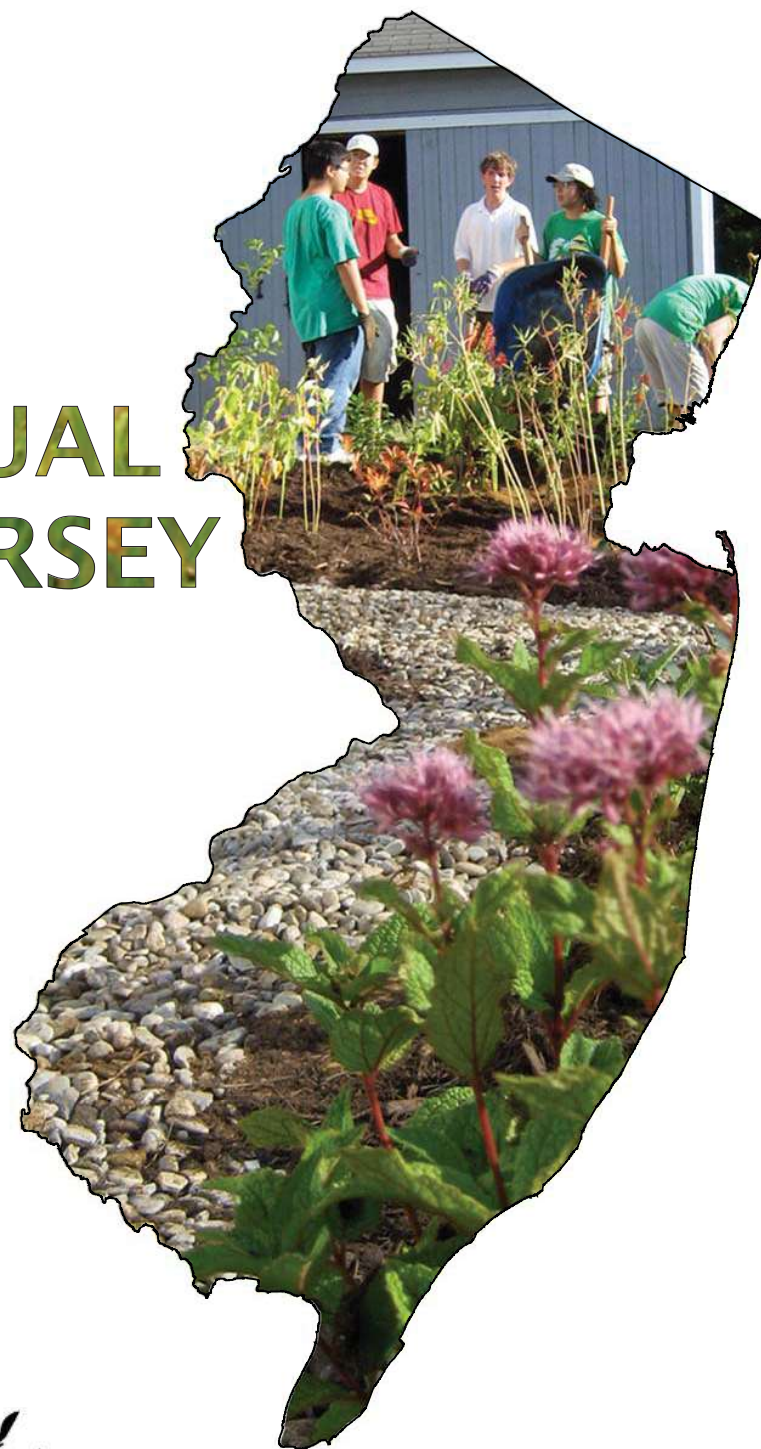


RAIN GARDEN MANUAL OF NEW JERSEY



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Special thanks to all of our partners throughout New Jersey who have contributed photographs and images to help make this Manual a success for the Rain Garden State!

Front cover photo courtesy of Pat Eisemann

Cooperating Agencies: Rutgers, The State University of New Jersey, U.S. Department of Agriculture, and County Boards of Chosen Freeholders. Rutgers Cooperative Extension, a unit of the Rutgers New Jersey Agricultural Experiment Station, is an equal opportunity program provider and employer.

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Site Selection

Locating Your Rain Garden

The first step is to identify an appropriate location on your property for constructing the rain garden. Consideration must be given to where the water will enter, how it will fill up the rain garden, and where it will flow out. Remember that you will want to control how the rain garden overflows during a large storm. Where will the water go when it overflows? Consider the impact of this potential overflow, and try to minimize it by directing the overflow towards grassy areas, wooded areas, or existing storm drains. Make sure that the rain garden will neither drain towards your foundation, nor towards the neighboring property.

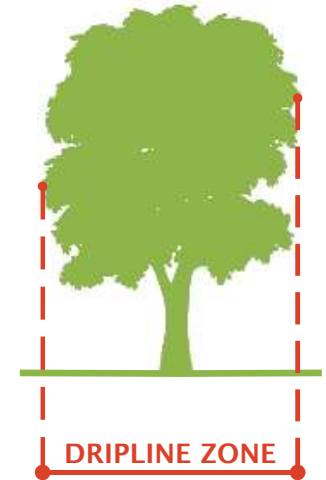
FIRST THINGS FIRST!

Before you design your rain garden, remember to:

- Research site specific information such as the location of utilities, wetlands, fire lanes, future building plans, etc.
- Survey the grounds to identify possible rain garden sites including areas with downspouts, gutters, soil erosion or locations where water ponds and puddles during/after storms.
- Do you need a permit? Not typically, but if you are in doubt, it is best to contact your county and municipal offices.
- Pay attention to drainage problem areas. It may help to take pictures.

