

StormwaterWise Landscapes: Rain Garden Specification

Purpose & Benefits

- Stormwater runoff reduction
- High pollutant removal
- Pollinator habitat
- Attractive landscaping feature

Description

A rain garden is a shallow landscaped depression that receives runoff from surrounding rooftops, driveways, or yard areas. Compared with traditional landscaping, which is usually raised a few inches above the surrounding landscape, rain gardens are graded as shallow depressions that accumulate runoff from surrounding areas. A rain garden simulates the runoff treatment provided by natural areas, such as forests or meadows (but of course, should not replace existing wooded areas). The primary component of a rain garden is the filter bed, which can consist of the existing soil (if it percolates well) or an assembled mixture of sand, soil, and organic material, topped with a surface mulch layer and native plants.

What to Expect

During storms, runoff temporarily ponds up to 6 inches above the mulch layer and then filters through the bed within 1 to 2 days (this is not enough time for mosquitoes to breed). Native plants in a rain garden must withstand both dry and wet conditions and may need to be thinned and/or replanted over time. Weeds will need to be removed by hand.

Note: Rain gardens often require minor inlet and outlet adjustments to avoid erosion issues. Rain gardens should be monitored closely after the first few storms and adjusted as needed.



1. Submittals

The following items must be submitted to the Arlington County StormwaterWise program as part of a rain garden implementation project.

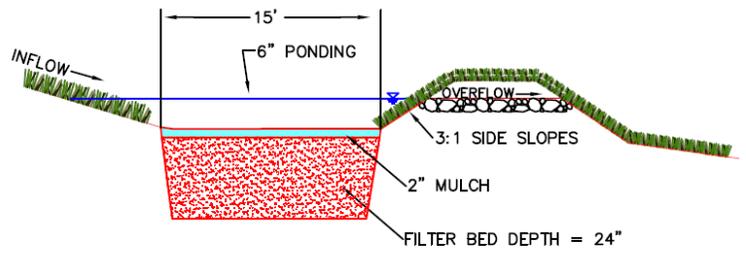
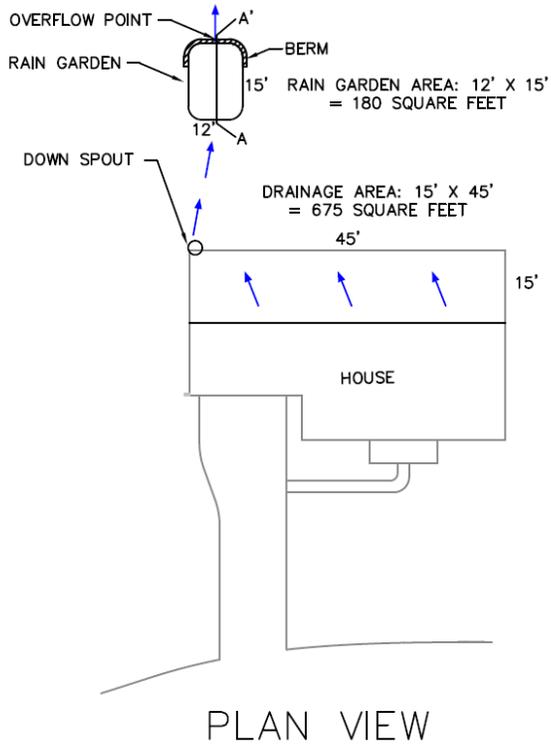
Pre-Construction:

- Contractor name
- Infiltration test results (See specification below)
- Plan of the site, depicting:
 - The dimensions and area of the rain garden;
 - The dimensions and area of the contributing impervious drainage area,
 - Water inflow information - Location, material, and how energy is dissipated [if applicable]
 - Water outlet/overflow path – Location, material, and how energy is dissipated [if applicable] (see example below).
- Cross Section of the rain garden, including layer types and depths (see example below)
- Treatment volume sizing calculation
- Planting Plan - Plant list and planting plan (with Latin names). Include the number of plants of each species to be installed. (Note: Any modifications to an approved planting plan due to lack of plant availability or cost must be re-submitted to the County representative for approval prior to installation.)
- Type of soil amendment (i.e., LeafGro, SoilMate)

Post-Construction:

