



*Rain Gardens for Healthy Streams
 Navigating the Water Audit
 Project Approval & Rebate Process*



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Purpose of this Guide

Rain Gardens for Healthy Streams is intended to assist participants of Blue Water Baltimore's *Water Audit Program* in completing the **Rain Garden Project Approval Form** and qualifying their project for the Rain Garden rebate. The rebate is available for both residential and nonresidential properties within the four watersheds located in and around Baltimore City: Gwynns Falls, Jones Falls, Herring Run, and Direct Harbor. The **Water Audit Program** will reimburse for qualified projects based on the square footage of pervious and impervious surfaces that are draining to the garden. No rebate will exceed half the cost of a rain garden. In order to receive a rebate, residents must register for the program and have their property assessed by Blue Water Baltimore before the project is installed. A **Project Approval Form** must be submitted at least 2 weeks prior to installing the project. Upon project approval, there may be changes required to ensure that the project meets the program standards. These changes must be incorporated in order to qualify the project for a rebate. **For up-to-date incentives, to register for the *Water Audit Program*, or to complete forms, visit www.bluewaterbaltimore.org/water-audit-resource/.**



Blue Water Baltimore created the *Water Audit Program* to assist residents in reducing the negative impact their properties have on the natural environment. Of particular concern in the Baltimore area is the water that runs off of hard (impervious) surfaces such as roofs and roadways. In urban settings, even “green” spaces can generate this runoff because of soil compaction. This runoff carries trash, chemicals, nutrients, sediment, and heat into our streams and is often referred to as “polluted runoff” or stormwater. Stormwater is conveyed directly to local streams and the Chesapeake Bay without being treated. By capturing this water in a rain garden, you will protect the health of your local streams, the Baltimore Harbor, and the Chesapeake Bay.

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About Rain Gardens

Rain gardens have the following qualities:

- Create a bowl like surface, the center of which is at least 6” lower than the surrounding ground where water ponds for no more than 24-48 hours after a storm, slowly seeping into the surrounding soil; and
- Capture runoff from uphill surfaces including but not limited to rooftops, roadways, and lawns.

Rain gardens have three zones or distinct areas. On the following page is a description of each area, the conditions that the plants will need to tolerate, and the ideal slope for that area.

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Ponding Area or Zone 1: This is the majority of your garden, where the ponding depth is the greatest.

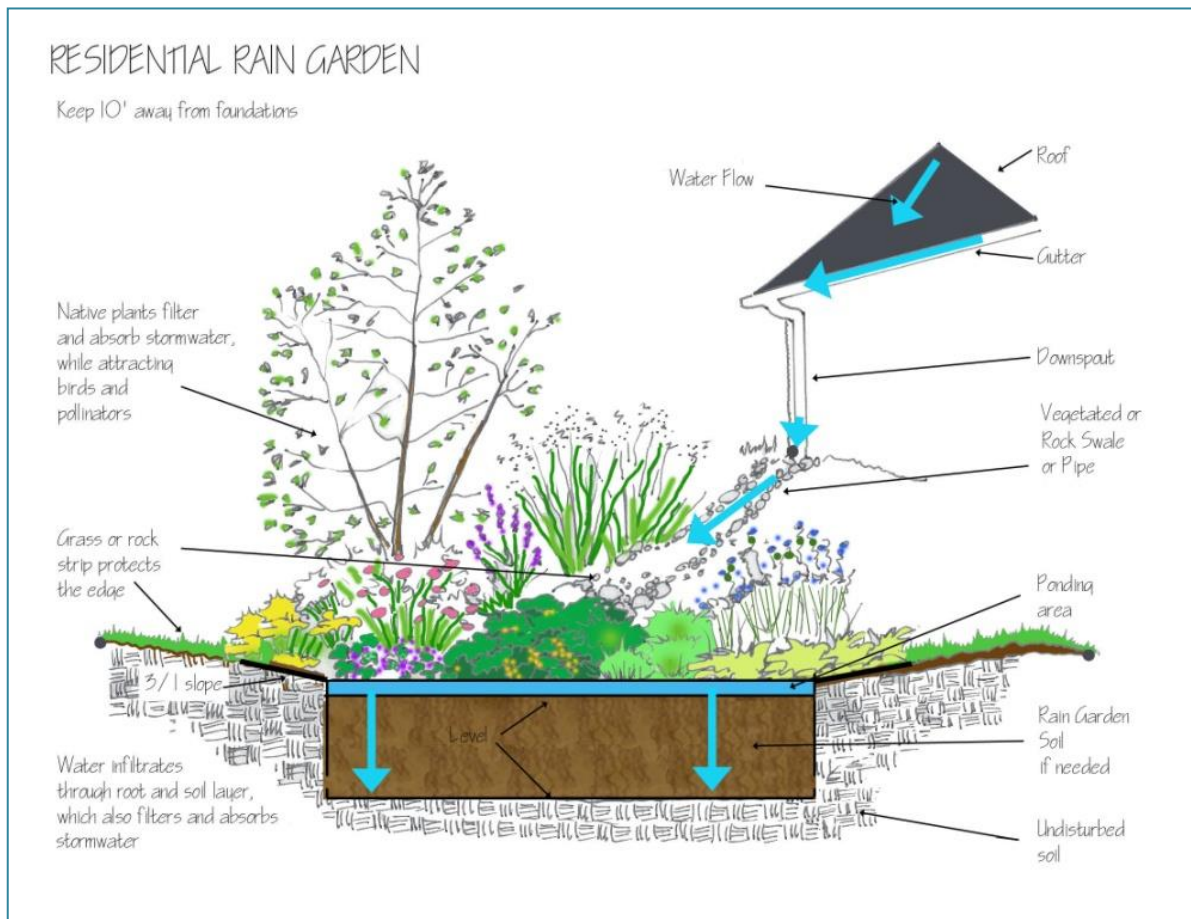
- Plants in zone 1 need to be able to tolerate 24 hours of standing water above the mulch layer and consistently damp soils. The plants also need to be able to tolerate dry periods between rain events, when the soil will dry out.
- Soils in this area should be perfectly level.