There are several important things to consider when selecting the site of a rain garden:

1. For a building with a basement, the rain garden should be located at least ten feet from the building. This will prevent water from seeping into the building's basement. For a building with no basement, the rain garden can be placed two feet away from the building.
2. Do not place the rain garden within 25 feet of a septic system, and make sure that the rain garden is placed upslope of any leach field.
3. Do not situate the rain garden in soggy places where water already ponds. Instead, capture the water before it collects in these locations.
4. Avoid seasonably-high water tables within two feet of the rain garden depth. For real time data regarding the water table in your area, refer to the U.S. Geological Survey website (www.nj.usgs.gov/publications and from there, go to the link www.waterdata.usgs.gov). While this data provides a general idea of the water table, keep in mind that the water table fluctuates seasonally depending upon rainfall amounts.
5. Consider flat areas of the yard first. This will make digging out the rain garden much easier.
6. To prevent disrupting large tree roots, refrain from positioning the rain garden within the dripline of large trees. The dripline of a tree is the ring around the tree canopy on the ground surface that receives most of the rainwater from the tree canopy. Most of the tree's roots are located within this zone, as indicated in the illustration above, right.
7. Provide adequate space for the rain garden. A typical rain garden for most homes ranges from approximately 100 to 300 square feet in area.








Evidence of erosion: This photograph shows that, during a rainstorm, water flows down the impervious sidewalk and carves a gully through the ground surface as it flows downhill. A rain garden situated here could contain the water and improve infiltration.

LOCATE YOUR UTILITY LINES!

Call BEFORE You Dig!

*NJ One Call
1-800-272-1000*

The different colors of the markout flags represent specific utilities.

-  **ELECTRIC**
-  **GAS, OIL, STEAM**
-  **COMMUNICATIONS, CATV**
-  **WATER**
-  **SEWER**

Call Before You Dig

It is critical that work not damage underground water, gas, and electrical services. Contact New Jersey's "One Call" system at 1-800-272-1000 or 811 for a free markout of underground gas, water, sewer, cable, telephone, and electric utility lines before any outdoor construction or digging. Making this call before you dig will help prevent property damage and potential injuries. Call at least three full working days, but not more than ten days, prior to the planned installation date. Mention that you are going to be installing a garden that may have a depth of one foot (or more, if you are installing an under-drain). Utility company representatives will come to your site and mark the locations of utilities with spray paint, so you can be certain of avoiding them. Before their visit, make sure that you mark out the general location of the proposed rain garden with white spray paint or white flags (you can purchase these at a local hardware store). The representatives should inspect a larger area of the yard, not just the specific boundary of the rain garden. This will provide more flexibility for the location of the rain garden. Do not place the rain garden within five feet horizontally and one foot vertically from any utilities.

Understanding Your Property

A rain garden could probably fit in several different areas on your property. To find the most suitable location, it is essential to understand how rainwater flows through your yard. Walk around your property either during or soon after a large rainstorm. You will notice that on pervious areas of your property such as the lawn, a stone driveway, or a garden bed, the ground absorbs much, if not all, of the rain. On the other hand, take a look at the hard surfaces, such as a rooftop, a driveway, a road, or a compacted lawn area. The water does not soak into these impervious surfaces; instead, it runs off and flows downhill, looking for a place with a more porous surface in which to infiltrate. Positioning a rain garden so that the stormwater runoff flows from an impervious surface towards and into the rain garden can alleviate most flooding and erosion issues commonly found on small properties.

PLACES TO AVOID:

Do not locate a rain garden:

Next to trees. Soils near trees tend to have the best drainage, and should not be disturbed.

Near heavily used pedestrian areas. Foot traffic will cause soil compaction, which will decrease infiltration rates and disturb plant growth.

On top of buried utility lines, septic tank leach fields, water supply wells.

Over the buffer strip between the street and the sidewalk. This area usually holds multiple buried utility lines.

Within ten feet from your house if you have a basement foundation.

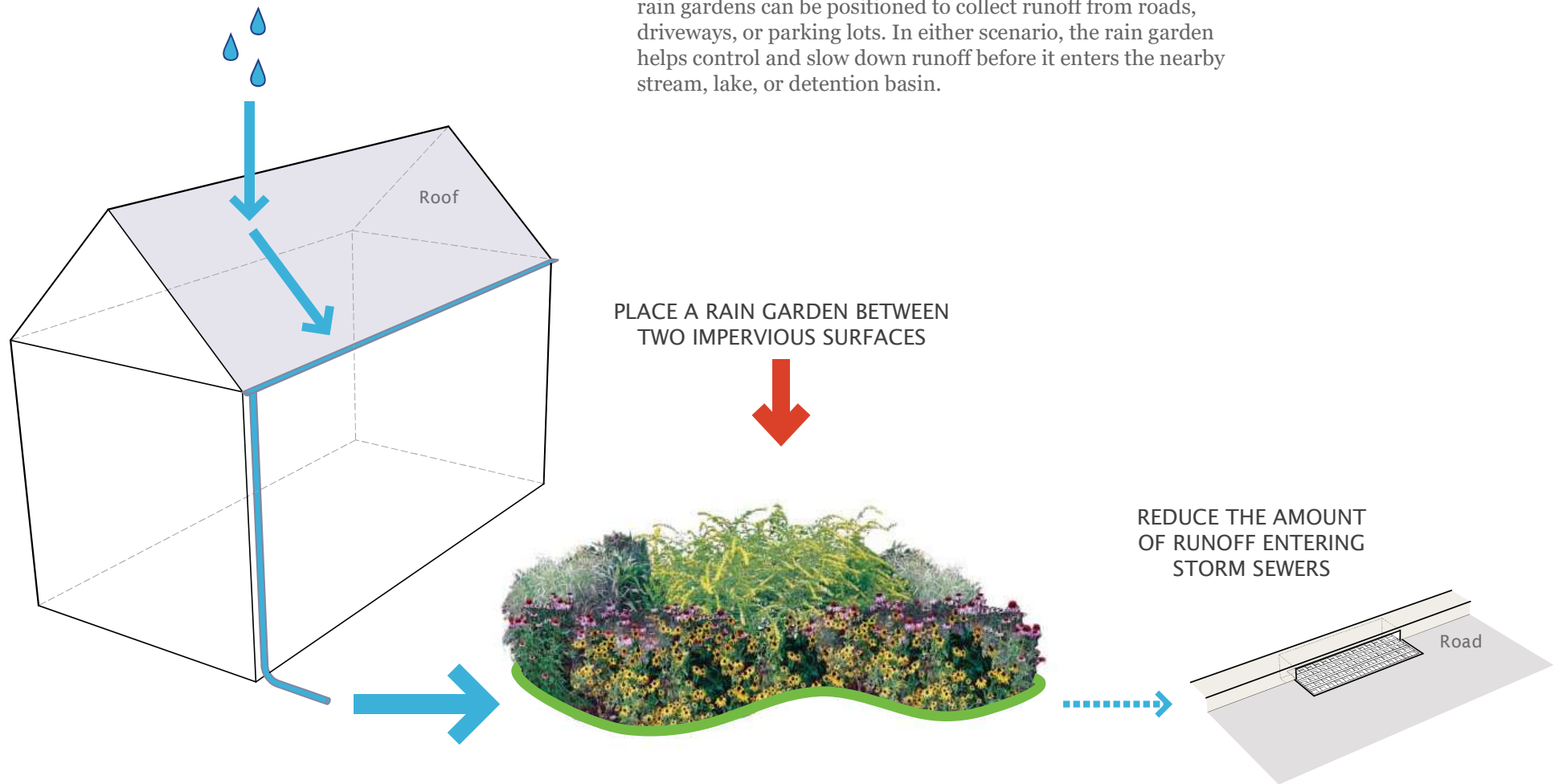
On the uphill side of a retaining wall if it is a structural feature (and not merely decorative) and was not specifically designed with a drainage system.