- Photograph documentation of excavated rain garden area, prior to adding filter bed soil or amendments, including a tape measure documenting the depth of excavation
- Photograph documentation of tilling for rain gardens that do not require replacement of the soils with a pre-made filter bed soil
- Photograph documentation of the completed rain garden, including inlets and outlet/overflow path

Example Plan View and Cross Section Submittal



CROSS SECTION A-A'

2. Materials

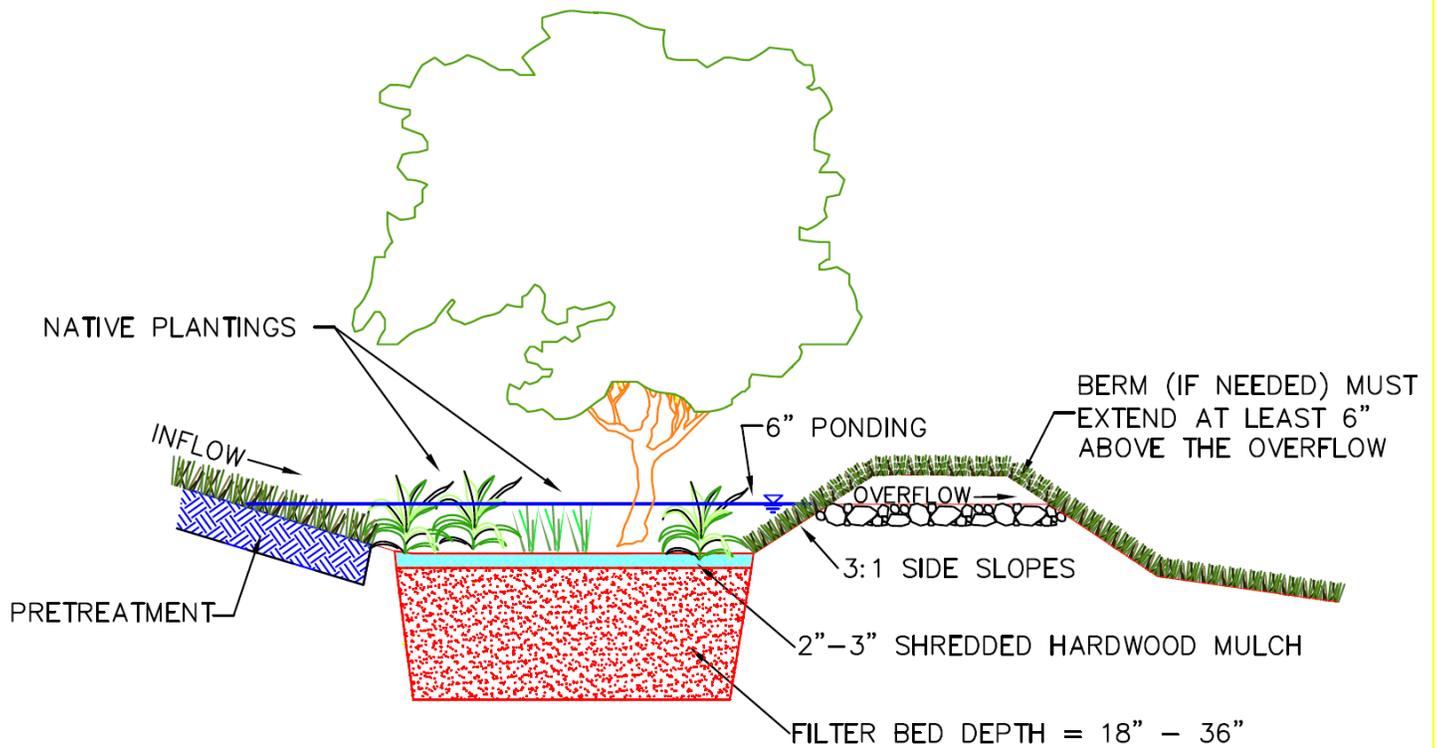


Figure 1. Typical Rain Garden Cross Section (N.T.S.). Cross section is depicted at the point where the overflow cuts through the berm.

Table 1 includes a list of materials needed to install a rain garden.