Sloped Perimeter or Zone 2: This is the transition area between zone 1 and zone 3.

- Plants in zone 2 need to tolerate occasional standing water and drought.
- The ground in this area should have a 3:1 slope, meaning that for every inch of depth at the center, zone 2 should be three times as wide. For example, if your ponding depth is 6", then zone 2 should be 18" wide.

Edge, Berm or Zone 3: This is the border around your rain garden.

- Plants in zone 3 need to tolerate drought.
- Depending on the site and design, the ground in this area may be flat or slightly sloped towards the center of the garden. This area will include your berm on the downhill side of the garden, if a berm is needed.



Locating & Sizing Your Rain Garden

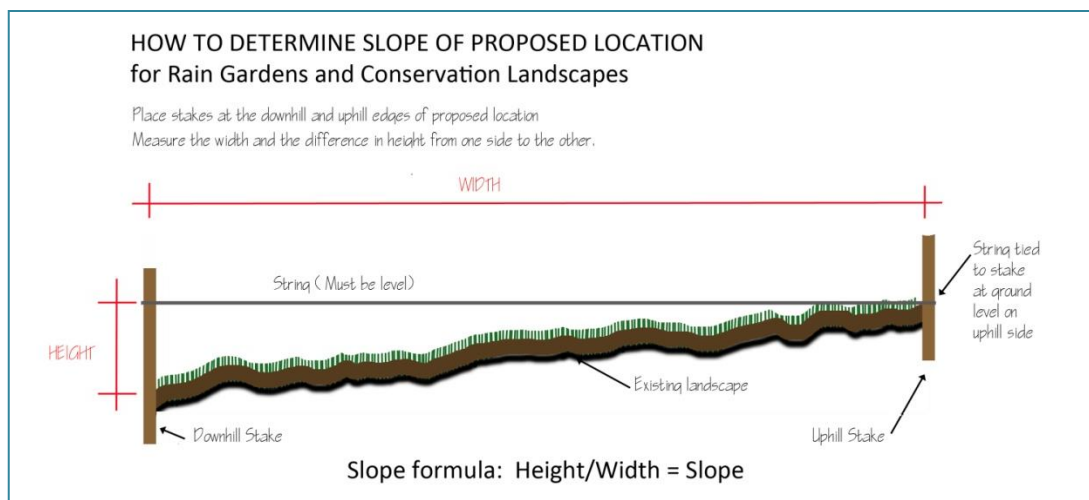
Many manuals have been written describing how to design and install a rain garden. Blue Water Baltimore recommends using an existing rain garden manual, several of which are listed in the Resources section. These existing guides will help you to everything except for size your garden. For this step, use the Blue Water Baltimore **Rain Garden Size Calculator** to ensure your garden meets the storage capacity standards.

Rain gardens must meet **specific size requirements** in order to qualify for a financial incentive. The above ground storage capacity, or ponding area, must capture all of the runoff from a 1" storm from both pervious and impervious drainage areas. Blue Water Baltimore's **Rain Garden Size Calculator** is available at www.bluewaterbaltimore.org/water-audit-resource/. It will provide the area needed for a square or circular garden. If you are designing a rain garden that will be a shape other than a square or circle, you will need to prove that the ponding area is sufficient to hold the volume of runoff from a 1" storm. Your Water Audit results will include the volume of runoff and garden size appropriate for your property to maximize stormwater capture.

