Greenville County

Green Infrastructure for Single Family Residences

Greenville County, SC
Stormwater Guidelines

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INTRODUCTION

Background and Purpose

Land development permanently alters the way in which stormwater flows across a site due to grading, compaction, and the installation of impervious cover. Water quality control is intended to reduce the impacts of development on the quality of the receiving water bodies after construction is complete. Because Greenville County's Phase I MS4 permit requires the County to support a post-construction permitting program, the County's requirements supersede statewide post-construction water quality requirements.

The purpose of these Green Infrastructure for Single Family Residences (SFR) Guidelines is to provide guidance for selecting and installing the appropriate stormwater management measures when constructing a home. These guidelines employ simplified design standards that are more applicable to the homeowner/builder experience, thus avoiding the need for complex engineering calculations and analysis. **These guidelines are intended for use for lots created through the minor subdivision (zero lot disturbance option) and family subdivision process, as well as single residential lots (not part of a larger common plan).** These guidelines are meant to complement the use of the Greenville County Stormwater Management Design Manual under certain circumstances, but do not replace County stormwater management minimum requirements. Refer to the text below from Chapter 2 of the County Design Manual for scenarios where additional requirements must be addressed.

Stormwater management minimum requirements and standards apply to all land development within unincorporated, non-SCDOT regulated areas of Greenville County and within the municipalities that chose to participate with Greenville County as co-permittees (Simpsonville, Mauldin, Travelers Rest and Fountain Inn) in its NPDES MS4 stormwater permit, that consists of one or more of the following:

- All development and redevelopment that involves the disturbance of one acre of land or greater (or 10,000 square feet or greater for stormwater quality requirements);
- Any commercial or industrial development that falls under the NPDES Industrial Stormwater Permit;
- Development or redevelopment that creates a peak flow increase of greater than one cubic foot per second (cfs) for the critical storm (see Chapter 2);
- Development or redevelopment that requires a storm drain pipe conveyance system (one or more pipes) or alterations to existing storm drain systems;
- and, Development or redevelopment that causes downstream impacts requiring preparation by an engineer or design professional.

Submittal Information

The process for submitting a Green Infrastructure Plan for a SFR site will be an alternative permit option and will include the following steps:

- Contractor/Owner will come in to County Office to meet with a Plan Reviewer. The Reviewer will explain the guidelines and checklist of what is needed for the Plan. The Plan Reviewer will then give the Contractor/Owner direction on next steps for the permitting process.
- Using the Green Infrastructure for SFR Guidelines booklet, the Contractor/Owner will choose appropriate/applicable SFR LID practices to implement on site. The booklet explains each measure and provides guidelines on construction. Once the measures have been chosen, the Contractor/Owner will provide the "tear-out" sheets and supporting attachments that will show the necessary calculations and information for their chosen SFR LID practices.
- The Contractor/Owner will bring these complete "tear out" sheets, GIS aerial print-outs including site topography, and plans showing locations of the house, roof, driveway, other impervious areas, and SFR practices on the lot, back to the Land Development Division so they can be reviewed for approval.
- A pre-construction meeting will be held between the Contractor/Owner and the County's Low Impact Development (LID) Inspector where a pre-construction checklist will be provided and completed. Completion of this checklist allows construction to begin. **The critical moments for**

inspection or photo documentation of underground features, described below, will be discussed during the pre-construction meeting.**

- **For LID practices that are underground or have underground features (e.g. perforated underdrain, Dry Well tank, level spreader trench, required excavation depth for stone subbase, amended soil, or filter media), a call to the County's LID Inspector to inspect is required prior to covering up the underground features. The LID Inspector will either perform an inspection or provide direction on verification pictures to be taken. In general, verification pictures should include a tape measure or other reference for scale, such as a brick of standard dimensions. The LID Inspector must either perform an inspection or provide written approval of verification pictures before underground features are covered up.**
- (CO) can be provided, the Contractor/Owner must provide the final survey (See Appendix C for Water Quality Easement Plat Checklist), maintenance agreement, and 70% permanent stabilization per square yard across the site, and other items outlined in the Green Infrastructure for Single Family Residence Site Plan checklist.
- Submit documentation for CO to Greenville County for review and approval a minimum 2 weeks (14 days) prior to desired date of CO.
- A final inspection and walkthrough of maintenance routines will occur with the homeowner and the County's LID Inspector and Post-Construction Stormwater Inspector.

Frequently Asked Questions

The following section provides, in a question and answer format, information to aid in understanding the SFR Guidelines and when and how they apply.

What types of projects may utilize Single Family Residential (SFR) practices?

The following types of SFR development are required to install stormwater management on site and may utilize the Green Infrastructure for SFR Guidelines:

- Minor Subdivisions applying for Summary Plat Submittal
- Minor Subdivisions applying for Zero Lot Disturbance Option
- Family Subdivisions

Additionally, the following land disturbance criteria must be met for the Green Infrastructure for SFR Guidelines to be applicable:

- Individual lot disturbance must be limited to a maximum of 0.5 acres of disturbance for lots that do not utilize a septic tank.
- Individual lot disturbance must be limited to a maximum of 0.75 acres of disturbance for lots that do utilize a septic tank.
- Common Plan of Development must be limited to less than 2 acres of total disturbance at any time during construction. Note that if total disturbance is 1 acre or more, a DHEC Notice of Intent (NOI) is also required.

What portions of SFR projects require Stormwater Management?

These requirements are intended to capture the main portions of SFR impervious areas.

Impervious cover is defined as *a surface composed of any material that significantly impedes or prevents the natural percolation of water into soil, which includes, but is not limited to, rooftops, buildings, streets and roads, and any gravel, concrete or asphalt surface.* Only the major impervious areas of the property need to be treated. This includes the rooftop of the main structure and garage, parking areas and paved patio areas. It excludes minor out buildings, walkways, small miscellaneous paved areas, and the entry driveway area leading from the road to parking and turn around areas. Minor out buildings and impervious areas are limited to a maximum of 400 square feet. Anything larger is considered major and must be included in SFR water quality calculations.

The area draining to any practice is called the "contributing drainage area" and normally consists of 100% impervious area for SFR stormwater practices, though for rain gardens and filter strips incidental small pervious areas can be included if unavoidable, and the areas are stabilized to eliminate soil erosion.

What are the principles for managing stormwater on SFR developments?

Individual residential lots are not required to provide the same types of stormwater management as major subdivisions or commercial projects; however, certain requirements must be met to ensure that stormwater runoff does not overwhelm stormwater infrastructure, impact water quality in our streams, or impact adjacent property. The key principles for managing stormwater from a SFR lot are:

- Green Infrastructure (GI) (see section below);
- Reliance on infiltration only where the water table or bedrock layer is at least two feet below the bottom of the practice in use; and
- Proper installation and maintenance of downspouts, channels, or any other sources of concentrated flow.

Note: Many of the native soils in Greenville County do not allow for adequate infiltration, therefore a perforated underdrain is required for practices that rely on infiltration. The perforated underdrain must flow to a stable outlet that daylights (emerges from the ground and is open to the air) or tie into a stormwater conveyance system. Specific underdrain requirements for each SFR practice will be discussed in the appropriate sub-section.

What is Green Infrastructure?

The terms Green Infrastructure (GI) and Low Impact Development (LID) refer to practices that reduce runoff and pollutant loads by utilizing stormwater practices that encourage the interception, evapotranspiration, infiltration and/or capture and reuse of stormwater runoff. Examples of applicable Green Infrastructure techniques on SFR developments include any appropriate combination of the following techniques:

- Installing a rain garden or bioretention area;
- Replacing traditionally impervious surfaces (driveways, patios, etc.) with pervious paving;
- Routing downspouts to underground dry wells;
- Routing downspouts to modified French drains;
- Directing sheet flow to adequately sized vegetated filter strips; or
- Directing sheet flow to undisturbed natural water quality buffers.

The goal of these techniques is to reduce the volume of runoff and load of pollutants generated and transported off-site. Other Green Infrastructure Practices that employ runoff reduction techniques may be used in lieu of these techniques with the assistance of a design professional and proper documentation of design criteria and details. These alternative techniques must be approved by the County and could add additional costs and longer review times.

How are Green Infrastructure techniques sized on SFR developments?

Applicants have the choice to meet water quality requirements for SFR lots by utilizing these Green Infrastructure for SFR Guidelines. In order to minimize the effort required by homeowners/builders for lots meeting SFR criteria, sizing tables and/or guidance are provided for each SFR LID practice based on its drainage area. As an alternative to the Green Infrastructure for SFR Guidelines, water quality practices may be professionally designed and sized using the more in-depth Greenville County Stormwater Management Design Manual.

How do the Green Infrastructure for SFR Guidelines relate to other Greenville County water quality requirements?

Greenville County's comprehensive approach to stormwater quality directly addresses pollutants of concern when they are indicated by state and federal regulations. Where there are no specific impairments, Total Suspended Solids (TSS) is used as an indicator to represent pollutants typically found in post-construction runoff. Previous modeling and calculation studies performed by the County have indicated that an average annual load of 600 pounds per acre per year of TSS is indicative of a well-controlled site in post-development conditions that is reducing pollutants to a practicable level. These SFR LID practices are intended to provide comparable water quality to this guideline if properly sized, installed, and maintained.

What is in the rest of this document?

The remainder of the document contains:

- A set of six information/specification sheets, one for each of the SFR LID practices recommended for use. For each measure, the last two pages are a "tear-out" set of specifications that can be filled in and submitted to the Plan Reviewer.
- Appendix A describing infiltration requirements and testing methods for these SFR LID practices.
- Appendix B describing the Greenville County filter media mix for use in SFR Rain Gardens (SFR-05).
- Appendix C describing the requirements for water quality easement plat approval.

Acknowledgements

The Greenville County Land Development Division would like to acknowledge and thank the City of Atlanta, Georgia Department of Watershed Management for making their City of Atlanta Stormwater Guidelines available for use and modification in the creation of the Greenville County Green Infrastructure for Single Family Residences Guidelines.

Greenville County Technical Specification for:

SFR-01 DRY WELL

1.0 Dry Well

1.1 Description

Dry wells are excavated stone-filled systems designed to intercept and temporarily store stormwater runoff until it infiltrates into the soil or leaves the system through a perforated underdrain that drains to a stable outlet. The stone filled excavation may contain either a seepage tank or a perforated pipe and standpipe in order to facilitate movement of runoff through the stone. The use of the seepage tank option is recommended, as it provides more storage volume and reduces the amount of area and excavation required compared to the perforated standpipe option.

Dry wells utilizing a seepage tank are particularly well suited to receive rooftop runoff entering the tank via an inlet grate or direct downspout connection. When properly sized, installed, and maintained, dry wells may provide reductions in stormwater runoff and pollutant loads from residential sites.

Dry wells are an infiltration-based LID practice which must reliably drain to function as designed. Many of the native soils in Greenville County do not allow for adequate infiltration, therefore a perforated underdrain is required. The perforated underdrain must flow to a stable outlet that daylights (emerges from the ground and is open to the air) or tie into a stormwater conveyance system. This daylighted outlet will prevent flow from backing up into the gutter system. A Y-shaped connection may also be added to the downspout as an additional overflow. Please note that very intense rain events may cause gutter systems to overflow at the roof edge when roof runoff exceeds the capacity of the gutter and that this observation does not necessarily indicate gutter backup or problems with the dry well.

The County acknowledges that on flat sites, an outlet that daylights may be difficult or infeasible due to the depth of dry wells. **If installation of an underdrain that daylights is infeasible, infiltration testing must be performed (see Appendix A) to demonstrate an infiltration rate of 0.5 in/hr in order to use a dry well.** If the infiltration rate is inadequate and an underdrain that daylights is infeasible, use other SFR practices.

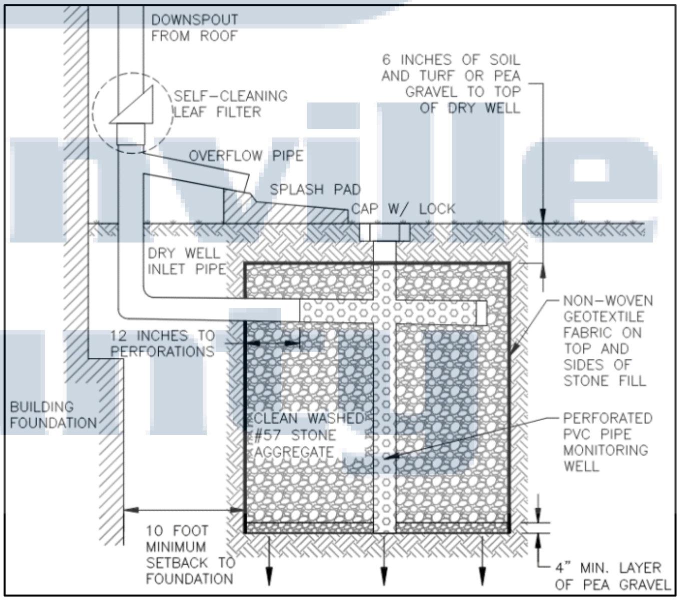
1.2 Using Dry Wells

- Dry wells must be located at least 10 feet from building foundations and 20 feet from property lines.
- To reduce the chance of clogging, dry wells should drain only impervious areas and runoff should be pretreated to remove leaves, debris, and other larger particles.
- For rooftop runoff that is directed to a dry well, provide gutters with pre-treatment including one or more of the options shown on the “tear-out” specifications sheet to prevent leaves, grit from roof shingles, and other debris from clogging the dry well.
- Ensure the dry well drains through the underdrain and/or infiltration within a drain time of 72 hours or less.
- Dry wells should be located in a lawn or other pervious (unpaved) area and should be designed so that the top of the dry well is located as close to the surface as possible.

- Dry wells should not be located: (1) beneath an impervious (paved) surface; (2) above an area with a water table or bedrock less than two feet below the trench bottom; (3) over other utility lines; (4) within roadway right-of-way; or, (5) uphill from or within 20 feet of a septic drain field. Always call 811 to locate utility lines before you dig.