Beneath trees. Disturbing tree root systems (the tree's dripline) will cause stress, particularly to oak trees. If you cannot avoid doing this, do not disturb more than 10% of a tree's root system.

Over areas of shallow bedrock or shallow groundwater (three feet below ground surface or less). Shallow bedrock will hinder infiltration and plant growth, and shallow groundwater may cause permanent flooding in the rain garden. Also, shallow conditions may pollute the groundwater as the rain garden may not have enough time to filter pollutants before they infiltrate into the soil.

In addition to establishing the source of the water, it is important to determine where the runoff travels to once it leaves your property. Look for signs such as erosion, patches of dead grass, and areas of sediment accumulation to identify the preferred flow path of stormwater runoff.

Rain gardens are commonly placed at least ten feet from the end of a downspout so that the runoff flows off of the rooftop, down the downspout, and into the rain garden. Similarly, rain gardens can be positioned to collect runoff from roads, driveways, or parking lots. In either scenario, the rain garden helps control and slow down runoff before it enters the nearby stream, lake, or detention basin.



REMEMBER:

*SURFACE AREA EQUALS
LENGTH MULTIPLIED BY
WIDTH!*

$$SA = L \times W$$

Things to Consider

To ensure that the location of the rain garden is most appropriate, ask the following questions:

1. Does the house have rooftop gutters and downspouts that can be associated with a rain garden?

IF YES:

- Does the house have gutters that catch the roof runoff and direct this water to downspouts?
- Do these downspouts discharge onto the ground?
- Are these downspouts directly connected to the underground storm sewer?

2. If a connection cannot be made to the rooftop, examine the existing stormwater infrastructure.

- Is there a curb and/or gutter connected to the road, driveway, or parking lot?
- Are there any nearby catch basins or storm sewers? If yes, look into the catch basins. What direction does the pipe flow?
- Are there any existing swales and/or ditches?
- Are there any existing detention or retention basins?

3. What is the topography of the yard? (flat or sloped)

IF FLAT:

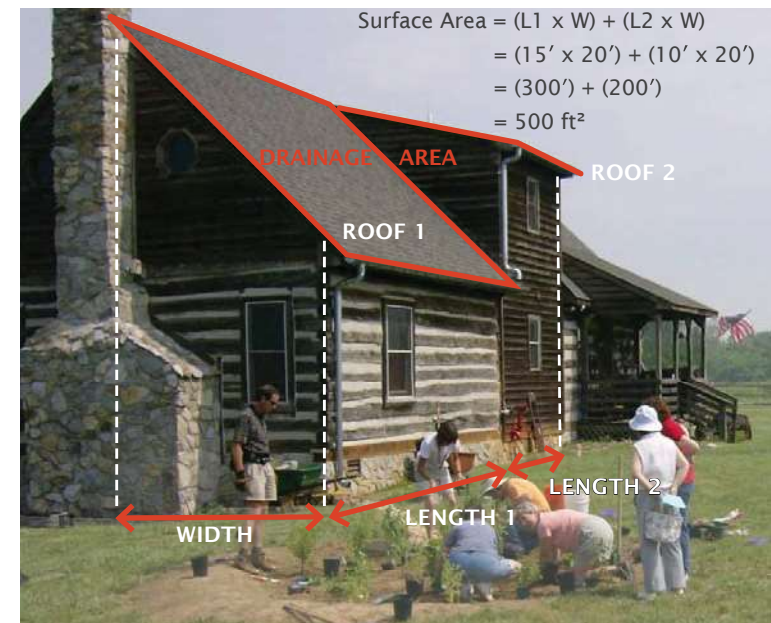
- A rain garden is best situated on a flat portion of the yard. This will make digging out the rain garden much easier.

IF SLOPED:

- A rain garden should not be placed on a slope of more than 12% because it may require a retaining wall or high berm to be able to hold the runoff entering the rain garden.

Drainage Area Calculation

Now that you have determined the appropriate site within your yard for the rain garden, you will need to determine the necessary size of the rain garden. To calculate this, identify the area of impervious surface that will drain into the rain garden. More than likely, this surface is either a rooftop or a paved surface such as a road, driveway, or parking lot. The size of this impervious surface area will help determine the size (square footage) of your rain garden.



In this example, the total impervious surface area consists of two roofs with the same width but different lengths.