Rain gardens should not be located on a ground with greater than 12% slope. If the slope is greater than 12%, then you'll need to install a retaining wall on the downhill side of the garden.

Measure your slope:

1. Pound stakes into the ground on the uphill and downhill sides of the area where you are considering installing your rain garden. The stakes should be 10-15' apart.
2. Tie a string to the uphill stake where it meets the ground, then to the downhill stake. Make the string taught, but not tied so tight that you won't be able to adjust it.
3. Using a string, or line, level adjust the string on the downhill stake until the string is level.
4. Measure the width (distance from the uphill to downhill stake).
5. Measure the height from the ground to where the string is attached to the downhill stake.
6. Divide the height by the width than multiply by 100 to calculate the slope.



Rain Gardens For Healthy Streams

Throughout the course of planning your project, you should be **sketching your site**. Begin with the property line and building footprints. You can draw by hand (it doesn't have to be museum worthy) or begin with an image generated by a mapping service of your choosing. Both Baltimore County and the City of Baltimore have mapping websites (see Resources for web links). You may also choose to download a base image using other mapping tools such as Yahoo or Google Maps. A site sketch with all of the information below is required when you complete your Project Approval Form.

Many of the site sketch requirements for rain gardens are the same as for conservation landscaping. Reference ***Conservation Landscaping for Healthy Streams*** or one of the rain garden guides listed in the Resources section to identify conflicts and opportunities on your site that will influence your rain garden's location.



Property line and building footprint of a single family home. Image taken from Baltimore City's 'CityView' mapping website.



Aerial image of the same single family home in Baltimore County taken from Bing Maps.

Stormwater Infiltration

Soil Characteristics Pertaining to Rain Garden Drainage

Soils that can allow infiltration of rainfall keep our streams flowing during dry weather. Rain gardens are the most effective strategy employed by Blue Water Baltimore to capture runoff and recharge groundwater supplies. In order to complete your rain garden approval form, you will need to determine your soil's infiltration capacity. This can be determined by performing a percolation test.

The result of the percolation test will help you determine if you will need to bring in more permeable soils. More information about soil testing is available in the Resources section of this document.

Conducting a Percolation Test

Ideally, a percolation test will be performed when the ground is saturated, or just following a significant rain storm. Conduct this test in the exact location of the proposed rain garden.

- 1) Dig a hole 18" deep and 12" in diameter.
- 2) Fill the hole with water.
- 3) Return after an hour or two and fill it again.
- 4) If it has not rained at least half an inch in the past 24 hours, repeat step 3 two more times.
- 5) Check the hole several times over 24 hours after the final filling of the hole.
- 6) Take note of how many hours it took for the water to drain.
- 7) Record your test results in the project approval form.
 - A. If it drains within 24 hours, then the soil passes the percolation test. On the project approval form you will write "passed" as well as the number of hours the hole took to drain.
 - B. If there is still water in the hole after 24 hours, then the soil fails the percolation test. On the project approval form you will write "failed" when it asks for the percolation test results.



An empty percolation test hole

What your test results mean

If your soil passes the test, you will dig to 3" below your planned ponding depth. For example, if you plan to have 6" of ponding (minimum required for rebate), **you will dig to 9 inches below the lowest point on the edge of your garden.** Once the required 3" mulch layer is added, you will be left with the appropriate amount of ponding space.

If your soil does not pass the test, you will need to dig an additional 15" below the ponding depth. The bottom 12" will be filled with a rain garden mix. This means that **you will dig a total of 24" deep in Zone 1.** There are several accepted rain garden soil mixes. Blue Water Baltimore recommends: 50% course sand, 30% compost, and 20% low clay content top soil.

Rain Garden Drawings, Plants & Planting Plans

Rain garden plants tolerate temporary standing water, and can also tolerate dry weather. The native rain garden plants listed on page 10 have been identified by Blue Water Baltimore as easily obtainable and typically successful in the Baltimore region. This is not an exhaustive list. For more native plant information, see the Resources section. When selecting plants for your landscape, be sure to take into account their mature size height and width as well as recommended planting distances. **To obtain a rebate, perennials must be planted at least 12-18" on center, the plant list must be at least 80% native by number (native cultivars are acceptable) and cannot include any invasive species.**

