

**VIRGINIA DEQ STORMWATER
DESIGN SPECIFICATION No. 1****ROOFTOP (IMPERVIOUS SURFACE)
DISCONNECTION****VERSION 1.9****March 1, 2011****SECTION 1: DESCRIPTION**

This strategy involves managing runoff close to its source by intercepting, infiltrating, filtering, treating or reusing it as it moves from the impervious surface to the drainage system. Two kinds of disconnection are allowed: (1) simple disconnection, whereby rooftops and/or on-lot residential impervious surfaces are directed to pervious areas, and (2) disconnection leading to an alternative runoff reduction practice(s) adjacent to the roof (**Figure 1.1**). Alternative practices can use less space than simple disconnection and can enhance runoff reduction rates. Applicable practices include:

- Soil compost amended filter path [Stormwater (SW) Design Spec 4]
- Infiltration by micro-infiltration practice (dry wells or french drains, SW Design Spec 8)
- Filtration by rain gardens or micro-bioretenion (SW Design Spec 9)
- Storage and reuse with a cistern or other vessel (rainwater harvesting) (SW Design Spec 6)
- Storage and release in a stormwater planter. (SW Design Spec 9, Appendix A)

Larger scale (e.g., commercial) applications that utilize disconnection and/or sheetflow for runoff reduction credit should consult Stormwater Design Specification 2: Filter Strips.

Figure 1.1 portrays various rooftop disconnection and alternative runoff reduction options.