Hockman Farm
Winchester, VA

Drainage Area: The Rooftop Scenario

To begin, the rooftop scenario is the easiest method for determining the drainage area, as it is a simple calculation of the volume of water that discharges from the impervious surface of the roof, into the gutter, and carried to the ground by a downspout.

Using a measuring tape, measure the area of the roof by measuring the length and width along the foundation of the building where the building meets the ground. If there are two different roof surfaces draining into the same downspout, add their areas together to get the total surface area. Refer to the image on the previous page for an example calculation. If a single rooftop has more than one downspout, and the rain garden will only connect to one of those downspouts, you will need to figure out the roof top area draining to just the one downspout. To do this, take the total surface area of the rooftop and divide it by the total number of downspouts.

If the building has no gutters or downspouts, you can install a shallow ditch lined with stones along the roof dripline to convey the water into the rain garden.

If the downspout connects with underground pipes directly to the storm sewer system, try to disconnect the downspout before the pipe goes underground. Divert the water to the rain garden using a PVC pipe and fittings and/or a corrugated plastic pipe.



Drainage Area: The Road, Driveway, or Parking Lot Scenario

The road, driveway, or parking lot scenario is a bit more difficult to calculate, as the drainage area may be more difficult to define. It is best to go outside after a rain event, observe the direction of the runoff, and measure the surface area of the impervious surface that is flowing into the rain garden. Sediment accumulation along curbs provides evidence of the direction of water flow; if there is no curb, look for dead grass patches and erosion. Remember that roads, parking lots, and driveways are often pitched to convey water to one side, or both sides (in this case, look for a slight ridge in the center).

If there is no curb between the impervious surface and the location of the rain garden, it is best to leave a grass buffer (at least two feet wide) between the road and the rain garden. To help direct the runoff into the rain garden, a notch (approximately one foot wide) lined with stone can also be cut into this buffer area. The stone will help to slow the flow of water.

If there is a curb between the impervious surface and the location of the rain garden, a curb cut is needed. This will allow the water to flow into the rain garden.



A curb cut and a stone buffer provides the inlet for runoff to enter the rain garden from the adjacent roadway.

Lions Lake Park
Voorhees, NJ



Make observations after a rainstorm to determine the direction of the runoff and the drainage area of the rain garden.

The image on the far left shows the approximate drainage area for a roof with more than one downspout. The two images in the center and near right depict both before and after the disconnection of the downspout from underground pipes.

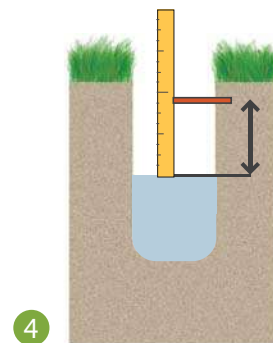
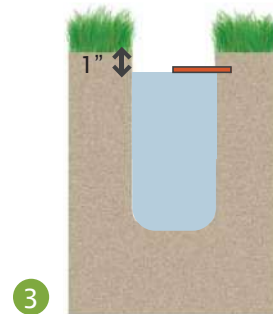
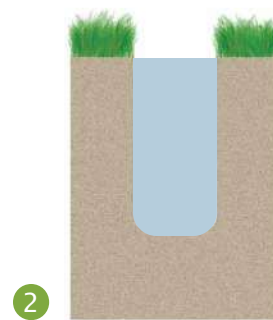
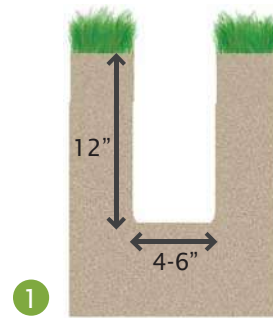
Summit Middle School
Summit, NJ

Check Your Soil: Infiltration Test (Percolation Test)

Good soil drainage is important. Determine how fast the soil drains at your site by conducting an infiltration test (also referred to as a percolation test). This test will let you know how well the existing soil infiltrates water. Ideal soils will infiltrate completely within 24 hours at a percolation rate of approximately 1.5 inches per hour.

As the diagram to the right indicates, complete the following steps:

1. Dig a hole in the proposed rain garden site, approximately 12 inches in depth and four to six inches in diameter. To be more accurate, dig two holes. A standard post-hole digger is typically the tool of choice for this activity.
2. Fill with water to saturate the soil and then let stand until all the water has drained into the soil.
3. Once the water has drained, refill the empty hole again with water so that the water level is about one inch from the top of the hole. Use a stick to indicate the location of the starting water level. Record the time using a watch. Measure the depth of the water with a ruler.
4. Check the depth of water with a ruler every hour for at least four hours.
5. Calculate how many inches of water drained per hour. With sandy soils, the water should descend quickly. With clay soils, the water should descend slowly.

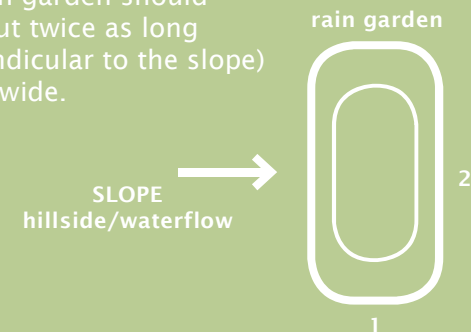


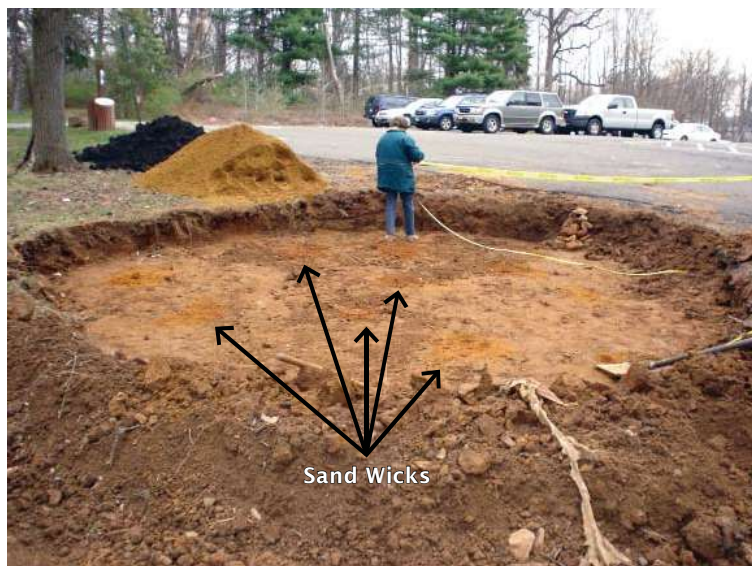
If the drainage rate is less than 1.5 inches per hour, or the water does not drain within 24 hours, add soil texture amendments such as coarse sand during installation. Alternatively, consider placing the rain garden in a different location on your property.