1.3 Construction

- Consider the drainage area size and the soil infiltration rate when determining the size of the dry well. See comments on infiltration rate and underdrains in Section 1.1 above and design guidance on "tear-out" specifications sheet.
- The sides of the excavation should be trimmed of all large roots that will hamper the installation of the permeable non-woven geotextile fabric.
- For seepage tank dry wells, the dry well hole should be excavated a minimum of 1 foot deeper and two feet larger in diameter than the seepage tank to allow for a minimum 12-inch stone fill jacket.
- The native soils along the bottom of the dry well should be scarified or tilled to a depth of 3 to 4 inches.
- Install non-woven geotextile fabric on the sides of the excavation between native soils and the washed stone and dry well tank. Leave enough extra fabric at the top of the excavation to cover the top of the stone above the tank. Do not install non-woven geotextile fabric across the bottom of the excavation.
- Install a minimum of 4 inches of pea gravel or #8 stone across the bottom of the excavation.
- Fill below and around dry well with a minimum of 12 inches of clean, washed #57 stone. #57 stone diameter averages ½ inch to 1-½ inches.
- Stone that is un-washed or contains fine particles is not acceptable, as fine particles may clog the system.
- Fill the final 6 inches of the excavation with native soil. Optionally, pea gravel or #8 stone can be carried to the surface. This top layer should also be separated from the washed stone by non-woven geotextile fabric.
- For rooftop runoff that is directed to a dry well (typical), provide gutters with pre-treatment including one or more of the options shown on the "tear-out" specifications sheet to prevent leaves, grit from roof shingles, and other debris from clogging the dry well.
- For non-rooftop runoff (not typical), precede dry well with an in-ground sump grate inlet leaf trap.
- A stabilized overflow area, such as a vegetated filter strip or grass channel, should be designed to convey the stormwater runoff generated by larger storm events safely bypassing the dry well.
- See "tear-out" specifications sheet for typical seepage tank dry well components and installation.
- As an alternative to the seepage tank dry well, see figure at right for perforated standpipe dry well constructed of a stone pit and perforated vertical standpipe connected to the inlet pipe. This option also requires a perforated underdrain at the elevation of the bottom of the stone pit (required but not shown) or infiltration testing if an underdrain is infeasible (see Appendix A).



- If you elect to measure infiltration rate (see Appendix A) and find it is greater than or equal to 1.0 in/hr, the dry well size can be reduced. For every 0.5 in/hr increase in measured infiltration rate above the required 0.5 in/hr, subtract ten percent of the required dry well size, as measured in contributing area captured (square feet) which determines the volume and dimensions of the dry well.

1.3.1 Vegetation

- In the typical application where a dry well receives only piped flow and no surface flow, it may be covered with an engineered soil mix and planted with managed turf or other herbaceous vegetation.
- Alternatively, a dry well may be covered with non-woven geotextile fabric and pea gravel. This installation is applicable if runoff from adjacent pervious areas is to enter a dry well through surface infiltration. This pea gravel layer provides sediment removal and pretreatment upstream of the dry well and can be removed and replaced when it becomes clogged.

1.4 Maintenance

Regular maintenance is important for dry wells, particularly in terms of ensuring that they continue to provide stormwater management benefits over time.

- Inspect gutters and downspouts, removing accumulated leaves and debris.
- Inspect dry well following rainfall events.
- Inspect pretreatment devices for sediment or debris accumulation. Remove accumulated trash and debris.
- If a pea gravel top layer is used, inspect pea gravel and top layer of non-woven geotextile fabric for sediment accumulation. Remove and replace if clogged.

1.5 Design Example

The fundamental principle of Dry Well design is to provide the required volume based on the drainage area. This requires calculations that will vary based on the size and shape of dry well tanks and the excavation of the stone pit around the tanks. The sub-sections below provide example calculations for a simplified design scenario. Note that Dry Well design is not limited to the tanks and excavation geometries used in this example, as these will vary based on available materials and site-specific constraints.

1.5.1 Calculating Required Volume

A home has a drainage area of 2400 sf that is to be treated for water quality using dry wells following SFR-01 Dry Well guidance. Calculate the required volume for **all dry wells** using the equation from the tear-out specification, shown below.

$$Volume\ required\ [cf] = 0.0833 * \ Drainage\ Area\ \ [sf]$$
$$Volume\ required\ [cf] = 0.0833 * \ 2400\ sf$$
$$\boldsymbol{Volume\ required}\ [\boldsymbol{cf}] = \mathbf{200}\ \boldsymbol{cf}\ \textbf{(all dry wells)}$$

The house is rectangular in footprint and the drainage area flows to each corner equally, with 600 sf draining to each corner. A dry well will be installed at each corner, for a total for four dry well installations around the home. Calculate the required volume for **each dry well** using the equation from the tear-out specification, shown below.

$$Volume\ required\ [cf] = 0.0833 * \ Drainage\ Area\ \ [sf]$$
$$Volume\ required\ [cf] = 0.0833 * \ 600\ sf$$
$$\boldsymbol{Volume\ required}\ [\boldsymbol{cf}] = \mathbf{50}\ \boldsymbol{cf}\ \textbf{(each of the 4 dry wells)}$$

The volume required for each dry well is 50 cf and the total volume required on the site is 200 cf. Calculations in the sub-sections below are for **one of the four dry wells**, assuming all four will be installed for full site compliance. Note that sites with uneven drainage area distributions may have different required volumes at different treatment locations.

1.5.2 Calculating Provided Volume

The dimensions of the dry well tanks and rock aggregate pit will be assessed by calculating the volume provided by the design and comparing it to the volume required (50 cf per dry well in this example). The volume provided by the design is calculated by adding the storage volume in the tank and the volume capacity of the surrounding rock aggregate, using the equation from the tear-out specification, shown below.

$$Volume\ provided\ [cf] = TV\ [cf] + (RV)(P)[cf]$$

$\mathrm{TV} = \mathrm{Tank\ volume}$
$\mathrm{RV} = \mathrm{Rock\ aggregate\ volume}$
$\mathrm{P} = \mathrm{Rock\ aggregate\ porosity}$

Tank volume (TV) is calculated from the dimensions of the tank. Rock volume (RV) is calculated from the dimensions of the rock aggregate, adjusted by the rock aggregate porosity (P) since only the volume of the pore space around the rock is available volume to be counted as volume provided.

The following sub-sections elaborate on calculations for TV and RV in two different scenarios, one with a cylindrical rock aggregate pit and another with a rectangular rock aggregate pit.

1.5.2.1 Scenario 1: Cylindrical Tank and Cylindrical Pit Excavation

In this example, the design will use stackable, round dry well tanks with a 2 ft diameter (D) and a height (H) of 2 ft. Two dry well tanks (each 2' D x 2' H) will be stacked on top of each other to create a 2' D x 4' H dry well tank. The tank volume is calculated using the formula for the volume of a cylinder, as follows:

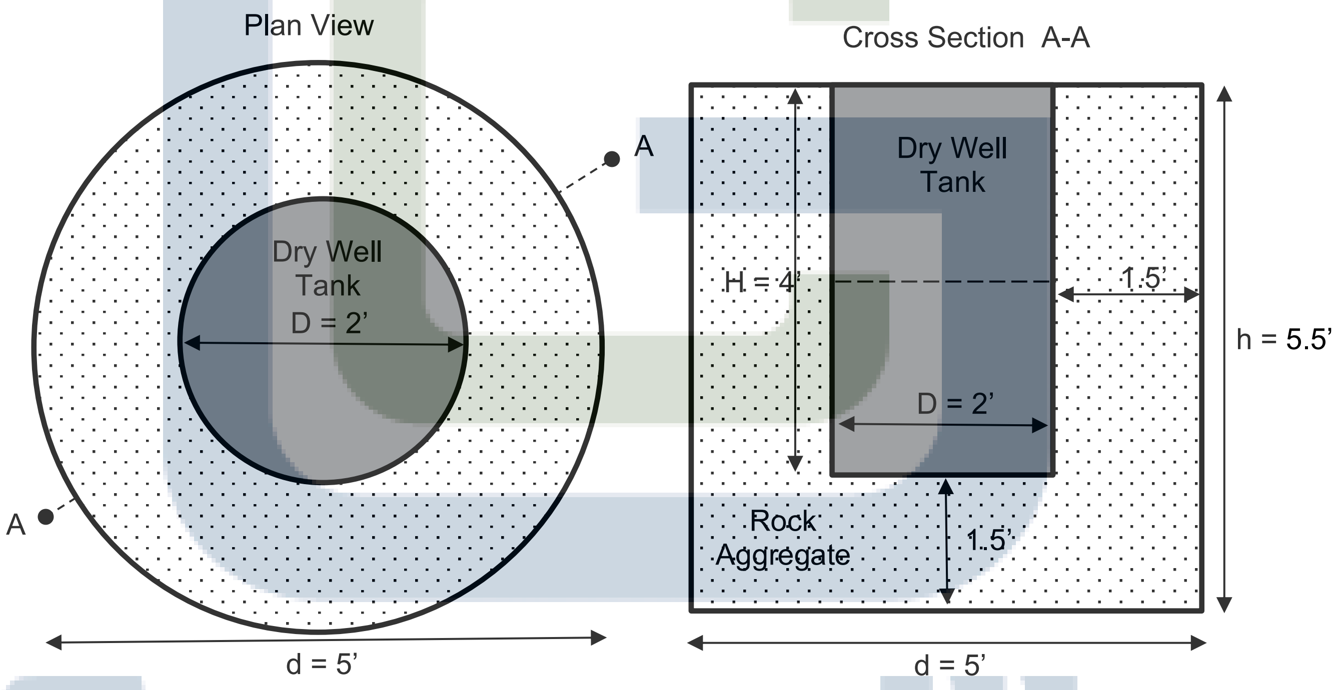
$$TV = 3.14 * \left(\frac{D}{2}\right)^2 * H$$

$\mathrm{D} = \text{diameter of tank} = 2\mathrm{ft}$

$\mathrm{H} = \text{tank height} = 4\mathrm{ft}$

$$TV = 3.14 * \left(\frac{2\,ft}{2}\right)^2 * 4\,ft = 12.5\,cf$$

The tank described above is installed in a cylindrical pit. The minimum rock thickness around the tank for a dry well installation is 1 ft for both sides and bottom of the tank. In this example, the rock thickness is 1.5 ft for sides and bottom of the tank, to provide adequate volume. The pit has overall dimensions of 5' diameter (d) x 5.5' height (h) from the bottom, as shown in the schematic below.



On the following page, the rock aggregate volume (RV) provided by the design will be calculated to determine if provided volume meets the required minimum volume required to treat the drainage area.

Rock aggregate volume is calculated as the volume of the pit excavated for the dry well minus the volume of the tank, since no rock will be present where the tank is located. The total rock aggregate volume is calculated below.

$$RV = V_{pit} - TV$$

$$RV = \pi * \left(\frac{d}{2}\right)^2 * h - TV$$

d = pit diameter = 5 ft
h = pit height = 5.5 ft
TV = tank volume = 12.5 ft^3

$$RV = \pi * \left(\frac{5ft}{2}\right)^2 * 5.5ft - 12.5ft^3$$

$$RV = 95\ cf$$

The total volume provided by the design can be determined from the previously calculated tank volume and rock aggregate volume. The porosity is determined by the type of rock aggregate used in the design. In this example, 0.4 is used as a typical value of rock aggregate porosity.

$$Volume\ provided\ [cf] = TV\ [cf] + (RV)(P)[cf]$$

$$Volume\ provided\ [cf] = 12.5\ [cf] + (95)(0.4)[cf]$$

$$Volume\ provided\ [cf] = 50.5\ [cf]$$

The volume provided by the dry well installation described above is 50.5 cf, which is greater than the required volume of 50 cf per dry well. The site design of four dry well installations (one dry well installed at each corner of the house receiving equal amounts of stormwater) will provide a total volume of 202 cf, which is greater than required 200 cf volume, so the design meets the drainage area requirements.

The final design Is four dry wells, one at each corner of the house, each consisting of a 2' D x 4' H dry well tank placed in a cylindrical rock aggregate pit that is 5' d x 5.5' h. Volume provided is greater than volume required so the design is acceptable.

1.5.2.2 Scenario 2: Cylindrical Tank and Rectangular Pit Excavation

In this example, the design will use stackable, round dry well tanks with a 2 ft diameter (D) and a height (H) of 2 ft. Two dry well tanks (each 2' D x 2' H) will be stacked on top of each other to create a 2' D x 4' H dry well tank. This is the same tank used previously in Scenario 1. The tank volume is calculated using the formula for the volume of a cylinder, as follows:

$$TV = 3.14 * \left(\frac{D}{2}\right)^2 * H$$

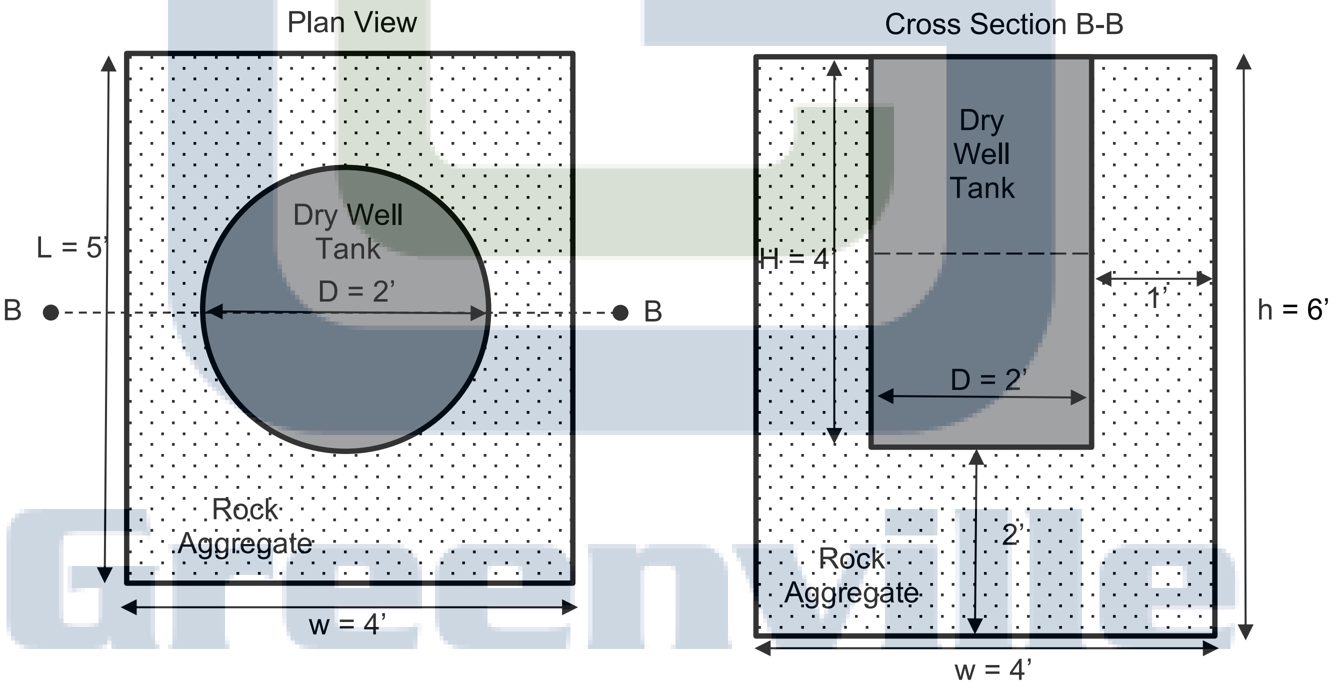
$$TV = 3.14 * \left(\frac{2\,ft}{2}\right)^2 * 4\,ft = 12.5\,cf$$

$\mathrm{D} = \text{diameter of tank} = 2\text{ft}$

$\mathrm{H} = \text{tank height} = 4\text{ft}$

The tank described above is installed in a cylindrical pit. The minimum rock thickness around the tank for a dry well installation is 1 ft for both sides and bottom of the tank. In this example, the rock thickness is 1.5 ft for sides and bottom of the tank, to provide adequate volume. The pit has overall dimensions of 5' diameter (d) x 5.5' height (h) from the bottom, as shown in the schematic below.