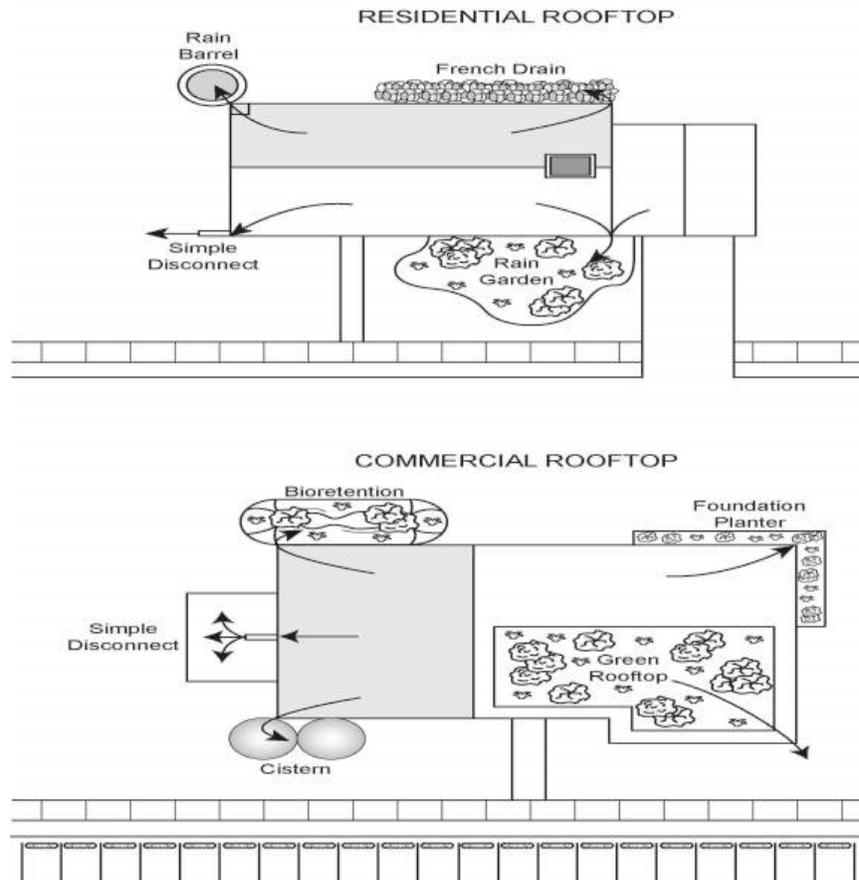


Figure 1.1 Roof Disconnection with Alternative Runoff Reduction Practices

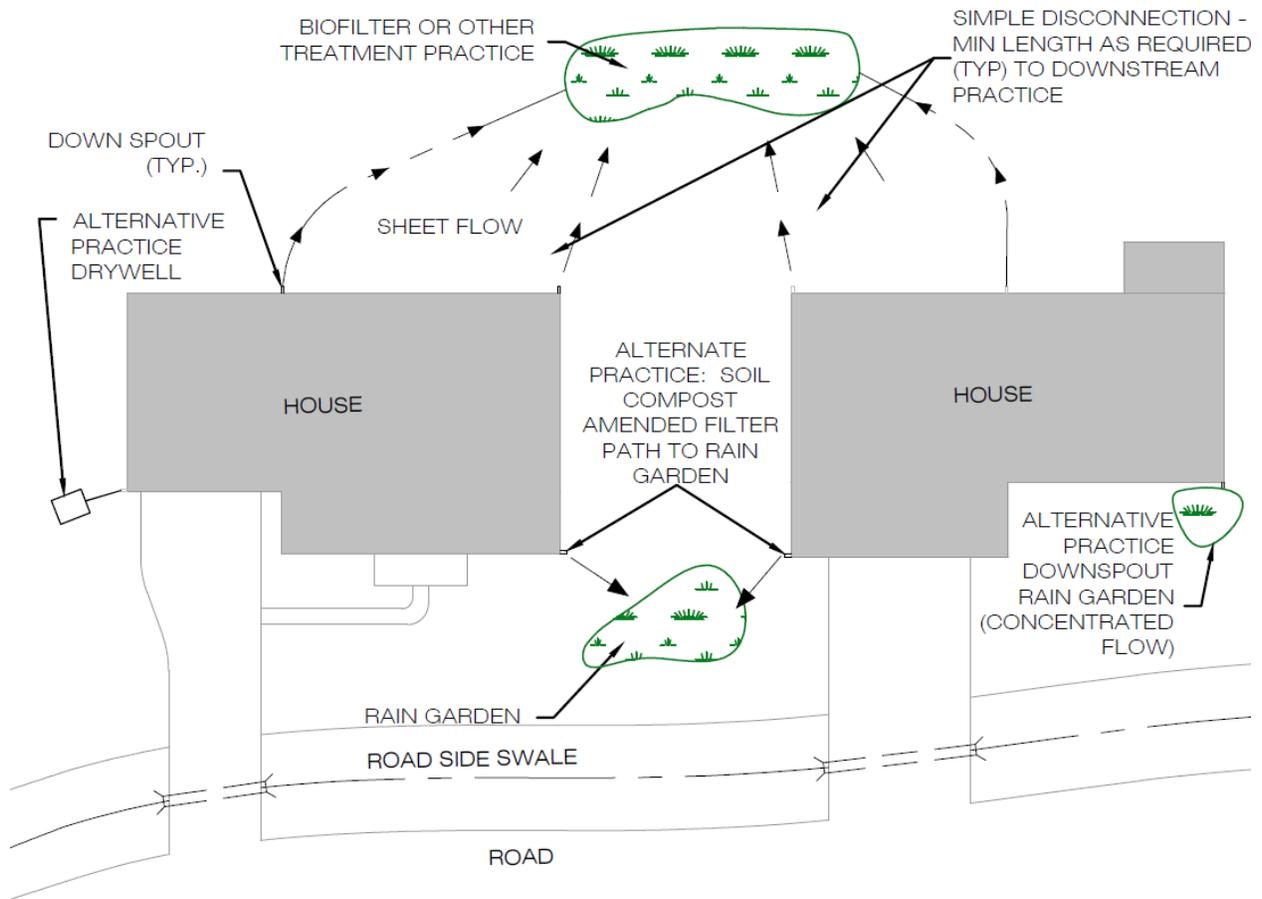


Figure 1.2. Residential Rooftop Treatment – Plan View:

- a) Simple Disconnection;
- b) Simple Disconnection to downstream Raingarden;
- c) Disconnection – Alternative Practice: Raingarden;
- d) Disconnection – Alternative Practice: Compost Amended Flow Path to downstream Raingarden;
- e) Disconnection – Alternative Practice: Dry Well (micro-infiltration);