It is important to note that sometimes an infiltration test provides a false reading of a site's soil conditions. For example, during dry conditions, an infiltration test may demonstrate that the soil drains quickly and does not need amendments. However, during a rainy season, an infiltration test on that same soil may reveal that it is clayey and does not infiltrate well.

A GOOD RULE OF THUMB:

The rain garden should be about twice as long (perpendicular to the slope) as it is wide.





As illustrated in the image on the left, in addition to the recommended soil amendments, it may be helpful to add sand wicks to a rain garden site with clay soils. To do this, dig out holes, preferably 1 foot deep if possible, and fill in with pockets of coarse sand. This will increase the infiltration capacity of the rain garden.

Trailside Nature Center
Mountainside, NJ

Check Your Soil: Soil Test

While the infiltration test will give an initial evaluation of the site's soil conditions, a soil sample that you collect and submit to Rutgers Cooperative Extension (RCE) Soil Testing Laboratory will provide the most accurate reading of the soil (refer to page 59 in the Appendix of this Manual for contact information and a sample soil test analysis). The standard soil fertility test, which includes both a nutrient and pH analysis and recommendations, costs approximately \$20. A soil texture test/mechanical analysis (sand, silt, clay percentage) is \$30. You can purchase a soil test kit from your local RCE County Office. At the potential rain garden site, take approximately ten random soil samples near the location that you would like for your future rain garden. When taking your soil sample, remember to take about ten soil cores randomly at depths of 3, 6, 9, and 12 inches. Combine all of these into one composite sample. Send the soil sample and the order form to the RCE Soil Testing Laboratory. The results usually take about two weeks and will recommend any amendments needed for the soil based on the nutrient and pH analyses. The results of the soil texture test will help in calculating if coarse sand, topsoil, and/or compost are needed for the rain garden.

It is very likely that your soils will be highly compacted and will not drain well. To compensate for this, you may need to use a special soil mix within the rain garden. An ideal soil mix for a rain garden is 85 to 95% sands with no more than 25% of the sands as fine or very fine sands; no more than 15% silt and 2 to 5% clay content. The entire mix shall be amended with 3 to 7% organics (*NJBMP Manual, 2009, page 9.1-4*). You may be able to use the existing soil, but if it is not in good condition, you may have to spend money on new soil and/or amendments such as lime, gypsum, and specific nutrients.

REMEMBER:

A rain garden is not a garden permanently filled with water!



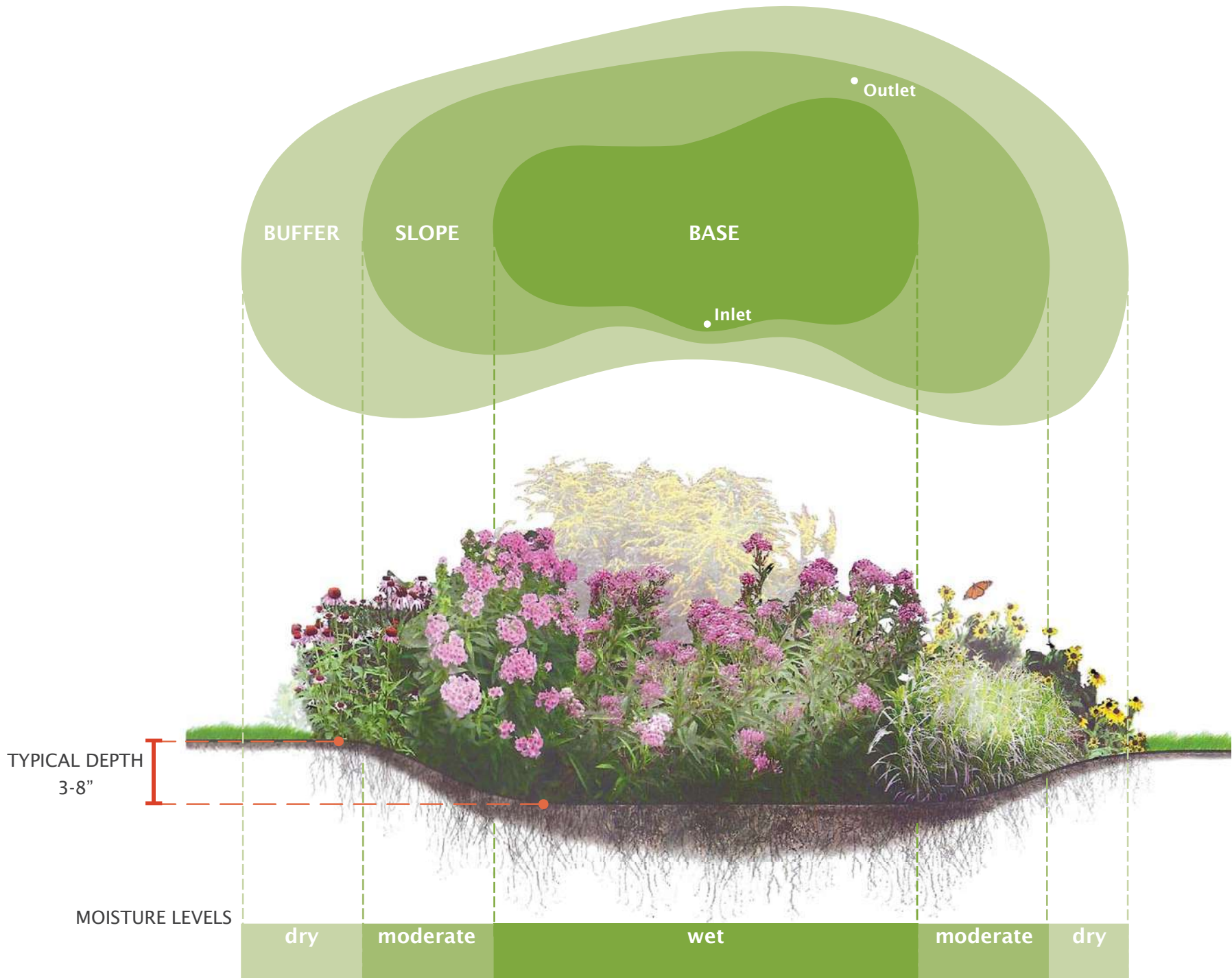
Insert the trowel or spade to a depth of 3, 6, 9, or 12 inches, remove some soil and set it aside.