The tank described above is installed in a rectangular pit. The minimum rock thickness around the tank is 1 ft for both sides and bottom of the tank. In this example, the rock thickness varies between 1 ft and 1.5 ft on sides and is 2 ft on the bottom of the tank, to provide adequate volume. The pit has dimensions of 4' width (w) x 5' length (L) x 6' height (h) from the bottom, as shown in the schematic below.



On the following page, the rock aggregate volume (RV) provided by the design will be calculated to determine if provided volume meets the required minimum volume required to treat the drainage area.

Rock aggregate volume is calculated as the volume of the pit excavated for the dry well minus the volume of the tank, since no rock will be present where the tank is located. The total rock aggregate volume is calculated below.

$$RV = V_{pit} - TV$$

$$RV = w * L * h - TV$$

$$RV = 4ft * 5ft * 6ft - 12.5ft^3$$

$$RV = 107\ cf$$

w = pit width = 4ft
L = pit length = 5ft
h = pit height from bottom = 6ft
TV = tank volume = 12.5 ft^3

The total volume provided by the design can be determined from the previously calculated tank volume and rock aggregate volume. The porosity is determined by the type of rock aggregate used in the design. In this example, 0.4 is used as a typical value of rock aggregate porosity.

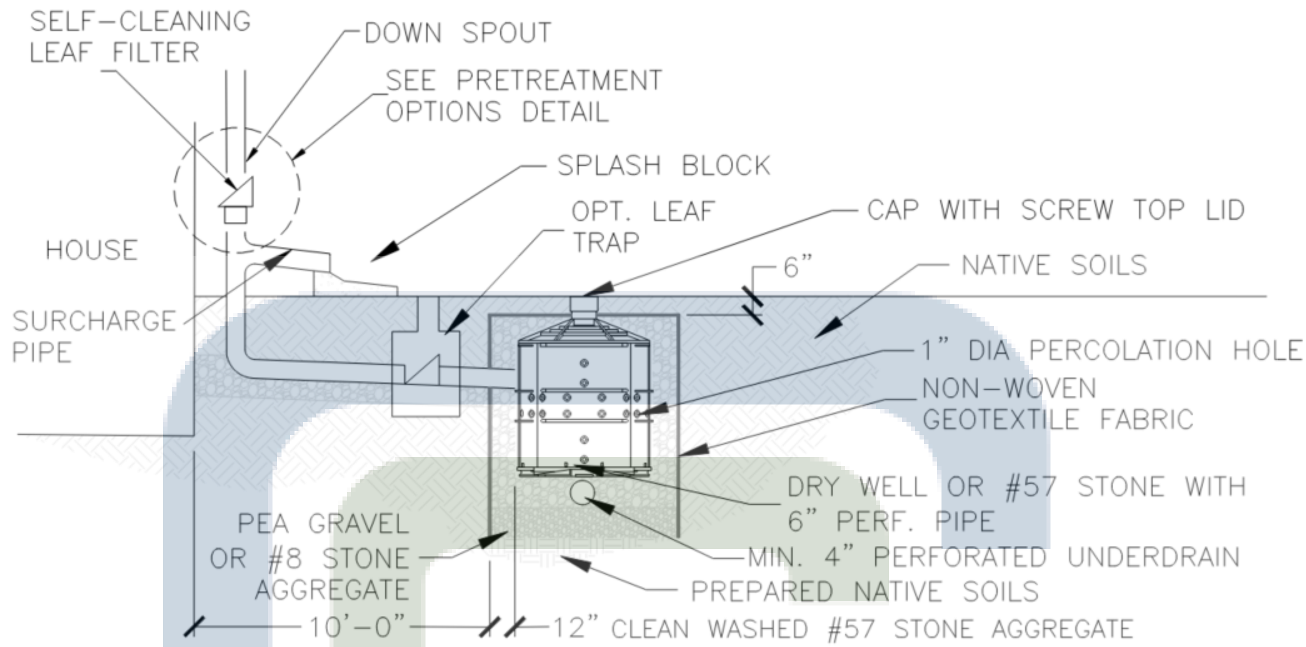
$$Volume\ provided\ [cf] = TV\ [cf] + (RV)(P)[cf]$$

$$Volume\ provided\ [cf] = 12.5\ [cf] + (107)(0.4)[cf]$$

$$Volume\ provided\ [cf] = 55\ cf$$

The volume provided by the dry well installation described above is 55 cf, which is greater than the required volume of 50 cf per dry well. The site design of four dry well installations (one dry well installed at each corner of the house receiving equal amounts of stormwater) will provide a total volume of 220 cf, which is greater than required 200 cf volume, so the design meets the drainage area requirements.

The final design is four dry wells, one at each corner of the house, each consisting of a 2’ D x 4’ H dry well tank placed in a rectangular rock aggregate pit that is 4’ w x 5’ L x 6’ h. Volume provided is greater than volume required so the design is acceptable.

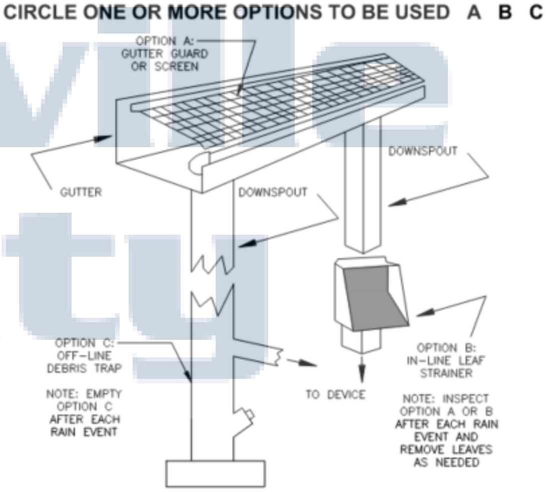


TYPICAL COMPONENTS OF SEEPAGE TANK DRY WELL
(ATTACH MANUFACTURER'S SPECIFICATIONS)

CONSTRUCTION STEPS:

1. Review potential dry well areas and layout. Dry wells should <u>not</u> be located: (1) beneath an impervious (paved) surface; (2) above an area with a water table or bedrock less than two feet below the trench bottom; (3) over other utility lines; (4) within roadway right-of-way; or, (5) uphill from or within 20 feet of a septic drain field. Ensure perforated underdrain outlet daylights at least 20 feet from property line.
2. Measure the area draining to the dry well and determine required volume on chart on the next page.
3. Design dry well tank and rock volume and demonstrate required volume is provided (attach if necessary).
4. Infiltration rate testing is not necessary when using the required perforated underdrain. If an underdrain is infeasible, see Appendix A for soil infiltration rate testing and requirements.
5. If the infiltration rate is greater than or equal to 1.0 in/hr, the contributing drainage area (square feet) may be decreased 10% for every 0.5 in/hr infiltration rate in excess of the required 0.5 in/hr. See Appendix A for soil infiltration testing and requirements.
6. Measure elevations and dig the hole to the required dimensions. Scarify the bottom soil surface 3" min.
7. Place and secure non-woven geotextile fabric on sides of the excavation leaving enough to fold over the top below the top layer of soil and turf or pea gravel.
8. Install a minimum of 4 inches of pea gravel or #8 stone across the bottom of the excavation.
9. Place and tamp a minimum of 12" of #57 washed stone in bottom. Pea gravel can be substituted for leveling purposes in the upper three inch layer below the tank.
10. Place tank and install piping. Bond top of tank in place.
11. For rooftop runoff, provide one or more options shown on Pretreatment Options Detail (**circle selected options**). If trees are present, Option A <u>and</u> Option B or C are recommended. Strap and support as needed.
12. Create a safe overflow at least 20 feet from your property edge and at least 10 feet from any building foundations and ensure it is protected from erosion.
13. Test connections with water flow.
14. Fill with #57 washed stone jacket around tank and ensure non-woven geotextile fabric is installed on sides and top between stone and soil.
15. Backfill with soil/sod or pea gravel.
16. Consider aesthetics as appropriate and erosion control for overflow.

CIRCLE ONE OR MORE OPTIONS TO BE USED A B C



PRE-TREATMENT OPTIONS DETAIL

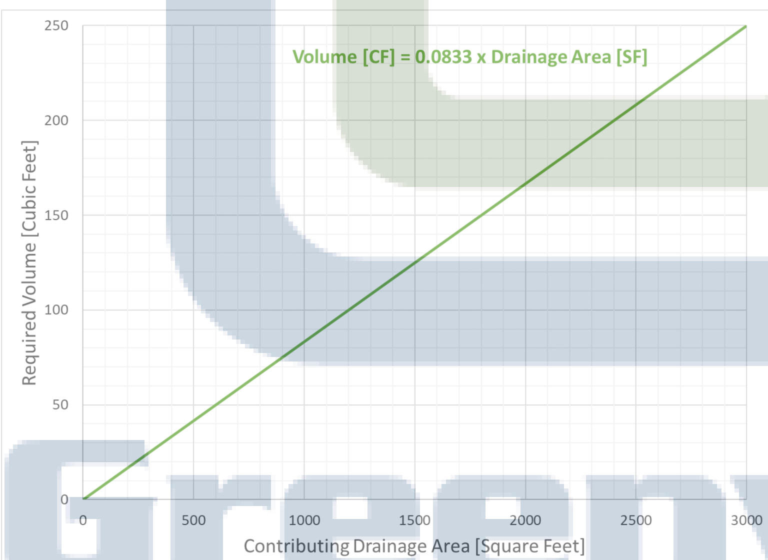
GREENVILLE COUNTY LAND DEVELOPMENT DIVISION	NAME/ADDRESS:	DRY WELL SPECIFICATIONS PAGE 1 OF 2

SKETCH LAYOUT

PROVIDE PLAN AND ELEVATION VIEWS OF DRY WELL AND HOUSE SHOWING ROOF AREA DIRECTED TO DRY WELL AND KEY DIMENSIONS, CONNECTIONS AND OVERFLOW RELATIVE TO PROPERTY LINE. ATTACH ADDITIONAL PAGES IF NECESSARY.

VOLUME REQUIRED:

CONTRIBUTING DRAINAGE AREA= ________ SQ FT



VOLUME REQUIRED =________ CU FT (FROM CHART)

VOLUME PROVIDED:

CALCULATE VOLUME PROVIDED, MUST BE GREATER THAN OR EQUAL TO REQUIRED VOLUME FROM CHART/EQUATION ON LEFT.

DRY WELL TANK VOLUME= (TV)* CU FT
ROCK AGGREGATE VOLUME= (RV) CU FT
ROCK AGGREGATE POROSITY= (P)**
*IF USING STANDPIPE-STONE PIT DRY WELL, TV = 0 (NO TANK PRESENT)
**USE P = 0.4 OR PROVIDE JUSTIFICATION

VOLUME PROVIDED = (TV) + (RV)(P)

= ______ + (_____)(____) CU FT

VOLUME PROVIDED =________ CU FT

IS VOLUME PROVIDED ≥ VOLUME REQUIRED? ________ (YES/NO)

MAINTENANCE:

1. INSPECT GUTTERS AND DOWNSPOUTS REMOVING ACCUMULATED LEAVES AND DEBRIS, CLEANING LEAF REMOVAL SYSTEM(S).
2. INSPECT PRETREATMENT DEVICES FOR SEDIMENT ACCUMULATION. REMOVE ACCUMULATED TRASH AND DEBRIS.
3. INSPECT DRY WELL FOLLOWING A LARGE RAINFALL EVENT TO ENSURE OVERFLOW IS OPERATING AND FLOW IS NOT CAUSING EROSION OR OTHER PROBLEMS.

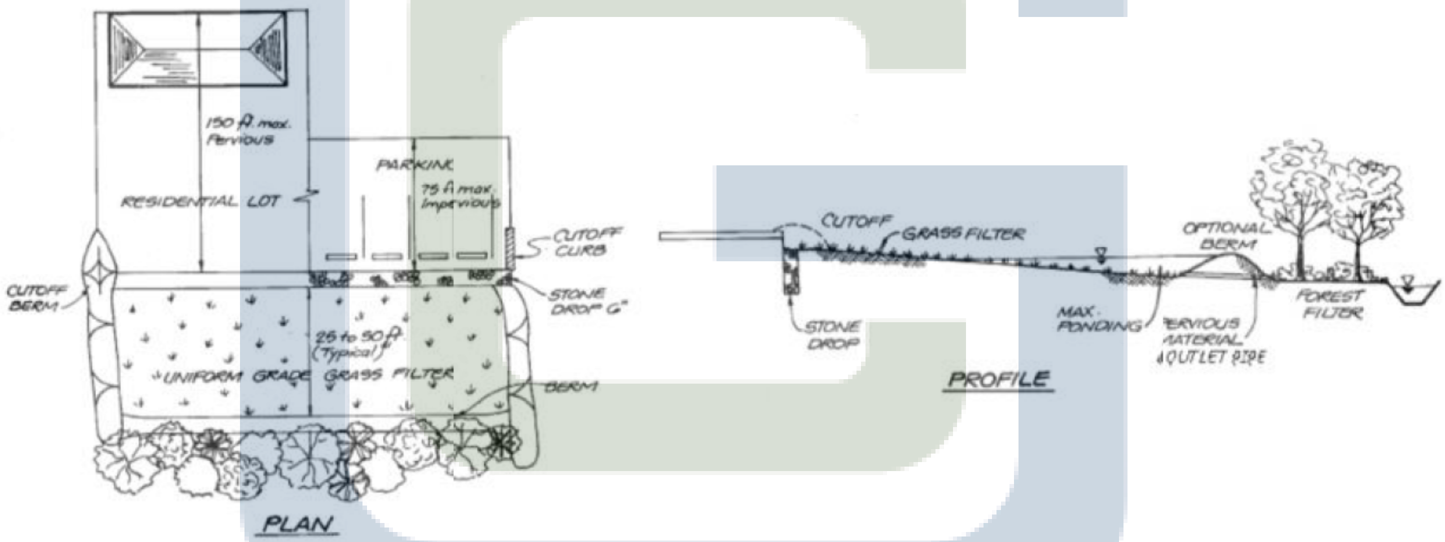
Greenville County Technical Specification for:

SFR-02 VEGETATED FILTER STRIP

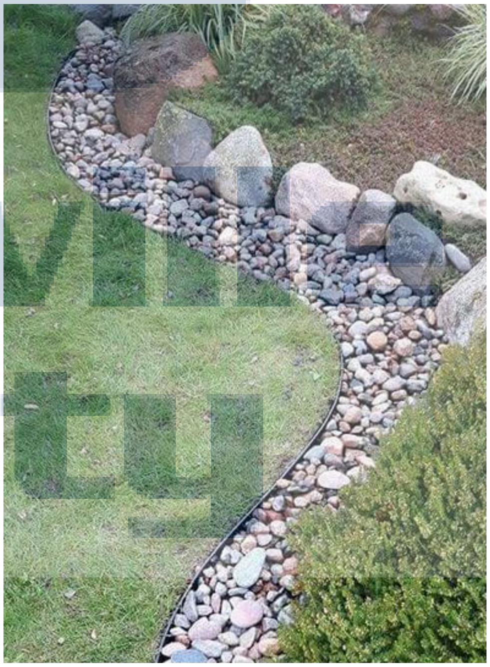
1.0 Vegetated Filter Strip

1.1 Description

A vegetated filter strip can be an attractive and functional addition to your home landscape. Vegetated filter strips (also known as grass filters) are uniformly graded, vegetated areas of land designed to receive rainwater as sheet flow and slow and filter stormwater runoff from roof downspouts or parking areas. When properly sized, installed, and maintained, vegetated filter strips may provide reductions in stormwater runoff and pollutant loads. Typical plan and profile schematics are shown below.