Table 1. Material Specifications for rain gardens

Material	Specifications	Size	Depth	Notes
Mulch	Double-shredded hardwood or approved pine straw substitute	N/A	2 – 3 inches	Aged minimum of 6 months
Cobble/Stone	Washed river rock, large gravel, or small rip-rap	3 - 5 inch diameter stone	1 or 2 layers deep	Use at downspouts, inlets, outlets, and along hardscape edges as needed to dissipate flow and prevent soil erosion Use filter fabric under stone
Compost <i>(if not replacing the soil)</i>	The material should be well composted and free of viable weed seeds Fresh manure should not be used because of its high bacteria and nutrient levels	N/A	Add 2 inches of compost across rain garden surface area and incorporate into top 6 inches of soil	Follow recommendations from soil test if compost amendments are suggested
Filter bed soil mix <i>(if replacing the soil)</i>	Bioretention soil mix from an approved Arlington County vendor OR mixture of approximately: <ul style="list-style-type: none"> • 80% - 90% sand • 10% - 20% topsoil • 3% - 5% organic matter (compost) 	N/A	18 – 36 inches	Plan for a volume of soil based on 110% of the design volume, to account for settling or compaction.

Note: Filter fabric is not necessary below the filter bed soil, and should not be used. Direct contact between the filter bed soil and the existing soil provides the best opportunity for drainage.

3. Location, Feasibility, and Design

The following must be considered when installing a rain garden:

Topography - A rain garden needs to be located in a low spot where stormwater runoff from the surrounding landscape and/or rooftops can drain to it. For the footprint of the rain garden itself, look for a relatively flat area, as the basin of the rain garden should be as flat as possible. Rain gardens may not be constructed on slopes steeper than 15 percent.

Setbacks - To avoid the risk of seepage into basements, do not install rain gardens adjacent to building foundations. Rain gardens must be located at least 10 feet away from a building foundation if it is down-gradient from the building. Rain gardens must be located 50 feet away if will be located up-gradient from the building. These setback requirements can be relaxed if an impermeable liner is installed along the sides and bottom of the rain garden wherever the setback distance is infringed upon.

Rain gardens must be set back at least 10 feet from the property line of a down-gradient property and 5 feet from the property line of an up-gradient property.

Proximity to Utilities – Always call Miss Utility before digging. Interference with underground utilities should be avoided whenever possible, particularly water, sewer, and gas lines. Excavation should be done very carefully to avoid damaging marked utilities. Also, be aware that Miss Utility may not always mark private cable, propane, electric, and similar lines, so some additional site work may be necessary to locate these.

Proximity to Trees – Ideally, rain gardens should not be placed within the dripline of a tree because the digging of the rain garden may damage the tree roots. If tree branches extend over the proposed rain garden, an arborist must be consulted to ensure that the required excavation will not harm the tree.

Rain Garden Size – The minimum size for a StormwaterWise rain garden is 100 square feet for a residential project, 150 square feet for an HOA project. As a very general rule, the rain garden surface area (not counting side slopes leading down to the flat basin) should be approximately 80 square feet for every 1,000 square feet of impervious area draining to the rain garden. This assumes a soil filter bed depth of 2 feet and 6 inches of ponding on the surface. This sizing allows the rain garden to capture the runoff generated by the first 1 inch of rainfall from the drainage area.

Soil Texture and Infiltration Test – The rate at which the existing soil at the proposed rain garden site percolates will have a significant impact on the design. Soils that already have good infiltration rates can be used in the rain garden, with added soil amendments, whereas, soils that have very slow infiltration rates will need to be replaced with a sandy loam soil mix. The minimum infiltration rate needed for a rain garden is ½ inch per hour. The infiltration test should measure the infiltration rate at the bottom of the rain garden to ensure that the water will be able to drain out of the amended soil area within a reasonable amount of time. Otherwise, the area where the amended and non-infiltrating soil meet will become anaerobic (lacking oxygen).

- If existing soils percolate/infiltrate well (greater than 1 inch per hour), the existing soils can be used as the filter bed, although it is recommended that soil amendments be added.
- If the existing soils infiltrate at a rate between 0.5 and 1 inch per hour, a pre-made rain garden soil mix should be used to replace the existing soil for the filter bed.
- If the existing soils infiltrate at a rate below 0.5 inches per hour, an underdrain will be necessary. Underdrained rain garden designs may be approved on a case-by-case basis. Contact the Arlington County StormwaterWise program for more information.

Instructions for conducting a soil infiltration test are available on the StormwaterWise Landscapes web site (<http://arlingtonva.s3.amazonaws.com/wp-content/uploads/sites/13/2013/10/Soil-Test.pdf>).