Insert the trowel again 1/2 inch from the first cut and just as deep. Collect a thin slice of soil, and place it in a clean bucket.



Repeat this procedure about ten times, and combine all of these soil cores into one composite sample.



Determining the Depth of the Rain Garden

The depth of the rain garden is dependent upon the soil texture found at the potential location for the rain garden. The depth of a rain garden usually ranges from three to eight inches. Typically, a rain garden with sandy soil should be eight inches deep, and a rain garden with silty soil (in between sandy and clayey) should be six inches deep. A rain garden with clay soil should be three inches deep. As mentioned on pages 22-23, clay soils do not infiltrate well and need soil amendments. Rain gardens in clay soils should have an increased surface area (square footage), as well as a decreased depth. For a further explanation on rain garden depths, refer to the diagram on the right.

Determining the Size of the Rain Garden

The size of the rain garden is dependent upon the amount of runoff entering the rain garden. Using the drainage area calculated on pages 20-21 and the existing soil texture of the rain garden, refer to the Rain Garden Sizing Table (below, right) to determine the necessary square footage of your rain garden. For example, a drainage area of 750 square feet with clay soils would need a rain garden with an area of 350 square feet. If you do not have the adequate space for the size of the rain garden that the Sizing Table recommends, build it as close to the recommended size, and then account for more overflow. A rain garden is sized to handle New Jersey's Water Quality Design Storm of 1.25 inches of rain over two hours.

6" DEEP RAIN GARDEN - NO SOIL AMENDMENTS



3" DEEP RAIN GARDEN - SOIL AMENDMENTS



Rain Garden Depth

The depth of a rain garden (usually in inches) refers to the open space of the rain garden's base. A rain garden with amendments needs to be dug deeper than a rain garden without amendments to accommodate for the sand and compost. As the above diagrams depict, the rain garden with soil amendments has a depth of three inches, while the rain garden without amendments has a depth of six inches, despite the fact that both rain gardens were both originally dug down to a depth of nine inches. The three inch layer of amendments (one cubic yard) accounts for the difference.

Rain Garden Sizing Table Based on New Jersey's Water Quality Design Storm

Drainage Area	Size of 3" Deep Rain Garden CLAY SOIL*	Size of 6" Deep Rain Garden SILTY SOIL	Size of 8" Deep Rain Garden SANDY SOIL
500 ft ²	200 ft ²	100 ft ²	75 ft ²
750 ft ²	350 ft ²	150 ft ²	112 ft ²
1,000 ft ²	400 ft ²	200 ft ²	149 ft ²
1,500 ft ²	600 ft ²	300 ft ²	224 ft ²
2,000 ft ²	800 ft ²	400 ft ²	299 ft ²

* SOIL TEXTURE AMENDMENTS NEEDED

REMEMBER:

Soil texture amendments improve the rain garden's infiltration rate.

Soil quality amendments improve the rain garden's growing conditions for plants.

Determining Soil Amendments of the Rain Garden

The existing soil conditions found at the site of your rain garden will determine whether or not soil amendments are necessary. There are two different types of amendments that you may need to add: soil texture amendments and soil quality amendments. Soil texture amendments will increase the rain garden's ability to retain water, and soil quality amendments will improve the rain garden's growing conditions for plants. See page 35 in the next Chapter for more information regarding the installation of soil amendments.

Soil Texture Amendments

Soil texture amendments improve the soil's ability to infiltrate water. Remember that sandy soils have the fastest infiltration; clayey soils have the slowest. The ideal soil texture for a rain garden is a sandy loam soil, as it retains nutrients and water, while still allowing for adequate infiltration.

The results of the infiltration test will determine if the soil needs soil texture amendments. As indicated on page 22, if your infiltration test resulted in more than 1.5 inches of infiltration per hour, amendments are not necessary. Conversely, if your infiltration test resulted in less than 1.5 inches of infiltration per hour, you should add soil texture amendments to the soil, as your soil is likely compacted or poorly drained. Coarse sand is typically used as a soil texture amendment, with a loamy topsoil, purchased at a local garden shop, mixed into it. Generally, it is recommended to add one cubic yard (a combination of sand and compost) of amendments for every 100 square feet of rain garden, which translates to a three inch layer of amendments.

Soil Quality Amendments

Soil quality amendments improve the soil's nutrient capacity, which results in improved growing conditions for plants. Adding soil quality amendments can be appropriate for any soil type based upon the soil test result recommendations from the Rutgers Cooperative Extension Soil Testing Laboratory. Common soil quality amendments include: gypsum, lime, fertilizer, or other organic matter.