1.2 Using Vegetated Filter Strips



- Take note of the drainage patterns to determine the best location for a vegetated filter strip. Assess the drainage area flow paths on your property and the slope of the drainage area. Ideal locations are places where there is a gentle slope away from the structure or paved area, the area is relatively flat, and where the flow can be evenly disbursed along the top of the filter area.
- The ideal slope of the vegetated filter strip is between 1% and 5%. Greater slopes would encourage the formation of concentrated flow within the filter strip, while lesser slopes would encourage unplanned ponding.
- Filter strips may not be located within the roadway right-of-way.
- Placing a filter strip over utilities is acceptable except where the amended soil option is used. In that case, ensure utility locations are noted and care is taken in soil amendment actions.

- Amended or bermed filter strips should not be placed uphill from or within 20 feet of a septic field.
- The length of the vegetated filter strip should be no less than 25 feet. If there is a permeable berm at the lower end, the length of the vegetated filter strip should be no less than 15 feet. Natural forested areas on site can be counted in the filter strip length total.
- The surface impervious area to any one discharge location cannot exceed 5,000 square feet.

1.3 Construction

- Measure the rooftop and any other area that is going to be directed to the filter strip. See sizing table on "tear-out" specifications sheet. From the site layout drainage area, select the size and type of filter strip from the table.
- There are three types of filter strips: conventional, amended soil, and berm. The use of amended soil or a berm reduces the required size of the filter strip, as shown in the sizing table.
- For example, a 1,000 square foot rooftop with a conventional filter strip would require at least 2,000 square feet of area with a minimum flow length of 25 feet. The use of amended soil reduces the required area to 670 square feet, still with a minimum flow length of 25 feet. If built with a berm, it can have a surface area of 500 square feet and have a minimum flow length of 15 feet.

1.3.1 Amended Soil Design Option

- Required filter area can be reduced by amending the soil within the filter strip by tilling the existing soil 12" deep and mixing 4" of compost. This increases infiltration within the filter strip.

1.3.2 Berm Design Option

- Filter area can be further reduced through the use of a permeable berm at the bottom end of the filter strip. The permeable berm is used to temporarily store stormwater runoff within the filter strip, which increases the infiltration and reduces the required width of the filter strip.
- Permeable berms should be constructed of well drained soils (sand, gravels, and sandy loams) that support plant growth and should be no more than 12" high.
- Appropriately sized outlets should be provided within permeable berms to ensure that vegetated filter strips will drain within 24 hours following the end of a rainfall event.
- A stone-protected overflow area through the berm may be used to manage the stormwater runoff generated by large storm events. The overflow point must be at least 20 feet from the property line if flow is onto adjoining property. Erosion protection is critical.

1.3.3 Level Spreader

- All vegetated filter strips require a level spreader to be used at the upstream end of the filter strip to evenly distribute stormwater runoff into the filter strip. The level spreader must be located at least 10 feet from building foundations.

- The standard level spreader for this application is a small stone trench filled with river rock, pea gravel, or #8 stone installed along a level contour. This stone trench should be 6” to 12” wide and 6” to 12” deep. Larger diameter stone may be required to stabilize entry points for larger contributing impervious areas.
- When applicable, the level spreader may be connected to the downspout through a T-connection to perforated pipes embedded in the stone trench.
- Alternatively, a level spreader may be constructed using manufactured landscape or playground borders/barriers (plastic or recycled material only; no lumber ties or railroad ties). This installation requires a 2” drop on the downstream side to ensure positive flow (see detail on “tear out” specifications sheet).
- Ensure level spreader overflow points are protected from erosion and not blocked by vegetation.
- If the impervious drainage area to any one entry point (e.g. a downspout) is less than or equal to 300 square feet, requirement for a level spreader **may** be waived if flow will flow as a sheet through the vegetated filter strip area. In this case splash blocks or downspout protection pads can be used to introduce flow into vegetated filter strip areas instead of a level spreader. Drainage areas greater than 300 square feet require construction of the level spreader. Vegetation requirements (below) for the vegetated filter strip are the same regardless of use of level spreader or other energy dissipation.

1.3.4 Vegetation

- Vegetation commonly planted on vegetated filter strips includes turf and other herbaceous vegetation.
- Choose grasses and other vegetation that will be able to tolerate the stormwater runoff rates and volumes that will pass through the vegetated filter strip.
- Vegetation used in filter strips should be able to tolerate both wet and dry conditions.
- Vegetated filter strip areas must be sodded as a part of the project if they drain to an LID practice.
- Do not use Bermuda grass. Use Zoysia or Fescue.

1.4 Maintenance

Maintain the vegetated filter strip so that it will continue to provide measurable stormwater management benefits over time.

- Water as needed to promote plant growth and survival, especially in the first two seasons.
- Provide normal turf or garden maintenance – mow, prune, and trim as needed.
- Inspect the vegetated filter strip following rainfall events. Fix erosion issues immediately.
- Remove accumulated trash, sediment, and debris.

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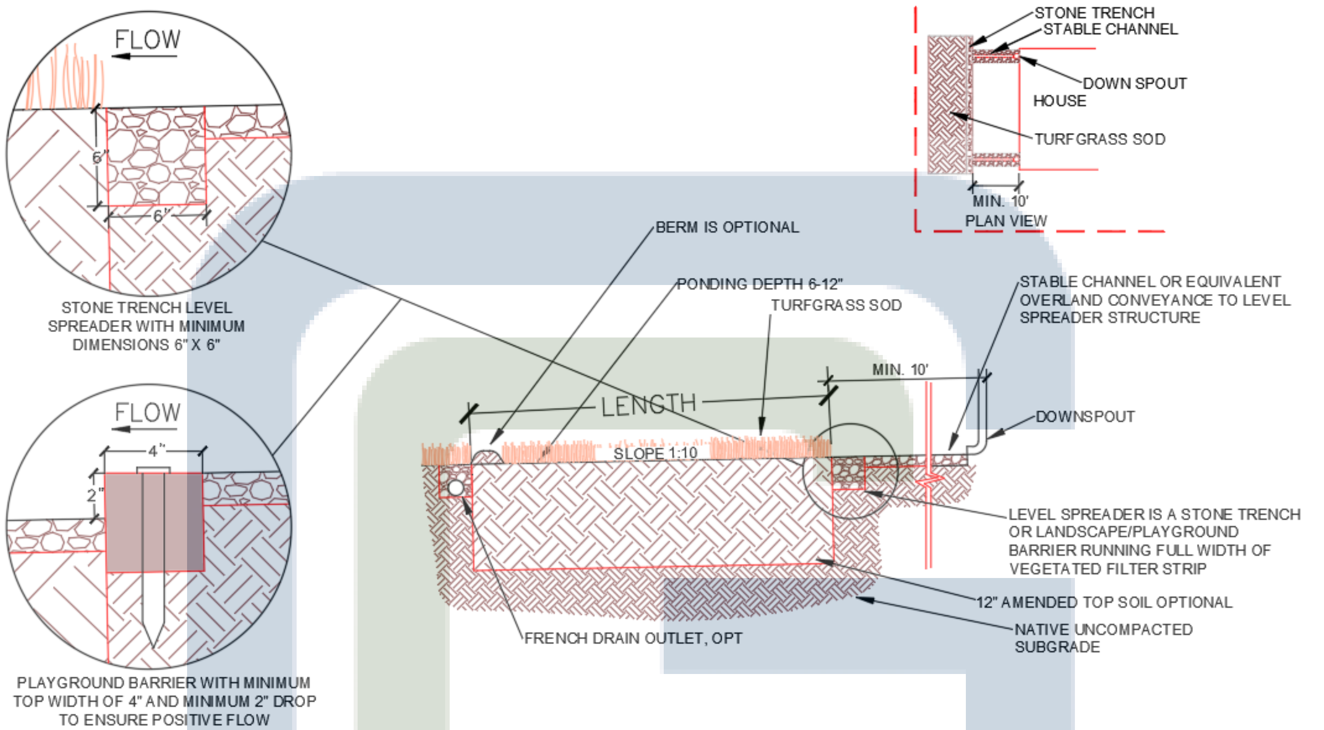


TYPICAL COMPONENTS

CONSTRUCTION STEPS:

1. Review potential filter strip areas and layout. Filter strips should slope between 1% and 5% away from the home or other structures. Filter strips may not be located within the roadway right-of-way.
2. Amended or bermed filter strips should not be located uphill from or within 20 feet of a septic field. If there is a concentrated overflow, ensure it is at least 10 feet from building foundations and 20 feet from adjacent property lines.
3. Placing a filter strip over utilities is acceptable except where the amended soil option is used. In that case ensure utility locations are noted and care is taken in soil amendment actions.
4. Measure the area draining to the filter strip and determine required surface area and minimum length from the table on the next page. Determine the desired filter strip and level spreader options. **All runoff entering the filter strip must be sheet flow**.
5. Lay out and mark filter strip area as well as level spreader location.
6. Construct level spreader by filling trench with appropriate stone and noting overflow points.
7. Construct filter strip option. Install berm or prepare amended soil if applicable.
8. Construct erosion control at the flow entrance and exit points as applicable.
9. Plant dense vegetation according to plan, or sod/seed. Ensure an irrigation plan is in place.
10. Ensure temporary erosion control is in place as needed until vegetation establishment.

SKETCH LAYOUT

PROVIDE PLAN AND ELEVATION VIEWS OF VEGETATED FILTER STRIP AND HOUSE SHOWING ROOF AREA DIRECTED TO FILTER STRIP AND KEY DIMENSIONS, CONNECTIONS AND OVERFLOW RELATIVE TO PROPERTY LINE. ATTACH ADDITIONAL PAGES IF NECESSARY.

SIZING CALCULATION:

Contributing Drainage Area (square feet)	Filter Strip Type		
	Conventional	Amended Soil	Berm
	Filter Strip Area (sq ft)		
100	200	70	50
500	1000	350	250
1000	2000	670	500
2000	4000	1400	1000
3000	6000	2700	1500
4000	8000	5400	2000
5000	10000	6700	2500

MEASURE CONTRIBUTING DRAINAGE AREA AND READ FILTER STRIP AREA FOR GIVEN FILTER STRIP TYPE. FOR SPECIFIC DRAINAGE AREAS NOT LISTED ON TABLE, INTERPOLATE BETWEEN THE CLOSEST VALUES LISTED.

CONTRIBUTING DRAINAGE AREA= _________ SQ FT
FILTER STRIP AREA= ________ SQ FT
CONVENTIONAL – 25' MINIMUM LENGTH
BERM OPTION – 15' MINIMUM LENGTH

MAINTENANCE:

1. INSPECT GUTTERS AND DOWNSPOUTS REMOVING ACCUMULATED LEAVES AND DEBRIS, CLEANING LEAF REMOVAL SYSTEM(S).
2. IF APPLICABLE, INSPECT PRETREATMENT DEVICES FOR SEDIMENT ACCUMULATION. REMOVE ACCUMULATED TRASH AND DEBRIS.
3. WATER AS NEEDED TO PROMOTE PLANT GROWTH AND SURVIVAL ESPECIALLY IN THE FIRST TWO SEASONS.
4. PROVIDE NORMAL TURF OR GARDEN MAINTENANCE – MOW, PRUNE, AND TRIM AS NEEDED.
5. INSPECT THE VEGETATED FILTER STRIP FOLLOWING RAINFALL EVENTS. FIX EROSION ISSUES IMMEDIATELY.

Greenville County Technical Specification for:

SFR-03 MODIFIED FRENCH DRAIN

1.0 Modified French Drain

1.1 Description

Modified French Drains (MFD) are shallow trench excavations filled with stone that are designed to intercept and temporarily store stormwater runoff until it infiltrates into the soil. When properly sized, installed, and maintained, MFDs may provide reductions in stormwater runoff and pollutant loads. They are particularly well suited to receive rooftop runoff but can also be used to receive stormwater runoff from other small impervious areas. The perforated pipe is daylighted at its end allowing for overflow of larger storms and a failsafe mechanism should infiltration not be as anticipated.

MFDs are an infiltration-based LID practice which must reliably drain to function as designed. Many of the native soils in Greenville County do not allow for adequate infiltration, therefore the perforated pipe drain of the MFD is required and critical to ensure the function of the MFD. The perforated pipe drain must flow to a stable outlet that daylights (emerges from the ground and is open to the air) or tie into a stormwater conveyance system. This daylighted outlet will prevent flow from backing up into the gutter system. A Y-shaped connection may also be added to the downspout as an additional overflow. Please note that very intense rain events may cause gutter systems to overflow at the roof edge when roof runoff exceeds the capacity of the gutter and that this observation does not necessarily indicate gutter backup or problems with the MFD.

If daylighting the perforated pipe drain is infeasible, infiltration testing must be performed (see Appendix A) to demonstrate an infiltration rate of 0.5 in/hr in order to use a MFD. If the infiltration rate is inadequate and daylighting the perforated pipe drain is infeasible, use other SFR practices. If it is infeasible to slope the MFD away from structures on site, use other SFR practices.

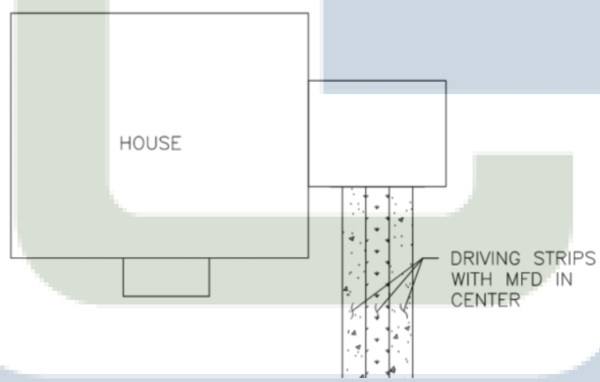
1.2 Using Modified French Drains

- MFD trenches should be located at least 10 feet from building foundations and 20 feet from property lines. Downspout connections within 10 feet of the building that direct flow to the MFD should be constructed of non-perforated pipe to direct flow away from the structure.