Filter Bed Soil – Where the existing soil needs to be replaced due to low infiltration rates, make sure to use a suitable filter bed soil mix at an appropriate depth. The soil should be a uniform mix, free of stones, stumps, roots, or other similar objects larger than two inches. The soil mix should also be free of invasive plants and noxious weeds. Several vendors approved by Arlington County area available:

- Harvest Power, contact Dave Lundberg at 410-970-5022
- JK Enterprises, 540-428-3094
- Luck Ecosystems contact Muriel Robertson at 804-476-6513 or MRobertson@luckecosystems.com
- M&J Organics, contact Anthea Laporte at 571-830-5826
- Quail Ridge Products, contact K.C. Stottlar at 703-268-1552 or quailridgesales@gmail.com

- Virginia Groundcovers, 703-450-4758 or info@vagroundcovers.com

Ponding – The rain garden must accommodate 6” of ponding depth above the mulch layer. Creating this ponding depth may require construction of a small berm if the rain garden is constructed on a sloped site.

Sizing – The total volume captured and treated by a rain garden is calculated as follows:

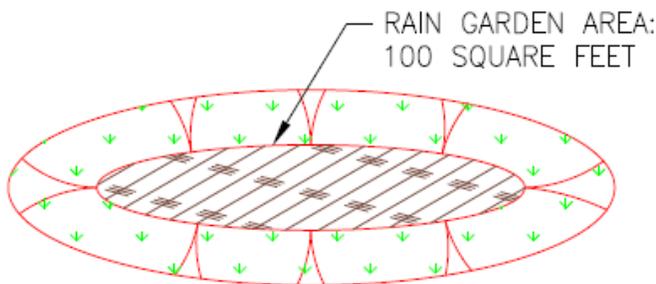
$$Tv = A_{rg} \times [d_{ponding} + (d_{filter\ bed} \times 0.25)]$$

where:

Tv	=	treatment volume for the rain garden (cubic feet)
A_{rg}	=	surface area of the rain garden (square feet)
$d_{ponding}$	=	average depth of ponding in the rain garden (feet)
$d_{filter\ bed}$	=	depth of filter bed (feet)

Example Calculation

The proposed rain garden here has a surface area of 100 square feet, with a ponding depth of 0.5 feet and a filter bed depth of 1.5 feet.



$$Tv = A_{rg} \times [d_{ponding} + (d_{filter\ bed} \times 0.25)]$$

$$Tv = 100 \times [0.5 + (1.5 \times 0.25)]$$

$$Tv = 87.5 \text{ cubic feet}$$

Side Slopes – Slopes extending from the existing grade to the surface of the rain garden must be no steeper than 1 foot of vertical drop for every 3 horizontal feet, referred to as a 3:1 slope.

Excess Soil - Plan for a place to dispose of or use excess dirt when the rain garden is excavated. Some of the soil may be used to make a berm on the lower edge of the rain garden, but there will likely still be leftover soil. If some of the excavated soil is used on the lot, make sure to add some topsoil, as that will help grass or other vegetation to establish.

Pre-Treatment – Pre-treatment refers to a device that will remove leaves, grit from the roof, and larger particles of dirt from the runoff before it enters the rain garden, helping to keep the rain garden from clogging. Pre-treatment can consist of gutter leaf screens (for rain gardens that treat roof runoff), a filter strip, which is a strip of grass about 5 feet wide around the rain garden, or a stone and/or a shallow grass channel that leads into the rain garden. Some form of pre-treatment must be included for every rain garden.

Inlets - Ideally, runoff water should enter the rain garden as sheet flow. However, inlets with concentrated flow (e.g., from a downspout or uphill area where water becomes more concentrated), are common. It may be necessary to incorporate a pad of cobble stone to reduce flow velocity (energy) at these inlets to the rain garden.

Overflow – When the rain garden fills up during large rain events, it will need to have a place to safely overflow without causing erosion, damage to building foundations, or water problems for a neighboring property. The height of the overflow spillway must be set at the level of the maximum water ponding depth. The spillway can be made of compacted soil topped with filter fabric and cobble stone, or similar material.