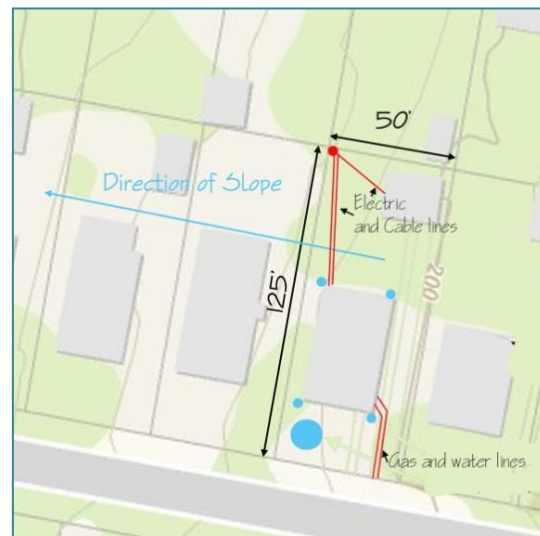
To determine the number of plants, begin by calculating the total number perennials you would need if they were to be the only type of plant in the landscape. You'll need between 1 to 2 plants per square foot. If you're not sure how to do this on your own, use the plant spacing calculator referenced in the Resources section. When including shrubs, you can omit one perennial for each square foot that will be occupied by larger plants. For example, a mature blueberry that is 4' wide will take up about 12 square feet, so subtract 12 perennials from the planting plan. Planting densely may cost more up front, but it will save you many extra hours of weeding and it ensures that the garden will be reducing runoff from day one. For more detailed directions on creating a planting plan, see additional rain garden guides listed in the Resources section at the end of this document.

You will need to generate several drawings to depict your rain garden when you complete the **Project Approval Form**. Directions for how to generate each of these images are available in the rain garden manuals listed in the Resources section.

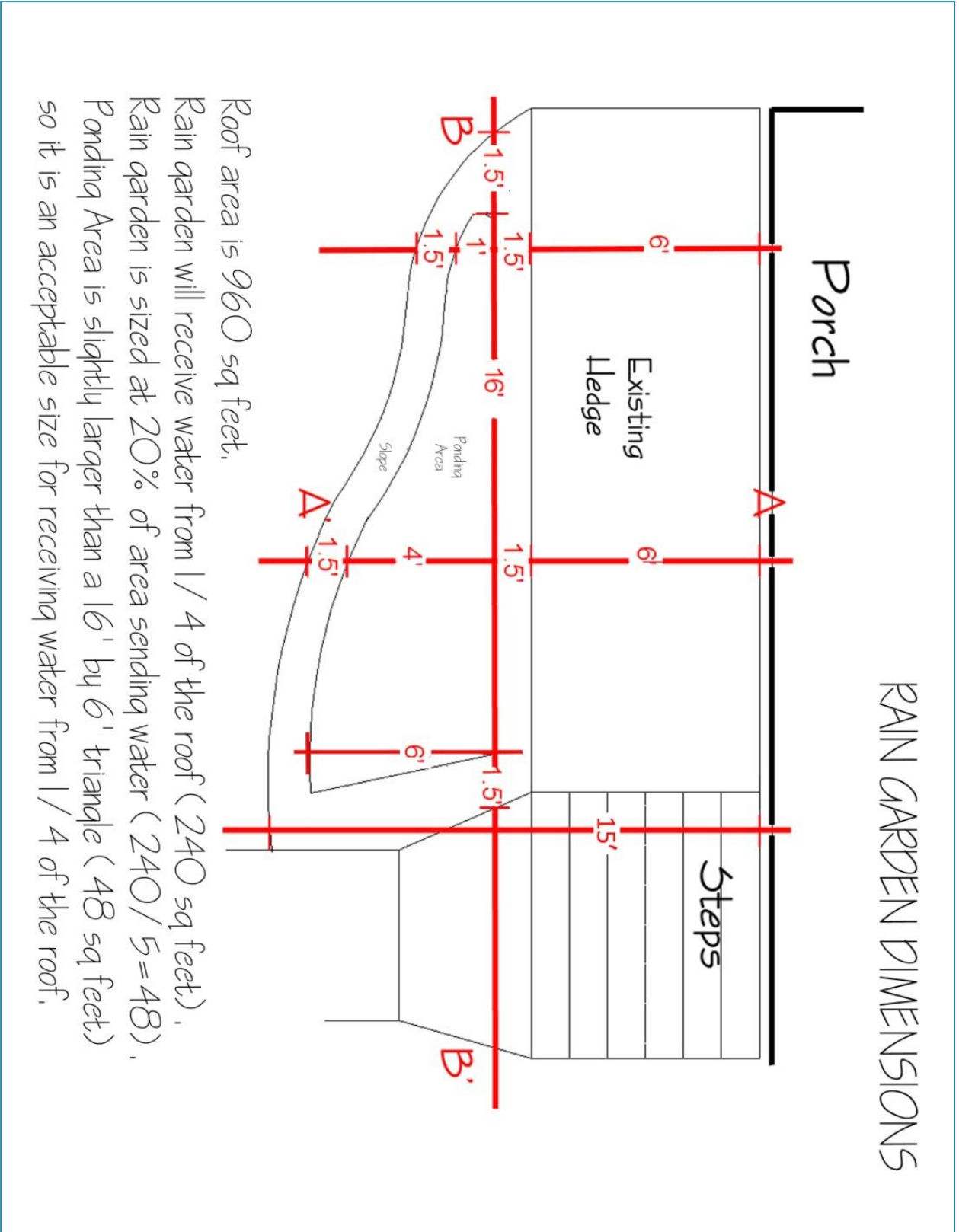
- Rain garden location, property size, and utilities (see images directly below)
- Garden dimensions
- Cross section
- Planting plan