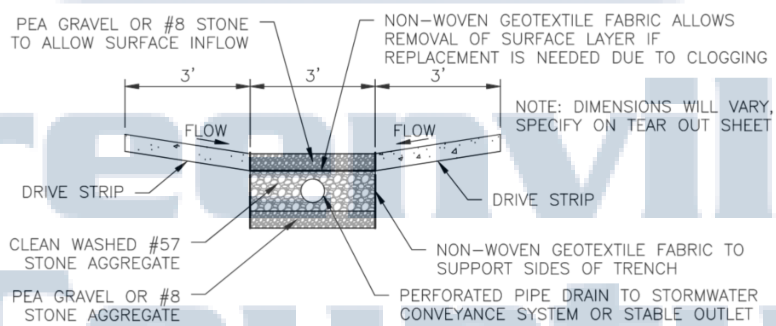
- MFDs must slope away from the structures. The slope of the MFD pipe should be between 0.5% and 6%. It can be serpentine or multi-pronged in construction if sufficient slope is available. If a perforated pipe drain with positive slope/flow is infeasible, MFDs cannot be used.
- To reduce the chance of clogging, MFDs should drain only impervious areas, and runoff should be pretreated to remove leaves, debris, and other larger particles.
- For rooftop runoff that is directed to a MFD, provide gutters with pre-treatment including one or more of the options shown on the “tear-out” specifications sheet to prevent leaves, grit from roof shingles, and other debris from clogging the MFD.
- MFD stone aggregate trench depth and width should each be at least 18 inches and no more than 36 inches.

- MFDs should be located in a lawn or other pervious (unpaved) area and should be designed so that the top of the MFD is located as close to the surface as possible to reduce excavation.
- MFDs should not be located: (1) beneath an impervious (paved) surface; (2) above an area with a water table or bedrock less than two feet below the trench bottom; (3) over other utility lines; (4) within roadway right-of-way; or, (5) uphill from or withing 20 feet of a septic field. Always call 811 to locate utility lines before you dig.
- The downstream end of the pipe must daylight for overflows more than ten feet from the property line.
- If you elect to measure infiltration rate (see Appendix A) and find it is greater than or equal to 1.0 in/hr, the MFD size can be reduced. For every 0.5 in/hr increase in measured infiltration rate above the required 0.5 in/hr, subtract ten percent of the required MFD size, as measured in contributing area captured (square feet) which determines the dimensions of the MFD.
- MFDs may be used in a variety of locations based on site constraints. In situations where the MFD receives surface inflow, the top layer should be non-woven geotextile and pea gravel so that it can be replaced if needed due to clogging. If the MFD receives only piped inflow, a surface layer of topsoil and turf may be used.
- One application is to install the MFD adjacent to a driveway or in the center of a split track driveway, such that the driveway is sloped to drain into the MFD. The split track driveway application is shown below:

PLAN VIEW



CROSS SECTION



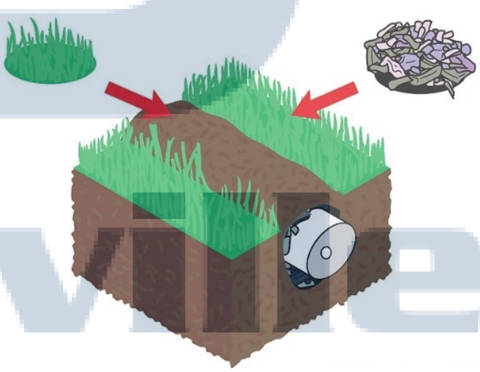
1.3 Construction

- As a rule-of-thumb there should be 21 cubic feet of stone for every 100 square feet of rooftop (0.21 cubic feet per square foot of rooftop). See “tear out” specifications sheet for MFD design guidance.
- Actual installed width and depth of MFD may vary between 18 and 36 inches and should match cross section shown on “tear-out” specification sheet.

- The sides of the excavation should be trimmed of all large roots that will hamper the installation of the non-woven geotextile fabric used on the sides and above the stone aggregate layer on top of the MFD.
- The native soils along the bottom of the MFD should be scarified or tilled to a depth of 3 to 4 inches.
- Install non-woven geotextile fabric along the sides of the trench between native soils and the washed #57 stone and perforated pipe. Leave enough extra fabric at the top of the excavation to cover the top of the stone trench. Do not install non-woven geotextile fabric across the bottom of the excavation.
- Install a minimum of 4 inches of pea gravel or #8 stone across the bottom of the excavation.
- Fill the MFD with clean, washed #57 stone embedding a 6-inch diameter perforated pipe in the stone such that the stone covers the top of the pipe. #57 stone diameter averages ½ inch to 1-½ inches.
- Stone that is un-washed or contains fine particles is not acceptable, as fine particles may clog the system.
- The pipe should have 3/8-inch perforations, spaced 6 inches on center, and have a minimum slope of 0.5% and a maximum slope of 6%.
- The perforated pipe must daylight at the downstream end of the trench or adequate infiltration must be demonstrated through testing (see Section 1.1).
- An overflow, such as a vegetated filter strip or grass channel, should be designed to convey the stormwater runoff generated by larger storm events safely out of the downstream end of the MFD.
- Place non-woven geotextile fabric over washed stone to keep soil or pea gravel from migrating downward and filling the pore spaces.
- Cover with topsoil and sod or with pea gravel. Use pea gravel if the MFD receives surface inflow.
- For rooftop runoff, install one or more leaf screen options prior to entering the MFD to prevent leaves and other large debris from clogging the MFD. For driveway or parking runoff a screened inlet grate over a sump or pea gravel pit can be used to settle out material prior to entering the pipe.

1.3.1 Vegetation

- MFDs are normally covered with topsoil and managed turf or other herbaceous vegetation.
- As an alternative, the area above the surface of the MFD may be covered with pea gravel (or larger depending on the inflow rates) to allow for inflow along the edge of ground level impervious surfaces.
- The downstream end of the pipe must be stabilized and can be landscaped for aesthetics.



1.4 Maintenance

Annual maintenance is important for MFDs.

- Inspect gutters/downspouts removing accumulated leaves and debris, cleaning leaf removal system(s).
- Inspect pretreatment devices for sediment or debris accumulation. Remove accumulated trash and debris.
- Inspect MFD following a large rainfall event to ensure overflow is operating and flow is not causing problems.
- If a pea gravel top layer is used, inspect pea gravel and top layer of non-woven geotextile fabric for sediment accumulation. Remove and replace if clogged.

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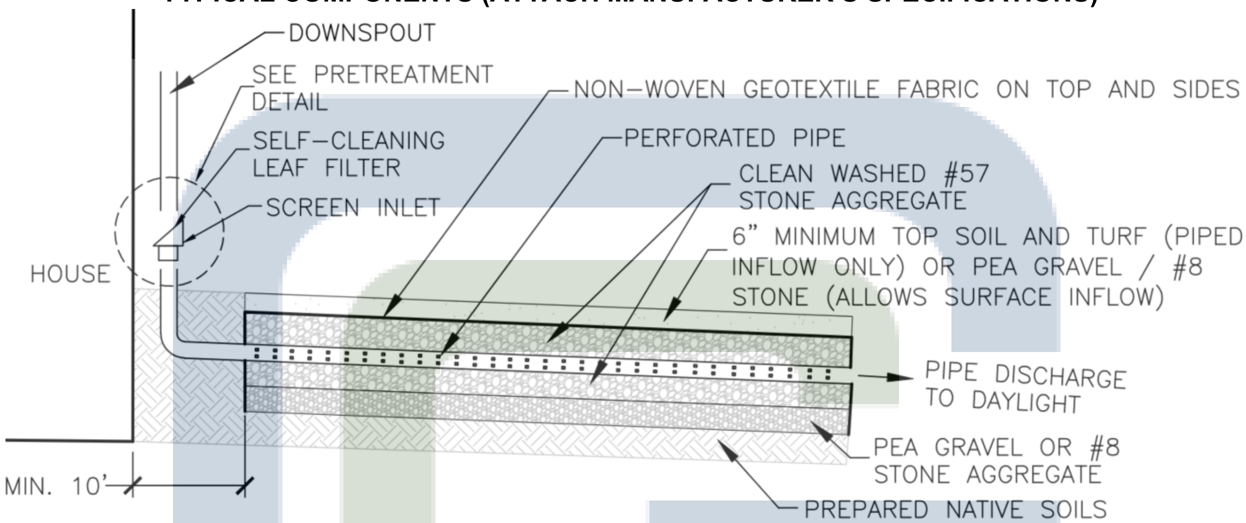
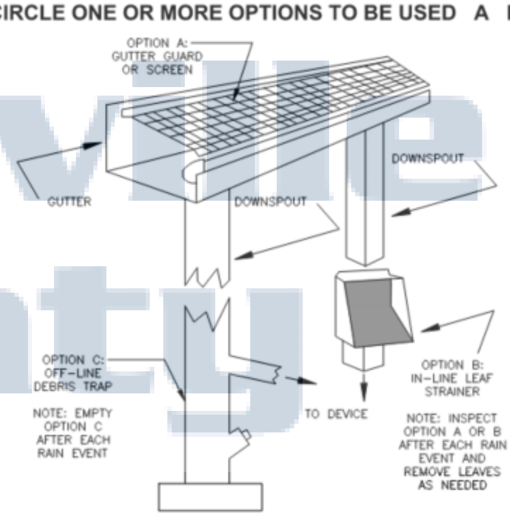
TYPICAL COMPONENTS (ATTACH MANUFACTURER'S SPECIFICATIONS)



CONSTRUCTION STEPS:

1. Review potential MFD areas and layout. MFDs should slope between 0.5% and 6% away from the structure and should not be located: (1) beneath an impervious (paved) surface; (2) above an area with a water table or bedrock less than two feet below the trench bottom; (3) over other utility lines; (4) within roadway right-of-way; or, (5) uphill from or within 20 feet of a septic drain field. Ensure outlet daylights at least 20 feet from property line.
2. Measure the area draining to the MFD and calculate the required volume of stone on the next page.
3. Determine the required length, width, and stone aggregate depth to provide the required volume of stone aggregate. Consider routing of flows, excavation depth, and space constraints on the site.
4. Infiltration rate testing is not necessary when using the required perforated pipe drain with a stable outlet that daylights. See specification Section 1.1 for detailed underdrain and infiltration requirements.
5. If the infiltration rate is greater than or equal to 1.0 in/hr, the contributing drainage area (square feet) may be decreased 10% for every 0.5 in/hr infiltration rate in excess of the required 0.5 in/hr. See Appendix A.
6. Measure elevations and lay out the MFD to the required dimensions, marking the route and required excavation depths. Often a level line (torpedo level) is used.
7. Excavate ditch to the specified depth. Be careful not to compact soils in the bottom. Level the bottom laterally as much as possible to maximize infiltration area. Roughen bottom to a depth of at least three inches and trim roots.
8. Place and secure non-woven geotextile fabric on sides of the excavation leaving enough to fold over the top.
9. Install a minimum of 4 inches of pea gravel or #8 stone across the bottom of the excavation.
10. Place and tamp stone in ditch to specified depth and install pipe.
11. Fold non-woven geotextile fabric over top of stone above the pipe.
12. Place topsoil and sod or pea gravel.
13. For rooftop runoff, provide one or more options shown on Pretreatment Options Detail (**circle selected options**). If trees are present, Option A and Option B or C are recommended. Strap and support as needed.
14. Create a safe overflow at least 20 feet from your property edge and ensure it is protected from erosion.

CIRCLE ONE OR MORE OPTIONS TO BE USED A B C



PRE-TREATMENT OPTIONS DETAIL

GREENVILLE COUNTY LAND DEVELOPMENT DIVISION	NAME/ADDRESS:	MFD SPECIFICATIONS PAGE 1 OF 2

SKETCH LAYOUT

PROVIDE PLAN AND ELEVATION VIEWS OF MFD AND HOUSE SHOWING ROOF AREA DIRECTED TO MFD AND KEY DIMENSIONS, CONNECTIONS AND OVERFLOW RELATIVE TO PROPERTY LINE. ATTACH ADDITIONAL PAGES IF NECESSARY.

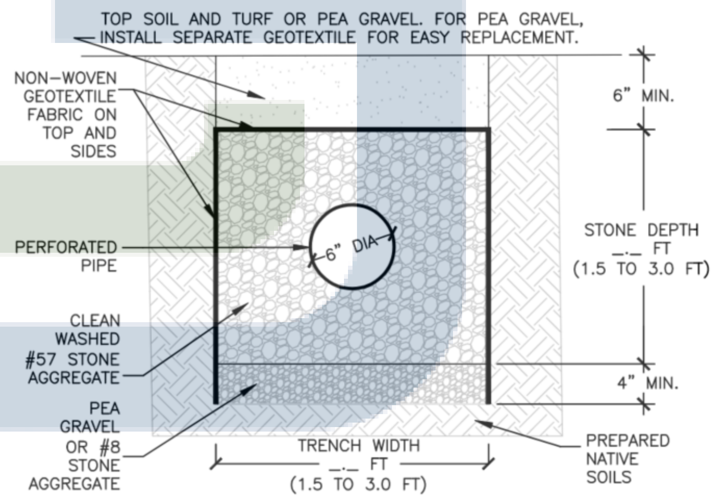
VOLUME REQUIRED:
0.21 CU FT OF STONE AGGREGATE TRENCH PER SQ FT OF CONTRIBUTING ROOF DRAINAGE AREA (21 CU FT PER 100 SF OF ROOF AREA)
_______ SQ FT ROOF AREA X 0.21 = _______ **FT^3**

DIMENSIONS OF MFD:
DEPTH OF STONE MEDIA= _______ FT
(1.5 TO 3.0 FT)
WIDTH OF MFD TRENCH= _______ FT
(1.5 TO 3.0 FT)
TOTAL LENGTH OF MFD= _______ FT
(SITE SPECIFIC)

VOLUME PROVIDED:
_____ FT X _____ FT X _____ FT = _________ **FT^3**

IS VOLUME PROVIDED ≥ VOLUME REQUIRED?
________ **(YES/NO)**

MFD CROSS SECTION: LABEL TRENCH WIDTH AND STONE DEPTH DIMENSIONS BELOW.



MAINTENANCE:
1. INSPECT GUTTERS AND DOWNSPOUTS REMOVING ACCUMULATED LEAVES AND DEBRIS, CLEANING LEAF REMOVAL SYSTEM(S).
2. IF APPLICABLE, INSPECT PRETREATMENT DEVICES FOR SEDIMENT ACCUMULATION. REMOVE ACCUMULATED TRASH AND DEBRIS.
3. INSPECT MFD FOLLOWING A LARGE RAINFALL EVENT TO ENSURE OVERFLOW IS OPERATING AND FLOW IS NOT CAUSING EROSION OR FLOODING PROBLEMS.