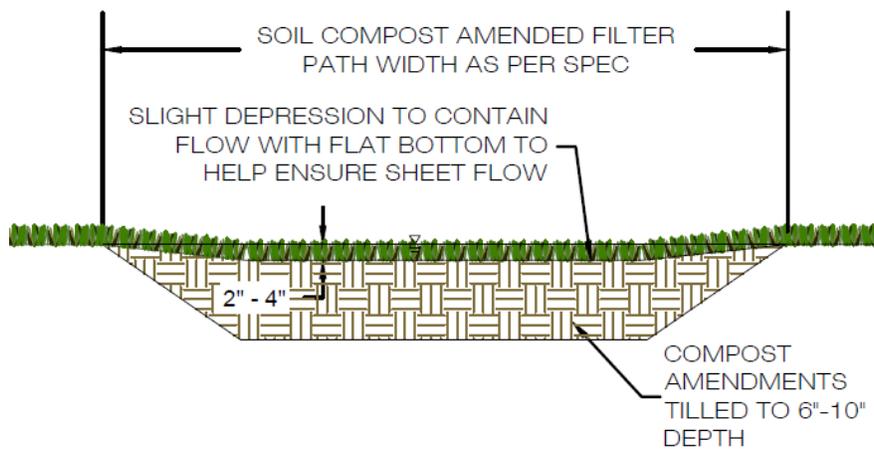


Figure 1.3. Disconnection: Soil Compost Amended Filter Path

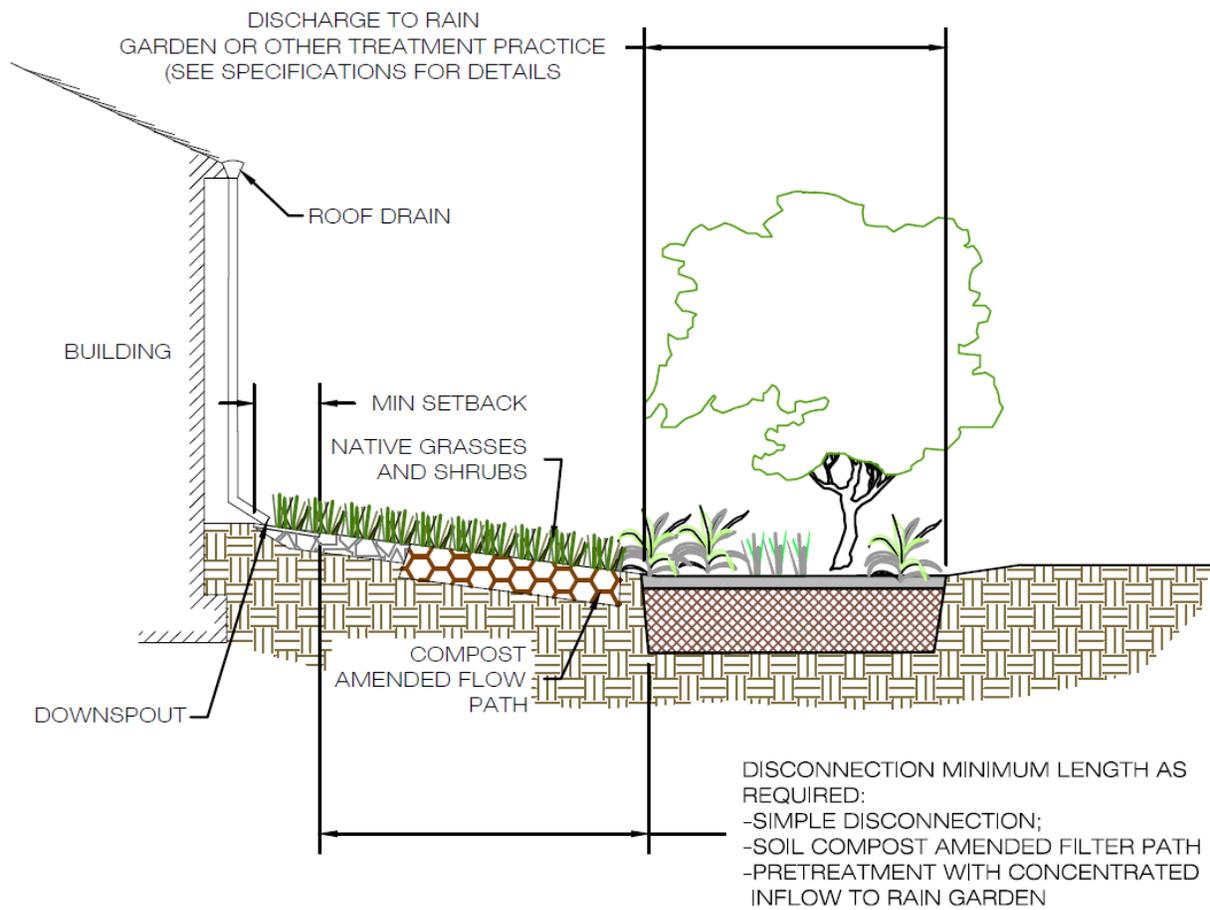
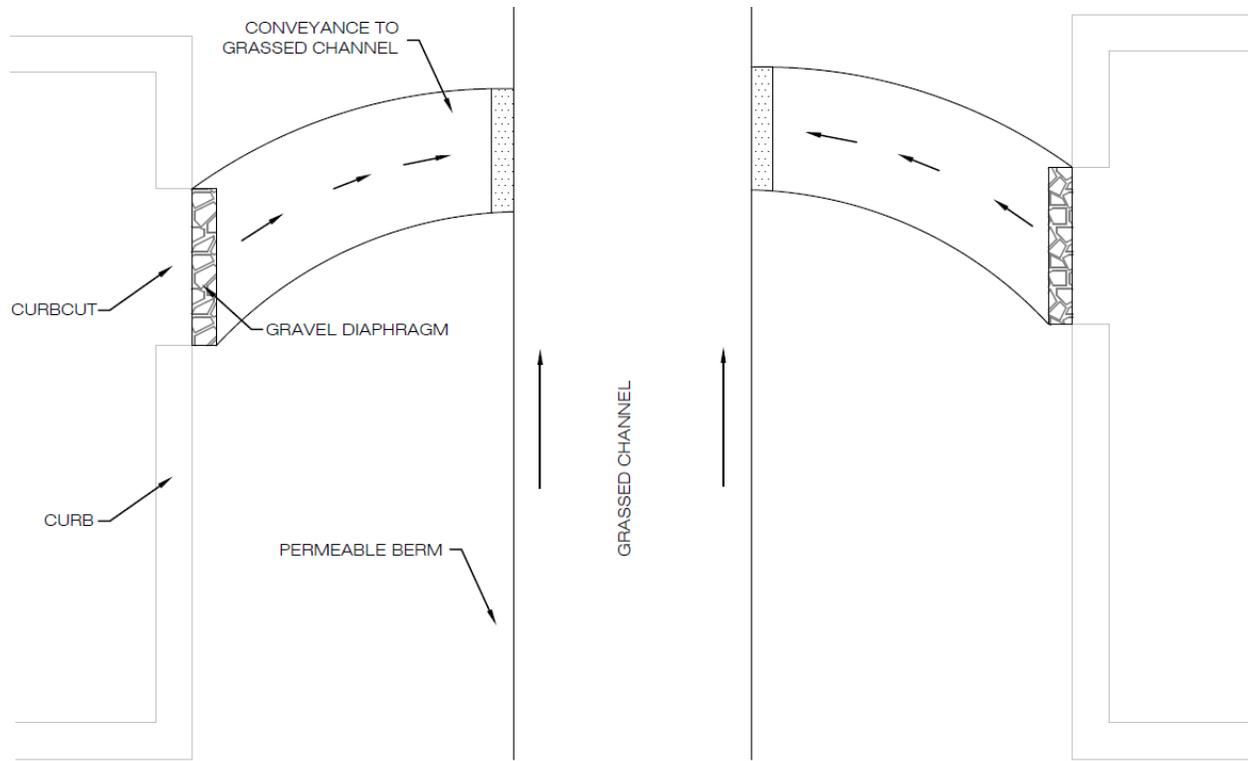


Figure 1.4. Residential Rooftop Disconnection – Section View:

- a) Simple Disconnection to downstream Raingarden**
- b) Disconnection – Alternative Practice: Compost Amended Flow Path to downstream Raingarden**