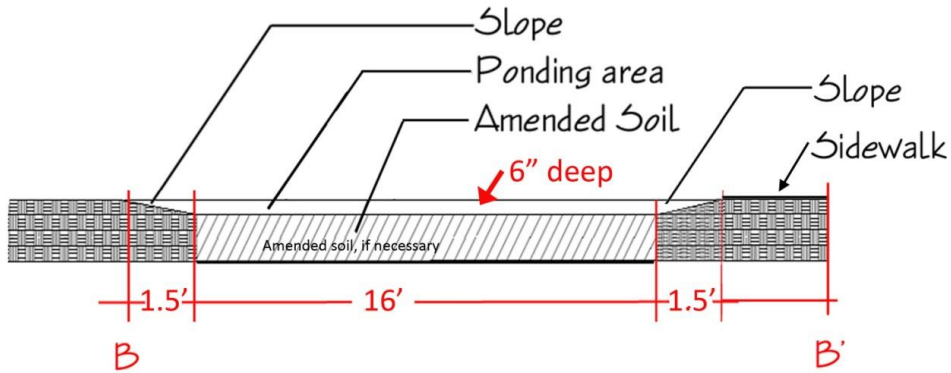
An image of the property marking downspout, the proposed rain garden and lot dimensions



An image of the property indicating locations of utilities



CROSS SECTION SHOWING SLOPE

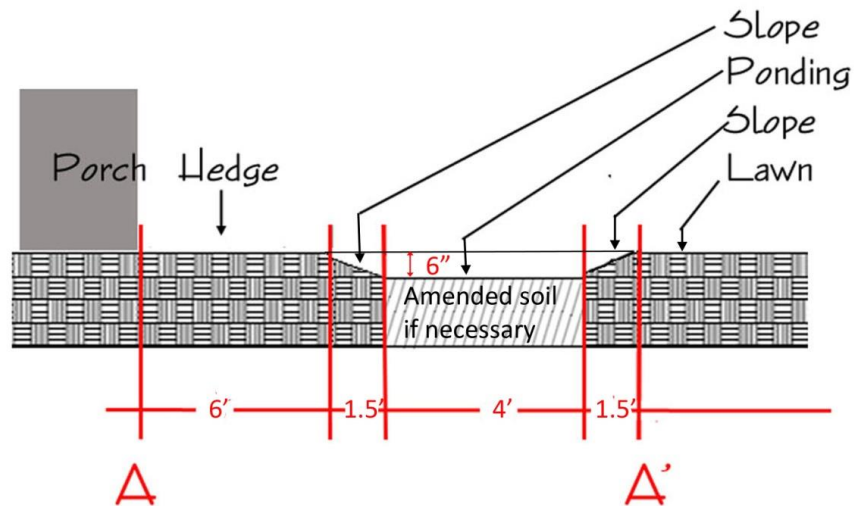


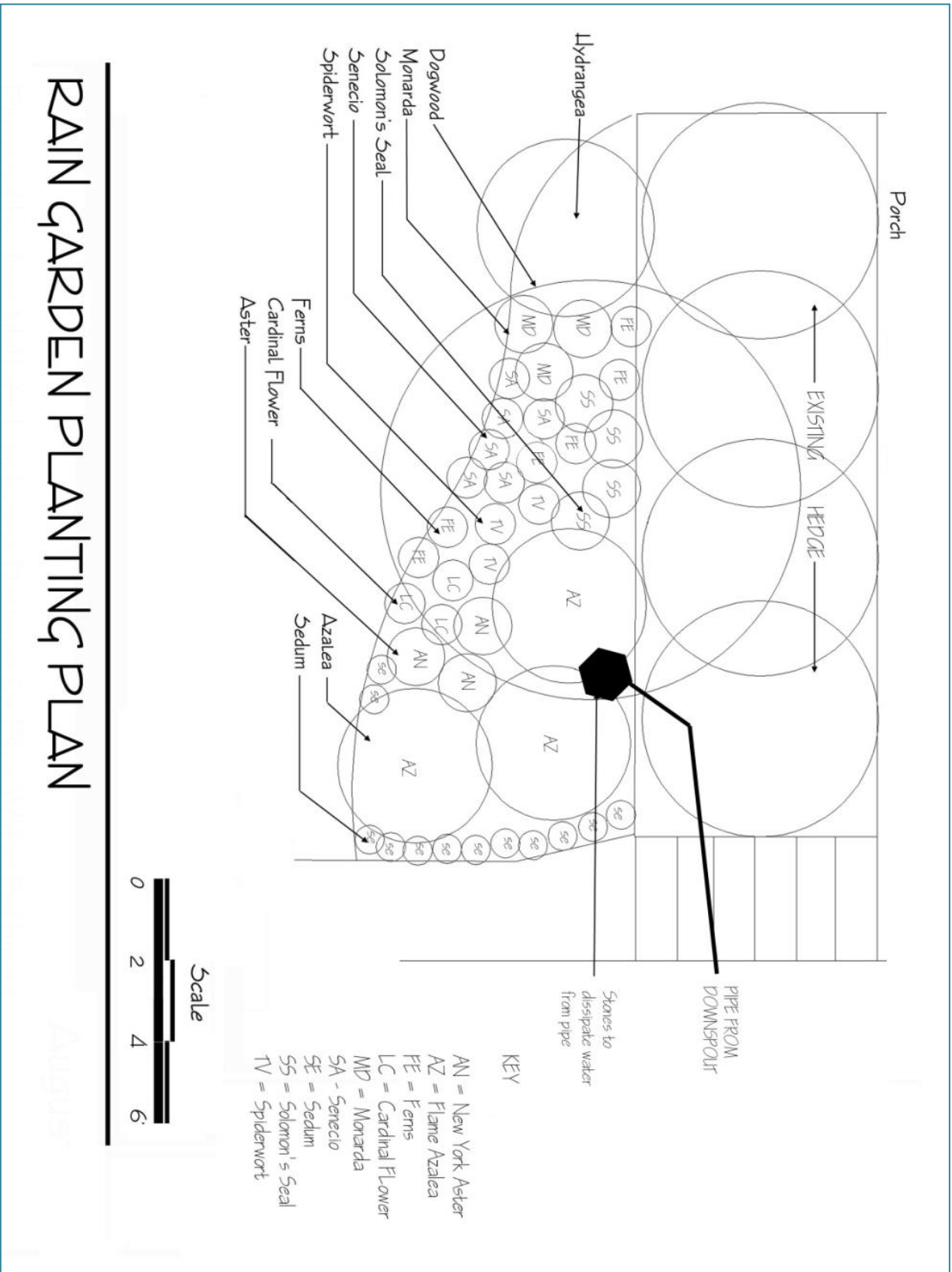
NOTE: Ponding area to be six inches lower than existing level.
Amend soil to 18 inches if necessary.

SLOPE: CHANGE IN DEPTH DIVIDED BY CHANGE IN DISTANCE EQUALS SLOPE

$$6/18 = .33 (= 1/3) \text{ Acceptable}$$

RAIN GARDEN CROSS SECTION





Rain Gardens For Healthy Streams



Site Conditions	Perennials	Shrubs & Trees
<p style="text-align: center;">Sun to Partial Sun (at least 6 hours of direct sunlight per day)</p>	<p><i>Asclepias incarnata</i> Swamp milkweed</p> <p><i>Asclepias tuberosa</i> Butterflyweed</p> <p><i>Aster novae-angliae</i> New England Aster</p> <p><i>Chelone glabra</i> turtlehead</p> <p><i>Eupatorium perfoliatum</i> Boneset</p> <p><i>Iris versicolor</i> Blue flag</p> <p><i>Juncus effusus</i> Common rush</p> <p><i>Liatris spicata</i> Gayfeather</p> <p><i>Lobelia siphilitica</i> Great blue lobelia</p> <p><i>Monarda didyma</i> Beebalm</p> <p><i>Panicum virgatum</i> Switchgrass</p> <p><i>Senecio aureus</i> Golden ragwort</p> <p><i>Solidago rugosa</i> Rough-stemmed goldenrod</p>	<p><i>Betula nigra</i> River birch</p> <p><i>Callicarpa