Berms – Where topography allows, it may be possible to rain garden by constructing a berm to create the necessary depth, rather than excavating the entire depth. In these cases, it is very important that the berm be constructed properly to retain water. First, all vegetation must be cleared away before the berm is constructed (it cannot be placed on top of existing turf – the decaying turf will create a route for water flow, which will eventually erode the berm). The berm should then be constructed with high-clay-content soil (sandy soil will not hold water back). The berm soil should be compacted in 6-inch layers with a vibratory plate compactor to ensure compaction. The completed berm should be at least 6” higher than the overflow point to ensure that runoff does not bypass the overflow spillway. Finally, sod should be planted on the berm and side slopes to provide immediate vegetative stabilization.

Erosion Control – Rain gardens must be kept “off-line” during construction. This means that the inlet must be blocked (or not constructed) until construction of the rain garden is complete. In addition, depending on the size of the installation, anticipated weather, and number of days needed for installation, it may be advisable to place silt fence downhill from the rain garden excavation and/or stockpiles of excavated material. Stockpiles can also be covered temporarily with a tarp. Take all precautions necessary to not contribute sediment to downhill storm drainage systems and waterways.

4. Plants

Plants should be specified for different areas of the rain garden, as the bottom of the rain garden will be wetter than the side slopes or upper edges. Plants in the bottom of a rain garden must tolerate both periodic inundation and very dry conditions. The slopes and especially the upper edges of a rain garden are inundated rarely, so plants that can tolerate drier conditions should be specified for this zone. The use of seeds to plant the rain garden is not acceptable. The StormwaterWise program is only able to reimburse for native plants.

Native trees can be planted at the perimeter of the rain garden. Prior to purchasing and planting new trees, research the tree and learn its ultimate mature size and characteristics. Native species that are generally well-suited to rain gardens include:

- *Betula nigra*—River Birch
- *Carpinus carolinia*—American Hornbeam
- *Magnolia virginiana*—Sweetbay Magnolia
- *Nyssa sylvatica*—Black Gum
- *Quercus bicolor*—Swamp White Oak
- *Acer rubrum*—Red Maple
- *Amelanchier laevis*—Allegheny Serviceberry

Native shrubs provide erosion control and absorb a lot of water. Consider the color of the leaves and flowers when selecting shrubs. Native species that are generally well-suited to rain gardens include:

- *Aronia abutilifolia*—Red Chokeberry
- *Aronia melanocarpa*—Black Chokeberry
- *Calycanthus floridus*—Sweetshrub
- *Cornus amomum*—Silky Dogwood
- *Ilex verticillata*—Winterberry
- *Itea virginica*—Virginia Sweetspire
- *Sambucus canadensis*—Elderberry
- *Vaccinium corymbosum*—Highbush Blueberry

Ferns, grasses, and perennials provide seeds and nectar for wildlife throughout the year. Native species that are generally well-suited to rain gardens include:

- *Asclepias tuberosa*—Butterflyweed
- *Coreopsis tripteris*—Tall Tickseed
- *Echinacea purpurea*—Purple Coneflower
- *Eupatorium fistulosum*—Joe Pye Weed
- *Heliopsis helianthoides*—Ox-eye Sunflower
- *Hibiscus moscheutos*—Marsh Mallow
- *Iris versicolor*—Blue Flag
- *Monarda fistulosa*—Wild Bergamot
- *Monarda didyma*—Beebalm
- *Osmunda regalis*—Royal Fern
- *Osmunda cinnamomea*—Cinnamon Fern
- *Phlox maculata*—Phlox
- *Physostegia virginiana*—Obedient Plant
- *Rudbeckia fulgida*—Black-eyed Susan
- *Verbena hastata*—Blue Vervain
- *Vernonia noveboracensis*—Ironweed

For a more extensive list of rain garden plant options, see Appendix B of *Rain Garden Design and Construction: A Northern Virginia Homeowner's Guide*: <http://www.fairfaxcounty.gov/nvswcd/raingardenbk.pdf>

5. Construction

Step 1 – Call Miss Utility - Call Miss Utility before any excavation and also check for private cable, propane, electric, and other lines. Make sure to have a plan and phone numbers of who to call in case there is any damage to utilities.

Step 2 - Outline the Garden: Mark the boundaries of the rain garden excavation area. Confirm the flow of water into the rain garden, checking the areas that are to contribute runoff to the practice. This may require using a survey level or hand level and a survey rod to check spot elevations and confirm flow paths.

Step 3 – Erosion Control: It is best to dig the rain garden when the weather is expected to be dry for several days. Install a row of silt fence below the construction site in case of rain. Cover stockpiles of soil temporarily with a tarp to prevent the material washing away.