Determining the Inlet and Overflow

Stormwater runoff enters the rain garden from an inlet, which can be an extended gutter, a stone or concrete spillway, a vegetated or stone-lined swale, a diversion berm along the bottom of a slope, a paved surface, or across a sloped lawn. Most of the stormwater that enters a rain garden should infiltrate into the ground within the first 24 hours following a typical rain event. For larger storms, stormwater exits through the overflow area, which usually consists of a low point in the berm directing flow away from structures and toward open lawn areas or a stormwater catch basin. The area should be protected with stones and landscaping fabric to prevent erosion and weed growth.

The images to the right of the Cherry Hill Department of Public Works Building show how water flows from the gutter on the roof, descends through the downspout to the ground surface, and enters into the rain garden through the inlet. The water exits the rain garden through the outlet and overflow area. In this case, it flows through an underground pipe under the sidewalk to a nearby catch basin in the parking lot.

Preventing Erosion

There are several effective ways to prevent erosion from occurring in the rain garden. First, do not make the slopes of the garden too steep (a slope no greater than 3:1). In addition, slowing down the velocity of the water flowing through the rain garden will minimize erosion. In the inlet area, add a one foot wide area of rocks to slow the flow of water. Remember that more rocks can always be added after installation if there are any signs of erosion.

Determining Mulch Quantity

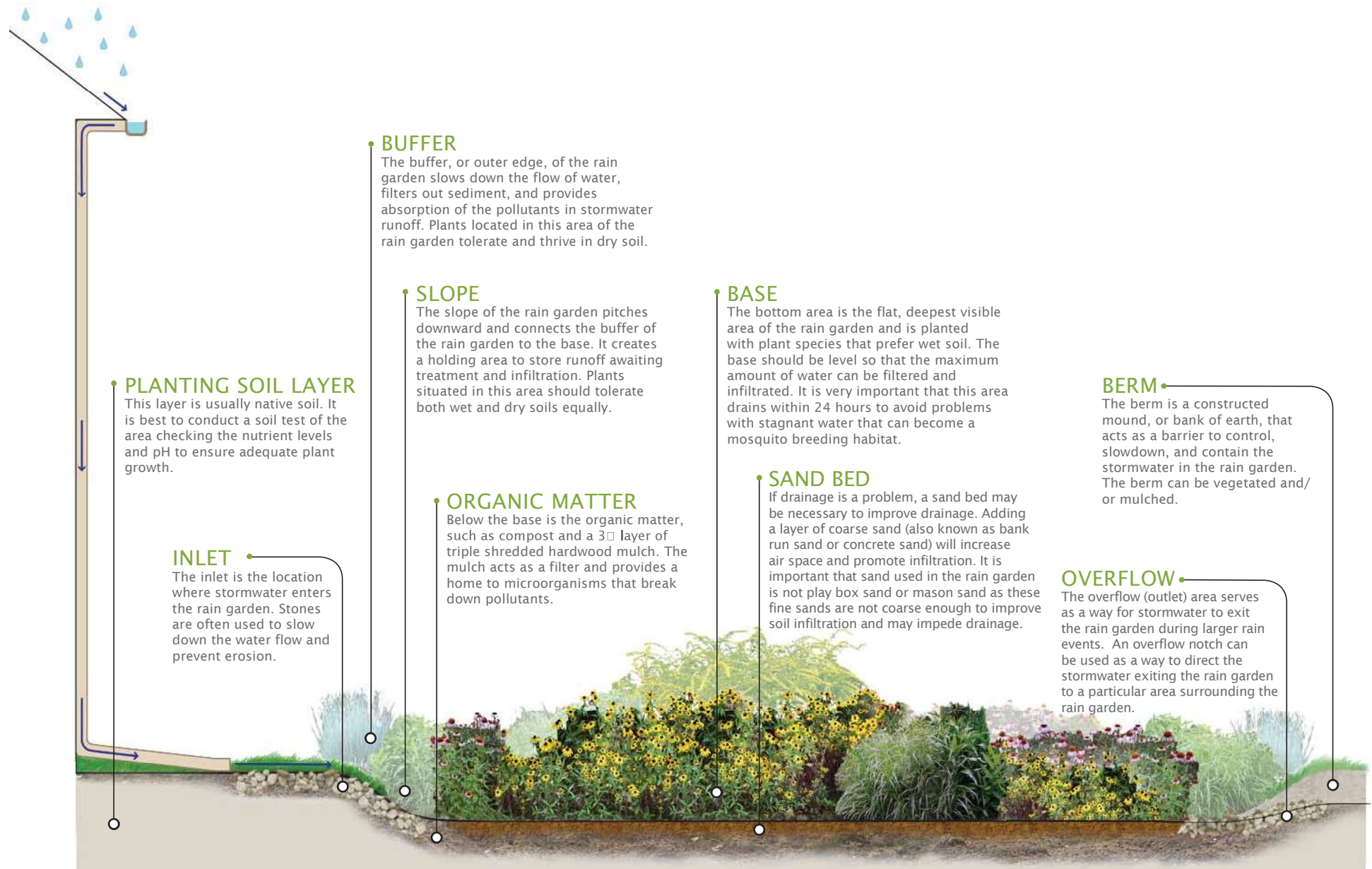
Allow for a three inch depth of mulch (triple-shredded hardwood with no dye) to be spread throughout the entire rain garden. This means that every 50 square feet of rain garden needs 0.5 cubic yards of mulch. For example, a 100 square foot rain garden requires 1.0 cubic yards of mulch.



This plastic catch basin serves as the rain garden's outlet by connecting to a pvc pipe running underneath the adjacent sidewalk so that the water can overflow into the parking lot.

Cherry Hill Department of Public Works
Cherry Hill, NJ

Parts of a Rain Garden



Rain Garden Design

Shaping Your Rain Garden

Go outside to the location of your rain garden. Using a garden hose or rope, outline the desired shape of your rain garden on the ground. This will provide you with the most flexibility to adjust the shape, but spray paint or stakes will also work.

Although many rain gardens are in the shape of a circle or a kidney bean, your rain garden can take on whatever shape you prefer. Sketching may help you develop a layout with which you are comfortable.