GREENVILLE COUNTY LAND DEVELOPMENT DIVISION	ATTACH THIS TWO-PAGE SPECIFICATION TO HOUSE PLAN SUBMITTAL	MFD SPECIFICATIONS PAGE 2 OF 2

SFR-04 PERMEABLE PAVERS

1.0 Permeable Pavers

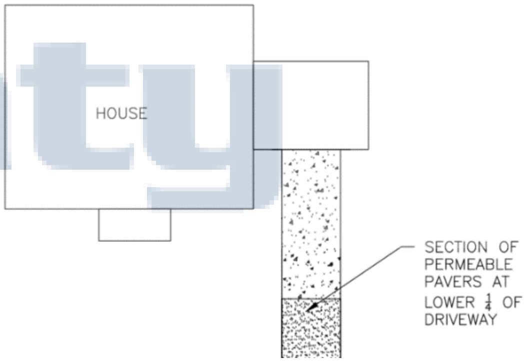
1.1 Description

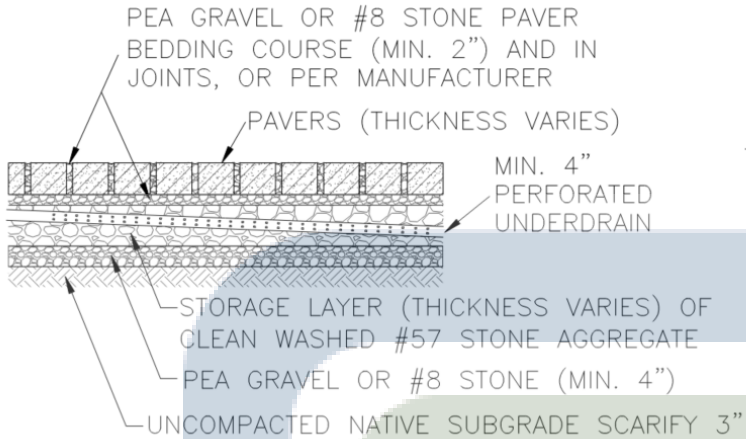
Permeable pavers are an alternative to traditional paving surfaces that can decrease stormwater runoff. They are well suited for use when constructing sidewalks, parking areas, patios, and driveways. Permeable pavers consist of permeable interlocking or grid concrete pavers underlain by a drainage layer. A permeable paver system allows stormwater runoff to pass in between the paver surface and into an underlying stone reservoir, where it is temporarily stored and allowed to infiltrate into the underlying soils. When properly sized, installed, and maintained, permeable pavers may provide reductions in stormwater runoff and pollutant loads.

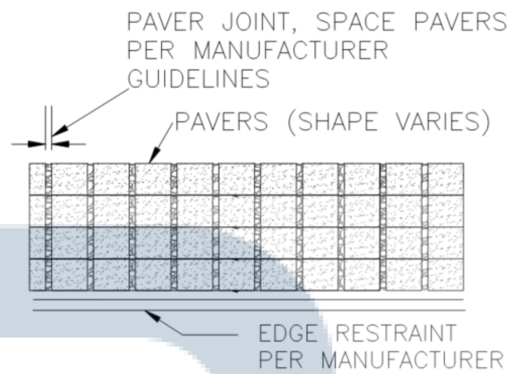
Permeable pavers are an infiltration-based LID practice which must reliably drain to function as designed. Many of the native soils in Greenville County do not allow for adequate infiltration, therefore a perforated underdrain is required. The perforated underdrain must flow to a stable outlet that daylights (emerges from the ground and is open to the air) or tie into a stormwater conveyance system. **If installation of an underdrain that daylights is infeasible, infiltration testing must be performed (see Appendix A) to demonstrate an infiltration rate of 0.5 in/hr in order to use permeable pavers.** If the infiltration rate is inadequate and an underdrain that daylights is infeasible, use other SFR practices.

1.2 Using Permeable Pavers

- Permeable paver systems should be located at least 10 feet from buildings foundations and 20 feet from property lines.
- Permeable pavers should not be located: (1) above an area with a water table or bedrock less than two feet below the gravel bottom; (2) over other utility lines; (3) within 10 feet of building foundations or 20 feet of property lines; (4) within roadway right-of-way; or, (5) uphill from or within 20 feet of a septic field. Always call 811 to locate utility lines before you dig.
- Permeable pavers should drain only impervious areas. Drainage from other areas onto the pavers will eventually clog them.
- For rooftop runoff that is directed to permeable pavers, provide gutters with pre-treatment including one or more of the options shown on the “tear-out” specifications sheet to prevent leaves, grit from roof shingles, and other debris from clogging the pavers.
- Permeable paver systems should be installed on slopes less than 6% to help ensure even distribution of runoff over the infiltration surface and should slope away from structures.
- Permeable pavers may be used for a portion of a driveway or parking area, ensuring it is downgradient from impervious areas that are to be treated. For example, the lower ¼ of a driveway could be permeable pavers that treats the upper ¾ of the driveway. See example at right.





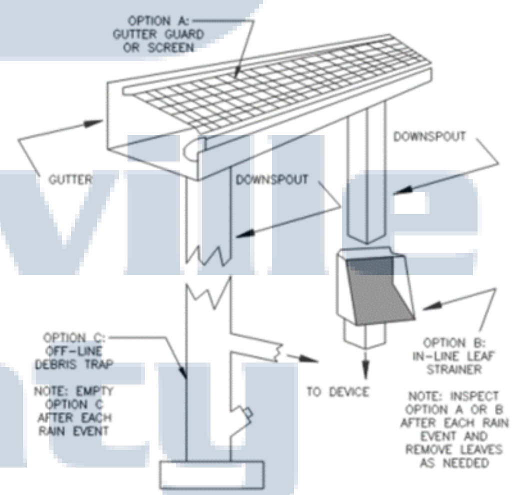


TYPICAL COMPONENTS (ATTACH MANUFACTURER'S SPECIFICATIONS)

CONSTRUCTION STEPS:

1. Review potential paver areas and layout. Pavers should slope away from the structure at less than 6% slope and should not be located: (1) above an area with a water table or bedrock less than two feet below the trench bottom; (2) over utility lines; (3) within 10 feet of building foundations or 20 feet of property lines; (4) within roadway right-of-way; or, (5) uphill from or within 20 feet of a septic field.
2. Measure the area draining to the pavers and determine required paver area from the table on the next page based on the depth of the lower stone storage layer.
3. Infiltration rate testing is not necessary when using the required perforated underdrain. If an underdrain is infeasible, see Appendix A for soil infiltration rate testing and requirements.
4. If the infiltration rate is greater than or equal to 1.0 in/hr, the area of pavers (square feet) may be decreased 10% for every 0.5 in/hr infiltration rate in excess of the required 0.5 in/hr. See Appendix A for soil infiltration testing and requirements.
5. Excavate area to appropriate depth and scarify soil to 3-4".
6. Install non-woven geotextile fabric along the sides of the excavation. Do not install across the bottom of the excavation, due to potential for clogging and failure.
7. Install a minimum of 4 inches of pea gravel or #8 stone across the bottom of the excavation, or follow manufacturer's specifications if applicable.
8. Place, level, and compact clean washed #57 stone to planned depth.
9. Place, level and compact #8 stone or pea gravel bedding layer. Two inch minimum depth.
10. Lay paving stone one at a time or using mechanical placement as applicable. Cut stone at edges to fit.
11. Install edge restraints per manufacturer's specifications.
12. Sweep more #8 stone or pea gravel into stone joints until filled and even, or follow manufacturer guidance. Some paver systems specify open joints.
13. For rooftop runoff, provide one or more options shown on Pretreatment Options Detail (**circle selected options**). If trees are present, Option A and Option B or C are recommended. Strap and support as needed.
14. This detail and these steps represent a typical installation, but always follow manufacturer's recommendations when available.

CIRCLE ONE OR MORE OPTIONS TO BE USED A B C



PRE-TREATMENT OPTIONS DETAIL

GREENVILLE COUNTY LAND DEVELOPMENT DIVISION	NAME/ADDRESS:	PERMEABLE PAVER SPECIFICATIONS PAGE 1 OF 2

SKETCH LAYOUT

PROVIDE PLAN AND ELEVATION VIEWS OF PERVIOUS PAVER AND HOUSE SHOWING ROOF AREA DIRECTED TO PAVERS AND KEY DIMENSIONS, CONNECTIONS AND ANY APPLICABLE OVERFLOW RELATIVE TO PROPERTY LINE. ATTACH ADDITIONAL PAGES IF NECESSARY.

SIZING CALCULATION:

Contributing Drainage Area (square feet)	Depth of Lower Stone Storage Layer (inches)				
	3	4	5	6	8
	Area of Pavers (square feet)				
100	54	45	39	34	27
500	280	230	200	170	140
1000	550	460	390	340	280
2000	1090	910	780	680	550
3000	1630	1360	1170	1020	820
4000	2180	1810	1560	1360	1090
5000	2720	2270	1940	1700	1360

MEASURE CONTRIBUTING DRAINAGE AREA AND READ AREA OF PAVERS FOR GIVEN LOWER STONE STORAGE LAYER DEPTH. FOR SPECIFIC DRAINAGE AREAS NOT LISTED ON TABLE, INTERPOLATE BETWEEN THE CLOSEST VALUES LISTED.

CONTRIBUTING DRAINAGE AREA= _________ SQ FT
DEPTH OF STONE MEDIA= _________ INCHES
PAVER AREA= ________ SQ FT

MAINTENANCE:

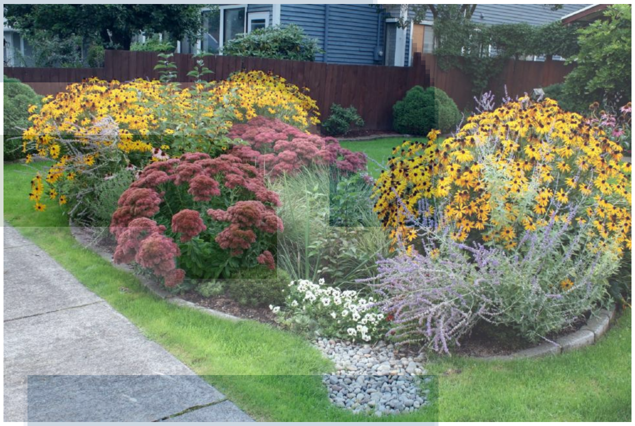
1. REMOVE ACCUMULATED SEDIMENT AND DEBRIS FROM JOINT SPACE MONTHLY.
2. OBSERVE THE PERMEABLE PAVER SYSTEM FOR EXCESSIVE PONDING DURING STORM EVENTS AND REPAIR AS NEEDED.
3. VACUUM, SWEEP, OR BLOW PERMEABLE PAVER SURFACE QUARTERLY TO KEEP THE SURFACE FREE OF SEDIMENT. NEW STONE MAY NEED TO BE SWEPT INTO THE JOINTS AS NEEDED.
4. INSPECT PERMEABLE PAVER SURFACE FOR DETERIORATION ANNUALLY. REPAIR OR REPLACE ANY DAMAGED AREAS AS NEEDED.

Greenville County Technical Specification for:

SFR-05 RAIN GARDENS

1.0 Rain Gardens

1.1 Description



Rain gardens are small, landscaped depressions that are filled with a mix of native soil or sand and compost and are planted with trees, shrubs and other garden-like vegetation. They are designed to temporarily store stormwater runoff from rooftops, driveways, patios and other areas around your home while reducing runoff rates and pollutant loads in your local watershed. A rain garden can be a beautiful and functional addition to a landscape plan. When properly sized, installed, and maintained, rain gardens may provide reductions in stormwater runoff and pollutant loads.

Rain gardens are an infiltration-based LID practice which must reliably drain to function as designed. Many of the native soils in Greenville County do not allow for adequate infiltration, therefore a perforated underdrain is required. The perforated underdrain must flow to a stable outlet that daylights (emerges from the ground and is open to the air) or tie into a stormwater conveyance system. **If installation of an underdrain that daylights is infeasible, infiltration testing must be performed (see Appendix A) to demonstrate an infiltration rate of 0.5 in/hr in order to use a rain garden.** If the infiltration rate is inadequate and an underdrain that daylights is infeasible, use other SFR practices.

1.2 Using Rain Gardens

- Rain gardens should be located to receive the maximum amount of stormwater runoff from impervious surfaces, and where downspouts or driveway runoff can enter garden flowing away from the home.
- Swales, berms, or downspout extensions may be helpful to route runoff to the rain garden.
- Locate at least 10 feet from building foundations and 20 feet from property lines, not within the roadway right-of-way, away from utility lines, not uphill from or within 20 feet of septic fields, and not near a steep bluff edge. Call 811 before you dig to locate the utility lines on your property.
- Rain gardens on steep slopes (>10%) may require an alternative design with terracing.

1.3 Construction

- The size of the rain garden will vary depending on the impervious surface draining to it and the depth of the filter media. See sizing table on “tear-out” specifications sheet.
- A maximum ponding depth of 6-8 inches is allowed within rain gardens. On average, rain gardens drain within a day which will not create a mosquito problem.
- Design rain garden entrance to immediately intercept inflow and reduce its velocity with stones, dense hardy vegetation or by other means.
- If sides are to be mowed rain gardens should be designed with side slopes of 3:1 (H:V) or flatter.

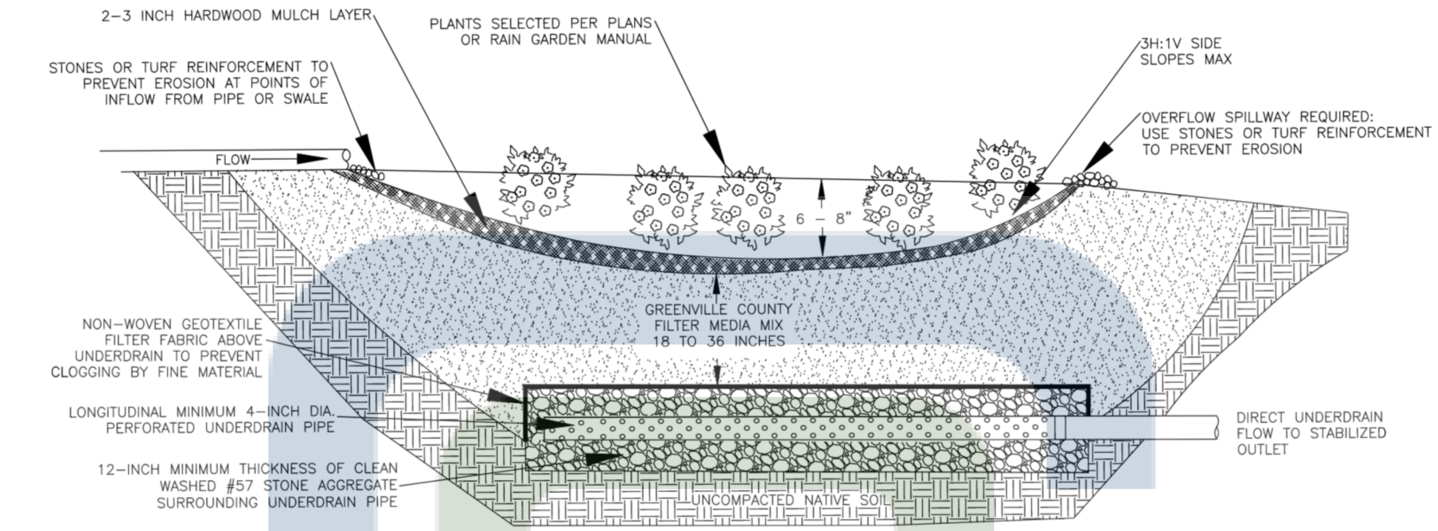
- For best results, it is suggested to test your soil characteristics as you would for a garden, or contact the Clemson Home & Garden Information Center for help https://hgic.clemson.edu/factsheet/soil-testing/.
- Filter media for rain gardens should be the Greenville County Filter Media Mix. See Appendix B for description of filter media requirements and local suppliers.
- A mulch layer consisting of 2-3 inches of non-floatable organic mulch (fine shredded hardwood mulch, pine straw, or leaf compost) should be included on the surface of the rain garden. Pine bark and wood chips should not be used.
- Often rain gardens have a better appearance and can be more easily maintained if they have defined edges, similar to a normal garden.
- The overflow from the rain garden should be non-eroding and can consist of a small berm or even an inlet grate set at the proper elevation in the garden. The grate should be set at a slant or be domed to allow clogging debris to fall off.
- If you elect to measure infiltration rate (see Appendix A) and find it is greater than or equal to 1.0 in/hr, the rain garden size can be reduced. For every 0.5 in/hr increase in measured infiltration rate above the required 0.5 in/hr, subtract ten percent of the required rain garden area (square feet).