americana</i> American beautyberry</p> <p><i>Cephalanthus occidentalis</i> Buttonbush</p> <p><i>Clethra alnifolia</i> Sweet pepperbush</p> <p><i>Cornus stolonifera</i> Red twig dogwood</p> <p><i>Hypericum densiflorum</i> Dense St. John's wort</p> <p><i>Itea virginica</i> Virginia sweetspire</p> <p><i>Ilex verticillata</i> Winterberry holly</p> <p><i>Magnolia virginiana</i> Sweetbay magnolia</p> <p><i>Photinia melanocarpa</i> Black chokeberry</p> <p><i>Physocarpus opulifolius</i> Ninebark</p> <p><i>Rhododendron viscosum</i> Swamp azalea</p> <p><i>Vaccinium corymbosum</i> Highbush blueberry</p>
<p style="text-align: center;">Shade to Partial Shade (less than 6 hours of direct sunlight per day)</p>	<p><i>Asarum canadense</i> Wild Ginger</p> <p><i>Conoclinium coelestinum</i> Mistflower</p> <p><i>Lobelia siphilitica</i> Great blue lobelia</p> <p><i>Osmunda cinnamomea</i> Cinnamon fern</p> <p><i>Osmunda regalis</i> Royal fern</p> <p><i>Polemonium reptans</i> Jacob's Ladder</p> <p><i>Tiarella cordifolia</i> Foam flower</p> <p><i>Tradescantia virginiana</i> Spiderwort</p>	<p><i>Cephalanthus occidentalis</i> Buttonbush</p> <p><i>Itea virginica</i> Virginia sweetspire</p> <p><i>Ilex verticillata</i> Winterberry holly</p> <p><i>Lindera benzoin</i> Spicebush</p> <p><i>Magnolia virginiana</i> Sweetbay magnolia</p> <p><i>Viburnum dentatum</i> Southern arrowwood</p>