Step 4 - Dig Basin – Elevations are Key: Excavate the rain garden area and side slopes. The rain garden surface area should be as flat as possible while side slopes can be no steeper than 3:1. In order to not compact the soil, ensure that heavy equipment works from the sides to excavate the rain garden to the depth and dimensions specified in the design.

The outlet or overflow should be set at the maximum ponding elevation and slope downward away from the basin, with the flow path unobstructed. If a berm is utilized to create the required ponding depth, the berm should be thoroughly compacted so it does not fail when it gets saturated. If the site soils are very loose or sandy, this may require some clay to be added.

The bottom of the excavation should be as deep as necessary to account for the component layers included in the design. Working downward from the top, these include ponding depth, mulch, and soil filter bed as necessary. For example:

- 6 inches ponding +
- 2 inches mulch +
- 18 inches soil =
- 26 inches deep, below the surface elevation.

If the existing soil has good infiltration for the rain garden, the excavation need not be as deep. In these cases, the installer should excavate to 2” below the bottom of the mulch layer (10” in the example above), to prepare for the addition of 2” of compost.

Step 5 – Add Compost Amendment (if applicable): If filter bed soil mix is not required, add 2” of compost to amend the existing soils.

Step 6 - Till Bottom of Basin: Till the bottom soils to a depth of 6” to promote greater infiltration and incorporate the compost amendment, if applicable. Ensure that the bottom is as level as possible.

Step 7 – Spread Filter Bed Soil Mix: Place the soil mix directly into the bottom of the excavation. Place the soil mix until the desired top elevation of the rain garden is achieved (accounting for 2” – 3” of mulch). Water the soil mix well with a hose to allow it to settle. Wait a few days to check for more settling, and add additional soil as needed.

Step 8 – Install Plants and Mulch: Prepare holes for trees and shrubs on rain garden basin surface, install vegetation, and water accordingly. Plant trees and shrubs after they go dormant in the late fall, if possible.

Avoid trees and shrubs on the berm, if it is present. Install any temporary irrigation. Place the mulch around the plants, as per the design. Water plants during weeks of no rain for at least the first two to three months.

Step 9 – Install Inlet: Install any pre-treatment features associated with the plan, such as a stone pad at the mouth of downspouts.

Step 10 – Restore Disturbed Area: Seed and straw or sod all side slopes, berms, and disturbed areas outside the rain garden area. Aside from the berm, these areas may also be planted with native plants.

Step 11 – Inspect: Inspect the rain garden after several rain events to look for any needed adjustments: ensure that runoff is entering the rain garden properly, the garden is draining properly, there is no erosion at inlets and outlets, and plants are surviving. Remove silt fence once the site is sufficiently vegetated and stable.

6. Maintenance

The following maintenance should be performed to keep pervious pavement functioning properly:

- During the first few months, water new plants to ensure establishment.
- In the spring or fall, replace dead plants or divide plants that have exceeded their allotted space.
- Once a year, add mulch to nourish the plants and minimize the growth of weeds.
- Do not add chemical fertilizers, herbicides, or pesticides.
- Remove any weeds by hand pulling.
- Check for signs of erosion near the inflow and outflow and address as needed by adding cobble or gravel.
- Remove accumulated sediment and debris as needed.

7. Resources

Arlington County, VA. 2016. *Stormwater Manual: A Guide to Stormwater Requirements for Land Disturbing Activities in Arlington County*. Available at: <http://topics.arlingtonva.us/building/stormwater-management-ordinance/>

Chesapeake Conservation Network. 2013. *Homeowner Guide for a More Bay-Friendly Property, Appendix C, List of Plant Resources*. Available at: <http://chesapeakestormwater.net/download/3859/>

[Northern Virginia Soil and Water Conservation District. *Rain Garden Design and Construction: A Northern Virginia Homeowner's Guide*. Fairfax, VA. Available at: http://www.fairfaxcounty.gov/nvswcd/raingardenbk.pdf](http://www.fairfaxcounty.gov/nvswcd/raingardenbk.pdf)

Virginia Department of Environmental Quality. 2013. *Virginia Stormwater BMP Specifications – Rev. 2013 (DRAFT)*. Richmond, VA. Available at: <http://www.deq.virginia.gov/Programs/Water/StormwaterManagement/Publications.aspx>