1.3.1 Vegetation

- Vegetation commonly planted in rain gardens includes native trees, shrubs and other herbaceous vegetation. When developing a landscaping plan, you should choose vegetation that will be able to stabilize soils and tolerate the stormwater runoff rates and volumes that will pass through the rain garden.
- Vegetation used in rain gardens should also be able to tolerate both wet and dry conditions. See The Carolina Yards Plant Database (https://www.clemson.edu/extension/carolinayards/plant-database/index.html) and The South Carolina Waterways Fact Sheet Series (https://hgic.clemson.edu/category/water/) for more information on grasses and other plants that are appropriate for use in rain gardens. Links are provided to assist with finding information but may change. If the specific link does not work, search Clemson University extension online publications for rain garden planting information.
- As with any garden in the first season the vegetation may require irrigation to become well established. It may be appropriate to plant more densely than a normal garden to obtain the benefit of plant soil stabilization and evapotranspiration as soon as possible.

1.4 Maintenance

Routine garden maintenance should include weeding, deadheading, replacing dead plants, and replenishing mulch when depleted. Catching areas of erosion is also important as is correcting standing water problems. If standing water persists it may be necessary to place a perforated underdrain in the garden daylighting downstream.



TYPICAL COMPONENTS

CONSTRUCTION STEPS:

1. Locate rain garden(s) where downspouts or driveway runoff can enter garden flowing away from the home. Locate at least 10 feet from building foundations or 20 feet from property lines, not within the roadway right-of-way, away from utility lines, not uphill from or within 20 feet of septic fields, and not near a steep bluff edge.
2. Measure the area draining to the planned garden and determine required rain garden surface area from the table on the next page and your planned excavation depth.
3. Infiltration rate testing is not necessary when using the required perforated underdrain. If an underdrain is infeasible, see Appendix A for soil infiltration rate testing and requirements.
4. If the infiltration rate is greater than or equal to 1.0 in/hr, the area of rain garden (square feet) may be decreased 10% for every 0.5 in/hr infiltration rate in excess of the required 0.5 in/hr. See Appendix A.
5. Measure elevations and stake out the garden to the required dimensions ensuring positive flow into garden. Establish an overflow elevation that allows for 6-8 inches of ponding, and a perimeter of the garden that is higher than the overflow point. Incorporate existing slope of the land as needed and provide erosion prevention.
6. Remove turf or other vegetation in the area of the rain garden. Excavate garden being careful not to compact soils in the bottom of the garden. Level bottom of garden to maximize infiltration area.
7. Install the perforated underdrain pipe and surround with stone aggregate. Install non-woven geotextile fabric above the underdrain and stone to prevent downward migration of fine material.
8. Do not wrap the entire underdrain with fabric, which may impede flow from entering the underdrain from the sides.
9. Obtain Greenville County Filter Media Mix (see Appendix B) to use for media layer and install as specified.
10. Fill rain garden with the required filter media, leaving room for the mulch layer and ponding depth. The surface of the rain garden should be as level as possible.
11. Build a berm at the downhill edge and sides of the rain garden with the remaining subsoil. The top of the berm needs to be level and set at the maximum ponding elevation.
12. Plant the rain garden using a selection of plants described previously in SFR-05 section 1.3.1.
13. Mulch the surface of the rain garden with two to three inches of non-floating organic mulch. The best choice is shredded hardwood mulch.
14. Water all plants thoroughly. As in any new garden or flower bed, regular watering will likely be needed to establish plants during the first growing season.
15. During construction, ensure inflow locations are stable and protected from erosion. Test the drainage of water from the source to the garden prior to finishing.
16. Create an overflow at least 20 feet from your property edge and 10 feet from building foundations and ensure it is protected from erosion.

GREENVILLE COUNTY LAND DEVELOPMENT DIVISION	NAME/ADDRESS:	RAIN GARDEN SPECIFICATIONS PAGE 1 OF 2

SKETCH LAYOUT

PROVIDE PLAN VIEWS OF RAIN GARDEN AND HOUSE SHOWING DRAINAGE AREA DIRECTED TO RAIN GARDEN AND KEY DIMENSIONS AND OVERFLOW AREA RELATIVE TO PROPERTY LINE. ATTACH ADDITIONAL PAGES IF NECESSARY.

SIZING CALCULATION:

Contributing Drainage Area (square feet)	Depth of Filter Media (inches)			
	18	24	30	36
	Area of Rain Garden (square feet)			
100	6.6	5.7	5.1	4.6
500	35	30	25	23
1000	65	60	50	45
2000	135	115	100	90
3000	200	170	150	140
4000	260	230	200	185
5000	330	290	255	230

MEASURE CONTRIBUTING DRAINAGE AREA AND READ RAIN GARDEN AREA FOR GIVEN MEDIA DEPTH. FOR SPECIFIC DRAINAGE AREAS NOT LISTED ON TABLE, INTERPOLATE BETWEEN THE CLOSEST VALUES LISTED.

CONTRIBUTING DRAINAGE AREA= ________ SQ FT
DEPTH OF FILTER MEDIA= __________ INCHES
AREA OF RAIN GARDEN= _______ SQ FT

MAINTENANCE:

1. IRRIGATE VEGETATION AS NEEDED IN FIRST SEASON
2. REMOVE WEEDS
3. REPLACE UNSUCCESSFUL PLANTINGS
4. REPLENISH MULCH
5. REPAIR ERODED AREAS
6. RAKE CLOGGED SURFACE TO RESTORE INFILTRATION
7. MONITOR RAIN GARDEN FOR APPROPRIATE DRAINAGE TIMES; IF GARDEN DOES NOT DRAIN, UNDERDRAIN MAINTENANCE OR MODIFICATIONS MAY BE NECESSARY

SFR-06 WATER QUALITY BUFFER

1.0 Water Quality Buffer

1.1 Description

In the context of Single Family Residential (SFR) developments, a water quality buffer is an undisturbed natural area along the lot perimeter which filters runoff, encourages infiltration, and functions as a LID practice. Water quality buffers may also provide protection of waterbodies when they are located along a lake, wetland, creek or stream. Development is restricted or prohibited in the water quality buffer to prevent impacts to the waterbody or adjacent properties. In addition, the water quality buffer provides the following:

- Protection to the overall stream or waterbody quality by providing shade for the stream or waterbody (if present),
- Natural habit for wildlife, and
- A setback from the stream or waterbody, when applicable, to prevent damage to structures or improved property due to flooding or changes in the stream or waterbody.

Ideally, water quality buffers are natural and undisturbed. When a buffer must be disturbed (or has previously been disturbed), promptly replant a dense cover of strong rooted grasses, native plants, and native trees.

For more information on water quality buffers, see Greenville County Specification WQ-11 Permanent Water Quality Stream Buffers.

1.2 Using Water Quality Buffers

- The most effective natural undisturbed water quality buffers for protecting water quality are those that consist of undisturbed natural vegetation, including maintaining the original tree line along the stream or channel banks, when applicable.
- The buffer should remain undisturbed to the maximum extent practical. Any area that is temporarily disturbed should be immediately replanted with a dense cover of strong rooted natural grasses, native plants, and native trees.
- Buffers may also be created or enhanced by planting new vegetation of native varieties.
- The ideal slope of the buffer is less than 8% to prevent flows that may cause erosion of the buffer and/or stream bank.
- Water quality buffers may not be located within the roadway right-of-way.
- The length of the buffer should be no less than 25 feet. If there is a permeable berm at the lower end, the length of the buffer should be no less than 15 feet. Note that bermed water quality buffers should not be located uphill from or within 20 feet of a septic field.
- The surface impervious area to any one discharge location cannot exceed 5,000 square feet.

1.3 Construction

- Measure the rooftop and any other area that is going to be directed to the water quality buffer. See sizing table on “tear-out” specifications sheet. From the site layout drainage area, select the size and type of buffer from the table.
- There are three types of buffers: disturbed, undisturbed, and berm. Undisturbed conditions or a berm reduces the required size of the stream buffer, as shown in the sizing table.
- Undisturbed buffers are likely to be less compacted and more likely to contain dense, well-established, vegetation. For these reasons, undisturbed buffers typically provide better stream protection (when applicable), infiltration, and pollutant removal.
- For example, a 1,000 square foot rooftop with a disturbed buffer would require at least 2,000 square feet of area with a minimum flow length of 25 feet. The use of an undisturbed buffer reduces the required area to 670 square feet, still with a minimum flow length of 25 feet. If a berm is added to undisturbed conditions, it can have a surface area of 500 square feet and have a minimum flow length of 15 feet.

1.3.1 Berm Design Option

- Buffer area can be further reduced through the use of a permeable berm at the bottom end of the buffer. The permeable berm is used to temporarily store stormwater runoff within the buffer, which increases the infiltration and reduces the required width of the buffer.
- Permeable berms should be constructed of well drained soils (sand, gravels, and sandy loams) that support plant growth and should be no more than 12” high.
- Appropriately sized outlets should be provided within permeable berms to ensure that the buffer will drain within 24 hours following the end of a rainfall event.
- A stone-protected overflow area through the berm may be used to manage the stormwater runoff generated by large storm events. The overflow point must be at least 10 feet from building foundations and 20 feet from the property line if flow is onto adjoining property. Erosion protection is critical.
- Bermed water quality buffers should not be located uphill from or within 20 feet of a septic field.

1.3.2 Level Spreader

- All water quality buffers require a level spreader to be used at the upstream end of the buffer to evenly distribute stormwater runoff into the water quality buffer. The level spreader must be located at least 10 feet from building foundations.
- The standard level spreader for this application is a small stone trench filled with river rock, pea gravel, or #8 stone installed along a level contour. This stone trench should be 6” to 12” wide and 6” to 12” deep. Larger diameter stone may be required to stabilize entry points for larger contributing impervious areas.
- When applicable, the level spreader may be connected to a downspout through a T-connection to perforated pipes embedded in the stone trench.
- Alternatively, a level spreader may be constructed using manufactured landscape or playground borders/barriers (plastic or recycled material only; no lumber ties or railroad ties). This installation requires a 2” drop on the downstream side to ensure positive flow (see detail on “tear out” specifications sheet).

- Ensure level spreader overflow points are protected from erosion and not blocked by vegetation.
- If the impervious drainage area to any one entry point (e.g. a downspout) is less than or equal to 300 square feet, requirement for a level spreader **may** be waived if flow will flow as a sheet through the water quality buffer area. In this case splash blocks or downspout protection pads can be used to introduce flow into water quality buffer areas instead of a level spreader. Drainage areas greater than 300 square feet require construction of the level spreader. Vegetation requirements (below) for the water quality buffer are the same regardless of use of level spreader or other energy dissipation.

1.3.3 Vegetation

- Vegetation commonly present in water quality buffers includes turf, trees, shrubs, and other herbaceous vegetation.
- When planting is necessary, choose grasses and other vegetation that will be able to tolerate the stormwater runoff rates and volumes that will pass through the buffer.
- Vegetation used in water quality buffers should be able to tolerate both wet and dry conditions.

1.4 Maintenance

Clearly mark the buffer extents before construction begins to prevent unnecessary disturbance. After construction, maintain the level spreader and buffer vegetation as needed. Removal of invasive species or diseased plants and planting of new native species is permitted, so long as disturbance from these activities is minimized and the area is replanted.

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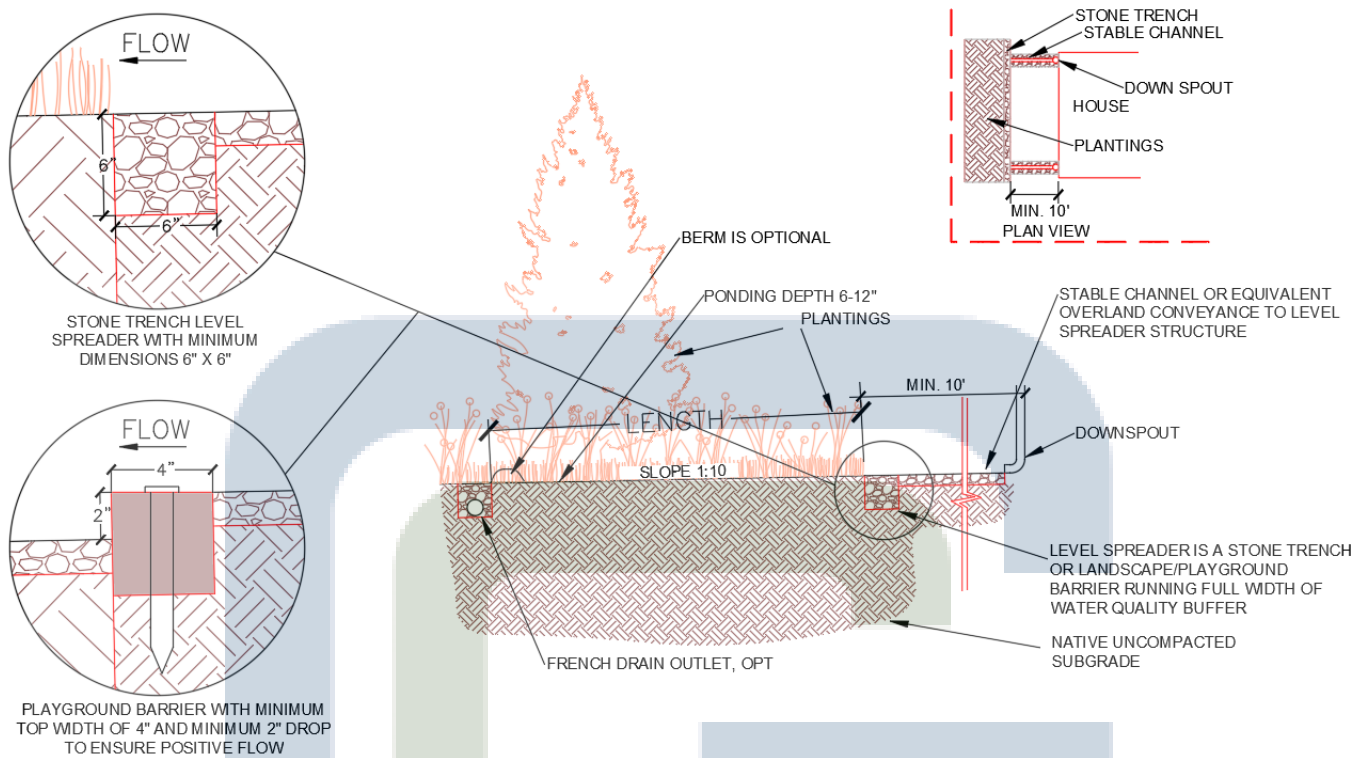


TYPICAL COMPONENTS

CONSTRUCTION STEPS:

1. Review potential water quality buffer areas and layout. Water quality buffer areas should not exceed 8% slope and should direct water away from the home or other structures. Water quality buffers may not be located within the roadway right-of-way.
2. Bermed water quality buffers should not be located uphill from or within 20 feet of a septic field. If there is a concentrated overflow, ensure it is at least 10 feet from building foundations and 20 feet from adjacent property lines.
3. Measure the area draining to the water quality buffer and determine required surface area and minimum length from the table on the next page. Determine the desired buffer and level spreader options. **All runoff entering the buffer must be sheet flow**.
4. Water quality buffer should be undisturbed when possible but may be replanted if disturbance is unavoidable.
5. Lay out and mark buffer area to remain undisturbed as well as level spreader location.
6. Construct level spreader by filling trench with appropriate stone and noting overflow points.
7. Construct water quality buffer option. Install berm if applicable.
8. Construct erosion control at the flow entrance and exit points as applicable.
9. If natural vegetation is sparse in some areas, plant dense vegetation according to plan, or sod/seed. Ensure an irrigation plan is in place if needed.
10. Ensure temporary erosion control is in place as needed until vegetation establishment.