Establishing & Maintaining Your Garden

In this section you will find basic information for taking care of your rain garden. For a more thorough set of rain garden maintenance directions, download Blue Water Baltimore's *Rain Garden Routine Maintenance* document from www.bluewaterbaltimore.org/water-audit-resource/.

Avoid compaction

Soil compaction occurs when heavy objects, machinery, and people compress the soil, creating an impervious layer of soil which water and plant roots cannot easily penetrate. Avoid compaction to give your plants' roots the greatest chance to grow deep into the soil and to maximize the amount of rain absorbed by your soil. Tips for avoiding compaction:

1. When installing your garden, place long, 6-8" wide boards across the garden to distribute your weight as you work; and
2. Place stepping stones strategically throughout your rain garden to prevent your soil from becoming compacted when you need to go into the garden to weed or replace mulch.

Irrigation

Irrigate deeply immediately after planting and mulching your new rain garden. Typically, 30 minutes of watering is sufficient, however the time needed may depend on your water pressure and the size of the area you are irrigating. Periodically check the soil moisture below the mulch layer. The ideal depth of moisture is to 4".

During the first year or two, between April and October, water your garden approximately once or twice a week during dry periods. When precipitation is less than an inch a week, consider irrigating. You should continue to check the moisture of the soil at around 4". If the soils are moist, you do not need to irrigate. The ideal time to irrigate is early morning, between 5:00 and 7:00 am. Watering at this time of day minimizes loss to evaporation and reduces the likelihood that your plants will suffer from mold and fungus which thrive in cool moist environments. After 1-2 years, once plants are established, you will only need to irrigate during extremely dry or hot periods of weather.

Mulching & Fertilizing

The mulch layer in your rain garden serves three purposes. The first is to prevent weeds. The second is to retain moisture between rain events. The third is to filter sediment and other pollutants out of the water that is entering the garden. It is for this third reason that you will need to be diligent about maintaining your mulch layer. In large gardens, the mulch may need to be changed each year. This is because the mulch layer is the first filtration mechanism and will become clogged quickly if parking lot or road runoff is draining to the garden. In residential gardens, the mulch does not need to be changed this often, but you will need to check the mulch layer for thin spots or where it's been washed away. In these spots, add new mulch.

To obtain a rebate, you must mulch a finished rain garden with 2-3" of aged shredded hardwood mulch. Remember not to mound or leave the mulch adjacent to the base of plants.

In an undisturbed ecosystem, nature provides a constant supply of mulch and fertilizer in the form of leaves and fallen branches. Therefore, it is best to leave leaf litter and stems where they fall in your landscape. The

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decomposition of these materials adds nutrients and organic content to the soil. Leaf litter also serves as a blanket for the soil and plants during the winter, protecting them from harsh weather and fluctuating temperatures. If the soils were replaced and compost was in the soil mix, it will serve as a nutrient base for the new garden.

In many cases, if a plant appears to be under stress it will likely be harmed – not helped – by fertilization. Organic matter and nutrients are good for plants, but they are also primary culprits in the degradation of our streams and the Chesapeake Bay. Since your rain garden is designed to capture water that is nutrient rich, you should never need to fertilize. Before applying any fertilizer to any landscape, including lawns, Blue Water Baltimore suggests that homeowners test their soil for nutrient levels and/or consult with a gardening professional. More information on soil testing can be found in the Resources section.

