	7.8	3
muhly grass	2	6	3.4	2
muhly grass	2	6	3.4	2
muhly grass	2	6	3.4	2
muhly grass	2	6	3.4	2
purple coneflower	1.5	6	2	3
purple coneflower	1.5	6	2	3
orange coneflower	1.5	6	2	3
orange coneflower	1.5	6	2	3
Stoke's aster	1.5	6	2	3
Stoke's aster	1.5	6	2	3
Stoke's aster	1.5	6	2	3
Stoke's aster	1.5	6	2	3

Vegetation Design Example 2
Wet Rain Garden

This rain garden vegetation plan was designed for a residential back yard. The design calls for a 3" ponding depth and is an 8' x 12' (96 ft²) rectangle on a triangular spacing pattern with standard (level) topography throughout the rain garden. The slope and buffer of this rain garden are planted with muhly grass.



Planting Diagram (ft²)



Plant List

Plant Common Name	Spacing (ft)	Area (ft²)	ft² / plant	Quantity
common rush	2	6	3.4	2
common rush	2	6	3.4	2
common rush	2	6	3.4	2
common rush	2	6	3.4	2
cardinal flower	1.5	12	2	6
cardinal flower	1.5	12	2	6
sweetflag	2	6	3.4	2
sweetflag	2	6	3.4	2
swamp milkweed	1.5	12	2	6
scarlet rose mallow	3	2	7.8	3

Maintenance

Sediment and Debris Removal: Rain gardens collect surface runoff from impervious surfaces and as a result, tend to trap sediment and other debris. Although sediment deposition means that the rain garden is functioning, this sediment should be removed periodically. Sediment in the rain garden can cover plants hindering their growth, create a favorable environment for weed seeds to germinate, and clog mulch void space, which may keep the rain garden from drying out between rain events. Trash and other inorganic items should be removed from the rain garden as they collect.

Mulch Replacement: Leaves will degrade and mulch will decompose to replenish organic matter to the soil. Mulch should be maintained at 3" and bare areas should be replaced as needed. Full mulch removal and replacement should occur every two to three years or when mulch has become matted, thus preventing adequate infiltration of stormwater. Mulch depth should never be in excess of 3". Applying excess mulch will limit the storage volume of the rain garden and can potentially lead to problems associated with root rot of plants.

Pruning: Shrubs will benefit from annual pruning to encourage bud break and help maintain plant shape and form. Plants should be pruned based on the May Rule (See Appendix D on Vegetation). Seed heads and spent flowers can be left on herbaceous perennials for winter interest and as a food source for wildlife. It is sometimes helpful to leave the seed heads so these plants are not mistaken as weeds in the spring when new shoots begin growing. Leaving the seed heads can also encourage these plants to reseed themselves.

Table 5.1.5
Maintenance Task List

Task	How Often	Comments
Soil test	Prior to planting and every 3 to 5 years thereafter	Soil quality amendments such as lime and fertilizer should be incorporated prior to planting
Irrigation	At planting and twice per week for 6 weeks after planting	Once established, irrigate only during drought
Inspection	After 0.5" or greater rainfall event	Visually inspect all components of the rain garden for erosion or damage.
Pruning	Annually	Prune based on the May Rule
Replace dead vegetation	After first growing season	Diseased or insect infested vegetation should be removed
Plant Division	Every 2 or 3 years	Plants may become crowded over time and many perennials recommended for rain gardens will need to be divided (See Appendix D on Vegetation for more information).
Remove trash	As needed	Rain gardens in more commercial settings will collect trash more frequently
Remove deposited sediment	As needed or annually	Use a flat shovel to remove
Check for invasive nonnative plants	Twice per year	Hand pull and make sure mulch is in place to prevent weed seeds from germinating
Replace mulch	every 2 - 3 years	May need to replace bare areas to maintain at 3" depth

Pollutant Removal

Rain gardens are designed to uptake nutrients found in runoff, such as nitrogen and phosphorus. To facilitate phosphorus removal, rain garden soil should have a low to very low extractable phosphorus as indicated by a routine soil test. Research has shown that rain gardens planted in soils with high phosphorus actually export this nutrient instead of trapping it. Many Alabama watersheds and waterways already have excess phosphorus. Select a different site for the rain garden if the soil test indicates high or very high phosphorus levels.

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