GREENVILLE COUNTY LAND DEVELOPMENT DIVISION	NAME/ADDRESS:	WATER QUALITY BUFFER SPECIFICATIONS

SKETCH LAYOUT

PROVIDE PLAN AND ELEVATION VIEWS OF WATER QUALITY BUFFER AND HOUSE SHOWING ROOF AREA DIRECTED TO WATER QUALITY BUFFER AND KEY DIMENSIONS, CONNECTIONS AND OVERFLOW RELATIVE TO PROPERTY LINE. ATTACH ADDITIONAL PAGES IF NECESSARY.

SIZING CALCULATION:

Contributing Drainage Area (square feet)	WQ Buffer Type		
	Disturbed	Undisturbed	Berm
	WQ Buffer Area (sq ft)		
100	200	70	50
500	1000	350	250
1000	2000	670	500
2000	4000	1400	1000
3000	6000	2700	1500
4000	8000	5400	2000
5000	10000	6700	2500

MEASURE CONTRIBUTING DRAINAGE AREA AND READ BUFFER AREA FOR GIVEN BUFFER TYPE. FOR SPECIFIC DRAINAGE AREAS NOT LISTED ON TABLE, INTERPOLATE BETWEEN THE CLOSEST VALUES LISTED.

CONTRIBUTING DRAINAGE AREA= ________ SQ FT
FILTER STRIP AREA= _______ SQ FT
CONVENTIONAL – 25’ MINIMUM LENGTH
BERM OPTION – 15’ MINIMUM LENGTH

MAINTENANCE:

1. INSPECT GUTTERS AND DOWNSPOUTS REMOVING ACCUMULATED LEAVES AND DEBRIS, CLEANING LEAF REMOVAL SYSTEM(S).
2. IF APPLICABLE, INSPECT PRETREATMENT DEVICES FOR SEDIMENT ACCUMULATION. REMOVE ACCUMULATED TRASH AND DEBRIS.
3. WATER AS NEEDED TO PROMOTE PLANT GROWTH AND SURVIVAL ESPECIALLY IN THE FIRST TWO SEASONS.
4. LEAVE UNDISTURBED AS MUCH AS POSSIBLE BUT PROVIDE VEGETATION MAINTENANCE - MOW, PRUNE, AND TRIM AS NEEDED.
5. INSPECT THE WQ BUFFER FOLLOWING RAINFALL EVENTS. FIX EROSION ISSUES IMMEDIATELY.

APPENDIX A: INFILTRATION TESTING

When Do I Need to Do Infiltration Testing?

The following SFR LID practices are infiltration-based features which must reliably drain (into the soil or through an underdrain that daylights to a stable outlet) to function as designed:

- SFR-01 Dry Well
- SFR-03 Modified French Drain
- SFR-04 Permeable Pavers
- SFR-05 Rain Gardens

The sizing criteria in the individual specifications are based on a required infiltration rate of 0.5 inches per hour. **Many of the native soils in Greenville County do not allow for adequate infiltration, therefore a perforated underdrain is required for these infiltration-based LID practices. No infiltration testing is required when using the required perforated underdrain.**

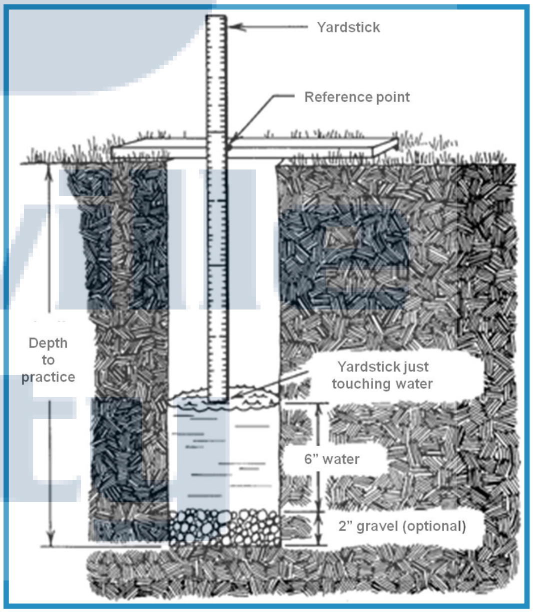
Infiltration testing may be done in either of the following two scenarios:

1. Perforated Underdrain Infeasible: If a functioning perforated underdrain is infeasible due to flat slopes (cannot install an underdrain with positive flow to a stable outlet that daylights) at the location of the infiltration-based LID practice and there are no other possible locations on site, then the following infiltration test may be performed to determine whether an infiltration-based SFR LID practice (listed above) may be installed without a perforated underdrain. The test must return a minimum infiltration rate of 0.5 inches per hour to allow installation without a perforated underdrain. If the test indicates the infiltration rate is less than 0.5 inches per hour and an underdrain is infeasible, then infiltration-based features are not applicable and other SFR LID practices should be used.
2. Verify High Infiltration Rate to Reduce BMP Size: If the site soils have an infiltration rate greater than or equal to 1.0 inch per hour, the size of infiltration-based SFR LID practices (listed above) may be reduced. At the discretion of the property owner, the following infiltration test may be conducted to assess infiltration rate. For every 0.5 inches per hour in excess of the required 0.5 inches per hour, the SFR LID practice size may be reduced by 10% (e.g. an infiltration rate of 1 inch per hour allows a decrease in size by 10%, an infiltration rate of 1.5 inches per hour allows a decrease in size by 20%, etc.) See each individual SFR LID practice specification and detail for the practice-specific size adjustment procedure.

Testing Infiltration: A Simple Approach

When applicable, the following simplified test may be used to determine the infiltration rate of your site's soils.

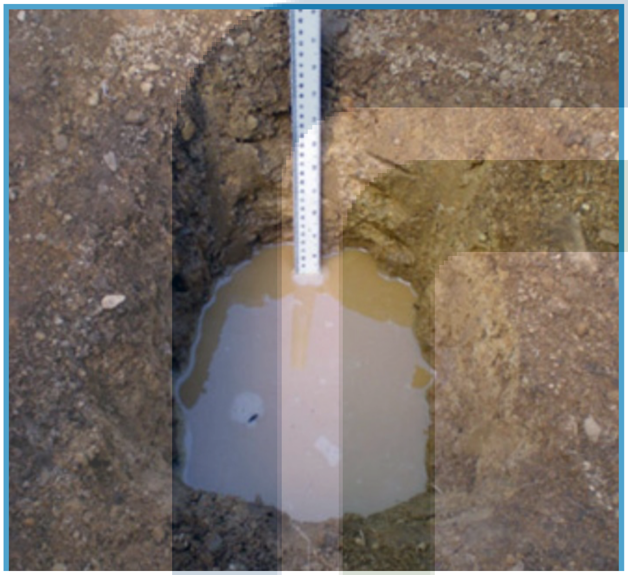
1. Locate the approximate center of the area where you expect to build your feature.
2. Dig an access pit down to the bottom of the amended soils or stone aggregate layer in the feature.
3. At that elevation dig a narrow test hole at least eight inches deep. You can optionally place 2" of coarse gravel in the bottom. The test hole can be excavated with small excavation equipment or by hand using a spade shovel or post-hole digger.
4. If you run into a hard layer that cannot be penetrated with a shovel or, you come across water in the hole, stop. **Infiltration features should not be sited over impenetrable rock surfaces or over high water tables**, so your site is inappropriate.
5. Place a flat board across the hole to serve as a measuring point (see figure).
6. Fill the hole with water to a depth of six inches. Measure from the flat board to the water surface. Record the exact time you stop filling the hole and the height of the water every 10 minutes for



Source: modified from www.ag.ndsu

fast draining soils for a minimum of one hour or every 30 minutes for slow draining soils for a minimum of two hours.

7. Refill the hole again and repeat step 6 twice more. The third test will give you the best measure of how quickly your soil absorbs water when it is fully saturated.
8. If on the third test the water is dropping at least ½" per hour, the soil will work for infiltration-based LID practices. If the water is dropping at least 1" hour, you may make be able to reduce the size of the infiltration-based LID practice at that location.


Source: https://newsstand.clemson.edu


Source: www.learntogrow.com

APPENDIX B: GREENVILLE COUNTY FILTER MEDIA MIX

When constructing a Rain Garden as a Single Family Residential (SFR) lot stormwater practice, use the Greenville County filter media mix. Greenville County has made updates to the filter media mix that is utilized for SFR Rain Gardens as well as other Low Impact Development (LID) practices for larger sites.

What is the required filter media mix?

LID practices improve water quality by filtering stormwater runoff though a permeable filter media. The specification for this filter media mix has been updated to the following:
The filter media shall be a uniform mix of sand and organic material meeting the following criteria.

- 80% medium to coarse washed sand
  - Use Masonry Sand
  - River Sand is NOT acceptable
- 20% stable composted material
  - Composted leaf/yard waste and organic/food waste are acceptable
  - Manure-based compost is NOT acceptable
- pH between 5.2 and 8.0 with an optimal range of 6.0 to 7.5

Receipt from the landscape supplier and documentation of pH test results must be provided to the County before construction of the LID practice to verify compliance with these requirements.

Why was the mix updated?

Updates to the filter media mix were made for the following reasons:

1. Water Quality: To ensure that filter media and LID practices are effective at pollutant removal to improve water quality of stormwater runoff and Greenville County waterbodies.
2. Ease of Implementation: To specify filter media that is composed of locally available materials and can be provided pre-mixed by landscape suppliers in Greenville County without extensive testing.
3. Encourage LID: To streamline the process of acquiring, filter media and encourage the use of for LID practices in Greenville County.
4.

Where do I get it?

There are landscape suppliers in Greenville County which have confirmed they can pre-mix and provide this filter media to order. Contact them in advance to arrange for timely filter media preparation.

Landscape Supplier	Website	Phone Number
Upstate Materials	http://upstatematerialsandmulch.com/	864-220-5154
Hensons' Inc. Mulch and More	http://hensonsinc.net/	864-963-9330

Who to contact with further questions?

Additional information is available in the Greenville County Stormwater Management Design Manual (https://www.greenvillecounty.org/LandDevelopment/DesignManual.aspx).
Further questions may be directed to:
Greenville County Land Development Division
301 University Ridge Suite 3900
Greenville, SC 29601
864-467-4610
landdevelopment@greenvillecounty.org

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APPENDIX C: WATER QUALITY EASEMENT PLAT CHECKLIST

When constructing a site utilizing Single Family Residential (SFR) Green Infrastructure stormwater practices, a water quality easement plat prepared by a licensed surveyor is required in order to document the practice, ensure correct installation for long term function, and provide permanent access for maintenance.

What is required to be included on the Water Quality Easement Plat?

1. A note that the SFR stormwater management feature will be placed within a water quality easement.

2. Location, dimensions, and size of the following:
   - all structures (home, garage, swimming pools, storage buildings etc.)
   - driveways
   - septic location (if on sewer, specify)
   - any buffers from water bodies/wetlands
   - all SFR practices and their distance from septic and building foundations

3. The following are required information, based on the specific SFR practice installed.
   a. For **Dry Well (SFR-01)**:
      - volume of storage tank (gallons) if present
      - dimensions of pit before it is filled (depth, either diameter or length and width)
      - depth of stone (bottom of pit previously surveyed to top of installed stone)
      - top, bottom, and outfall location of the underdrain
      - diameter (inches) of underdrain
      - location of connection with the home downspouts

   b. For **Vegetated Filter Strip (SFR-02)** and **Water Quality Buffer (SFR-06)**:
      - location of level spreader
      - length and width of level spreader
      - depth of excavated level spreader trench before it is filled
      - depth of stone (bottom of trench previously surveyed to top of stone)
      - length and width of vegetated treatment area
      - if amended soil option for Vegetated Filter Strip is chosen
        - depth of excavation for amended soil
        - depth of amended soil (bottom of excavation previously surveyed to top of amended soil)

   c. For **Modified French Drain (SFR-03)**:
      - dimensions of trench before it is filled (depth, length, width)
      - depth of stone (bottom of trench previously surveyed to top of installed stone)
      - top, bottom, and outfall location of the perforated pipe
      - diameter (inches) of perforated pipe
      - location of connection with the home downspouts

   d. For **Permeable Pavement (SFR-04)**:
      - top, bottom, and outfall location of the underdrain
      - length and width of Permeable Pavement area
      - depth of excavation for subbase before it is filled
      - depth of subbase stone (bottom of excavation previously surveyed to top of installed subbase stone)

   e. For **Rain Garden (SFR-05)**:
      - top, bottom, and outfall location of the underdrain
      - length and width of Rain Garden area
      - depth of excavation for media before it is filled
      - depth of media (bottom of excavation previously surveyed to top of installed media)

Who to contact with further questions?

Further questions may be directed to the Greenville County Land Development Division's Low Impact Development (LID) Inspector at 864-467-4610, landdevelopment@greenvillecounty.org

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