Plant Substitutes and Additions

As your rain garden matures, you may identify areas that would benefit from the addition of an existing or a different species of plant. Many native plants can be propagated by splitting the root mass. If you move, add, or transplant your plants, be sure to do this during the spring or the fall, followed by generous watering.

Weeding

Like any landscaping, a rain garden needs to be weeded periodically, especially during the first two years while your plants are getting established. Over time your plants will grow and spread, shading out the weeds. Mark your plants if you are not familiar with them to avoid accidentally pulling them out. It may add time and cost to plant more densely when your project is installed, but more densely planted landscapes will shade and out-compete weeds sooner, minimizing the need for extra work on your part in years to come.

A residential rain garden in Baltimore, Maryland



Before installation



During installation phase



After a winter rain event



During the growing season

Glossary

BMP- Best Management Practice; A method, process or technique which is most effective in achieving an outcome

Berm- A constructed barrier of earth

Contributing Drainage Area (CDA)- An area that provides flow that will discharge to a certain point of interest (to a downspout, into a rain garden, etc.)

Conveyance- A means of transport or flow; Conveyance systems can be natural (streams, rivers and wetlands) or constructed (downspouts, pipes and channels)

Grade- The slope, expressed as vertical rise over horizontal run

Infiltration- Absorption or passage of liquid through a filtering medium (such as soil)

Invasive Species- A plant or animal that is non-native or alien to the ecosystem and whose introduction causes harm to environmental and human health

Impervious- Unable to let water pass; Impervious surfaces include driveways, parking pads, and sidewalks

Mulch- Covering an area of ground to prevent erosions and weeds; Mulch provides insulation for soil and plants

Native Plant- A plant that has developed over hundreds or thousands of years in a balanced and natural ecosystem; Many plants grow naturally throughout the Chesapeake Bay Watershed and are considered native to Maryland's Coastal Plain and Piedmont regions

Overland Drainage- Water flowing over the surface of the ground due to saturation (soil is unable to absorb any more water) or the presence of impervious surface

Percolation- The movement of fluids through a porous material or filter; In geography, percolation is filtration of water through soil and permeable rocks to underground water table

Perennial - A plant that may die back during winter months, but returns year after year

Pervious- Able to let water pass through; Pervious surfaces include landscaping, gardens and turf

Ponding- Refers to the volume of storage above the ground created by a rain garden. Typical ponding depth for a residential rain garden is 6"

Soil Compaction- Occurs when soil particles are pressed together, reducing the ability to absorb water

Stormwater- The water that runs off of impervious surfaces such as rooftops and roadways

Swale- A shallow ditch in landscape to convey water

Top-dressing- The application of one inch or less of soil amendment to the surface of the ground where it will be slowly incorporated into the existing soils by the actions of invertebrates such as earthworms

Rain Gardens For Healthy Streams



Resources

Rain Garden Manuals & Resources

Low Impact Development Center

http://www.lowimpactdevelopment.org/raingarden_design/plant_lists.htm

Maryland Stormwater Design Manual

Maryland Department of the Environment
<http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/Pages/Programs/WaterPrograms/SedimentandStormwater/swm2007.aspx>

Rain Garden Alliance

<http://raingardenalliance.org/>

Rain Garden Design and Construction: A Northern Virginia Homeowner's Guide

Fairfax County, Virginia
<http://www.fairfaxcounty.gov/nvswcd/raingardenbk.pdf>

Rain Gardens: A Design Guide

University of Connecticut
<http://nemo.uconn.edu/raingardens/>

RainScapes Rain Gardens

Montgomery County, Maryland's Department of Environmental Protection
<http://www.montgomerycountymd.gov/content/dep/downloads/MocoRainGardens.pdf>

Plant Resources

Lady Bird Johnson Wildflower Center and Native Plant Database

www.wildflower.org

Native Plants for Wildlife Habitat and Conservation Landscaping: Chesapeake Bay Watershed

U.S. Fish & Wildlife Service
<http://www.nps.gov/plants/pubs/chesapeake/>

'Send-a-Question'

The University of Maryland Extension Service's Home and Garden Information get expert answers to all your gardening questions

<http://www.hgic.umd.edu/index.cfm>

Soil and Soil Amendment Resources

Natural Resources Conservation Service

<http://soils.usda.gov/technical/classification/>

Natural Resources Conservation Service

<http://soils.usda.gov/>

Urban Hydrology for Small Watersheds

Engineering Division of the Natural Resource Conservation Service

<http://www.cpesec.org/reference/tr55.pdf>

United States Forest Service

<http://www.fs.fed.us/t-d/pubs/htmlpubs/htm06232815/page04.htm>

<http://pubs.ext.vt.edu/426/426-724/426-724.html>

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<http://www.hgic.umd.edu/content/soil.cfm>

http://www.hgic.umd.edu/content/documents/hg42_002.pdf