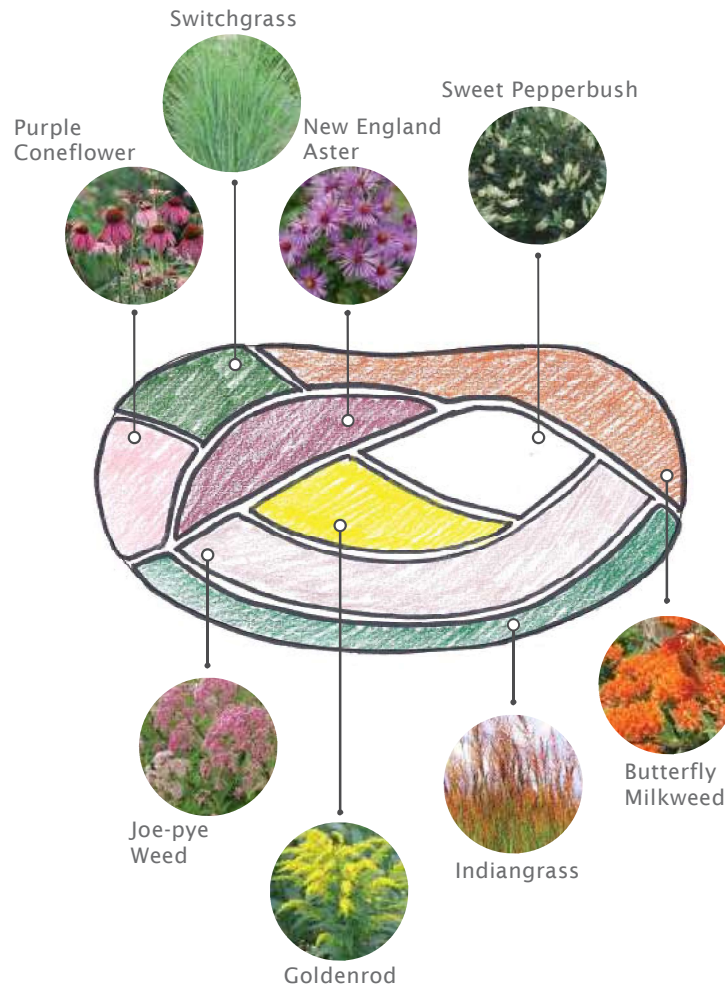
Selecting Plants for Your Rain Garden

The success of your rain garden depends on selecting the right plants for the right place. Observe your rain garden site and record pertinent information such as hours of sun, reflections off of adjacent buildings and excessive wind. These conditions may contribute to unusual 'microclimates' due to increased heat or exposure, and it is necessary to choose plants accordingly.

Plant your rain garden with plants adapted for your specific site. Whether in the sun or shade, rain gardens can be planted with shrubs and accentuated by flowers that are beautiful and low maintenance – as long as you select the plants that love the given conditions. Native plants, or plants that are indigenous to this climate or region, can thrive without a lot of care, extra water, fertilizer, or pesticides.

In particular, use native hardy perennial species with well-established root systems that survive in both dry and wet conditions. These plants do not require substantial fertilization, absorb water more efficiently than turf-style grasses, and are much easier to maintain than exotic species.

Butterfly Habitat Rain Garden: Planting Plan



WETLAND INDICATOR STATUS:

For standardized information on plant species, check this out:

www.plants.usda.gov

In addition to plant characteristics such as bloom time, sun and soil requirements, and flower color, this website provides the U.S. Fish and Wildlife Service wetland indicator status for each plant species. Page 31 of this Manual includes a sectional study of plant moisture tolerances.



May



June



July



August



September



October

Select species based upon the following qualities:

- Plant size
- Seasonal interest
- Moisture tolerances
- Sun preferences
- Plant aggressiveness
- Salt tolerance
- Habitat creation.

Using the planting plans included in this manual as inspiration, create a sketch of your rain garden design. Refer to pages 60-66 of the Appendix in this Manual for suggested planting plans and native plant lists. Refer to pages 54-57 for sources of native plant material.

Your planting layout should directly correspond with the layout of the buffer, slope, and base of your rain garden. The plant list on page 60 of this Manual lists appropriate plants for each rain garden zone. In particular, plants that like wet conditions belong within the base. Refer to the following page (page 31) for information regarding planting guidelines based upon the U.S. Fish and Wildlife wetland indicator status.

Plant spacing depends upon the future mature size and the growth rate of the plant species you select for your rain garden. Nurseries carry various sized containers. Although more expensive, larger plants may bloom faster; they are also more likely to experience transplant shock. Plugs, which are a small, economical option, may be available, particularly for grasses.

Plants that grow and spread quickly will need to be planted farther apart. Follow the spacing guidelines specific to each species. This will aid you in determining how many plants you need to fill your rain garden.



As this rain garden demonstrates, using plants that differ in height, color, shape, bloom time, and textures increase the aesthetic appeal of a rain garden. In addition, these homemade plant markers add interest and a bit of personality to the rain garden. Be creative!

Burlington County Community Agricultural Center
Moorestown, NJ

PLANTING DESIGN TIPS:

- Plants that prefer wet conditions should be planted in the deepest part (the base) of the rain garden where water will collect. Plants that prefer average or drier conditions should be planted along the edges of the rain garden.
- Create depth in the rain garden by placing large and tall plants in the back and smaller plants in the front.
- Plant masses of the same species together in odd numbers (generally three or five containers per species).
- Incorporate plants that have visual interest in the fall and winter. Grasses and evergreens can work well in a rain garden, and they provide color and interest in the colder months.
- Native plants provide habitat to animals and require less watering, and there are quite a few deer-resistant native plants species.

Wetland Indicator Status

Generalized Planting Guideline for Ponds + Wetlands Typical Planting Zones

This diagram illustrates typical planting zones for ponds and wetlands in New Jersey. Use a plant's wetland indicator status as a guide to where it should be planted in a rain garden.