TREATMENT TRAIN: PRETREATMENT TO SOIL COMPOST AMENDED FILTER PATH TO GRASS CHANNEL OR OTHER TREATMENT

PRETREATMENT AND DESIGN COMPONENTS: GRAVEL DIAPHRAGM, PERMEABLE BERM, COMPOST AMENDMENTS DIMENSIONS, PER DESIGN SPECS

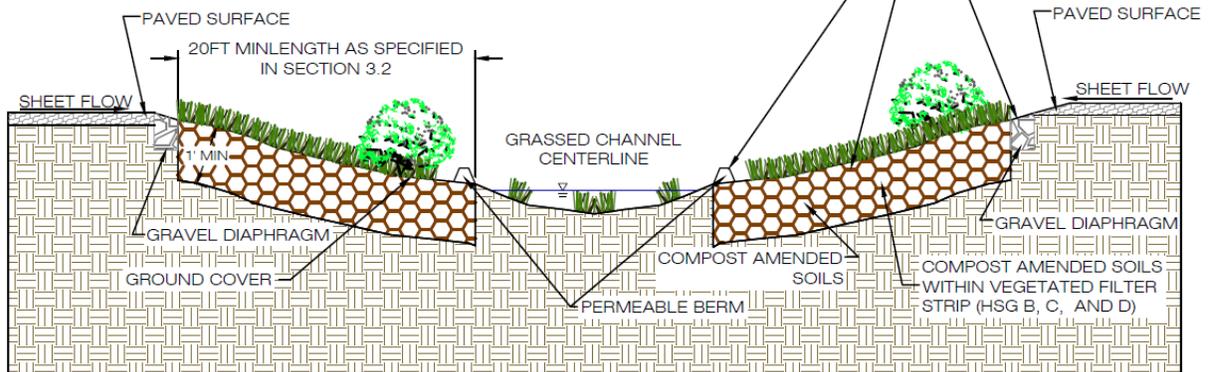


Figure 1.5. Amended Filter Path to Downstream Grass Channel (or other treatment)

SECTION 2: PERFORMANCE

With proper design and maintenance, the simple rooftop disconnection options can provide relatively high runoff reduction rates, although they are not credited with nutrient removal (**Table 1.1**). If an alternative runoff reduction practice is employed to achieve rooftop disconnection, the higher runoff reduction rate for that practice can be used for the contributing drainage area of the rooftop. In some cases, the designer may choose to use one of the alternative practices noted above in order to provide both runoff reduction and nutrient removal, regardless of space constraints.

The runoff reduction achieved by rooftop disconnections can help reduce the overall channel protection and flood control volume for the site. Designers can use the Runoff Reduction Method (RRM) spreadsheet to calculate a curve number adjustment for each design storm for the contributing drainage area, based on the degree of runoff reduction achieved.

Table 1.1. Summary of Stormwater Functions Provided by Rooftop Disconnection¹

FUNCTION PROVIDED BY SIMPLE ROOFTOP DISCONNECTION	HSG SOILS A and B	HSG SOILS C and D
Annual Runoff Volume Reduction (RR)	50%	25%
Total Phosphorus (TP) EMC Reduction by BMP Treatment Process	0	0
Total Phosphorus (TP) Mass Load Removal	50%	25%
Total Nitrogen (TN) EMC Reduction by BMP Treatment Process	0	0
Total Nitrogen (TN) Mass Load Removal	50%	25%
Channel & Flood Protection	Partial: Designers can use the RRM spreadsheet to adjust curve number for each design storm for the contributing drainage area (CDA), based on annual runoff reduction achieved	
NOTE: Stormwater functions of disconnection can be boosted if an acceptable alternative runoff reduction practice is employed. Acceptable practices and their associated runoff reduction rates are listed below. Designers should consult the applicable specification number for design standards.		
Alternative Practice	Specification No.	Runoff Reduction Rate
Soil compost-amended filter path	4	50%
Dry well or french drain #1 (Micro-infiltration #1)	8	50%
Dry well or french drain #2 (Micro-infiltration #2)	8	90%
Rain garden #1, front yard bioretention (Micro-bioretention #1)	9	40%
Rain garden #2, front yard bioretention (Micro-bioretention #2)	9	80%
Rainwater harvesting	6	Defined by user
Stormwater Planter (Urban Bioretention)	9 (Appendix A)	40%
¹ CWP and CSN (2008), CWP (2007)		

SECTION 3: DESIGN TABLES AND CRITERIA

3.1. Simple Rooftop Disconnection

Table 1.2 provides the primary design criteria for simple rooftop disconnection.

- Simple disconnection is generally not advisable for residential lots less than 6,000 square feet in area, although it may be possible to employ one of the alternative runoff reduction practices on these lots (e.g., cistern, infiltration, etc.).
- Simple disconnection can be used on any post-construction Hydrologic Soil Group. However, for Soil Groups C or D, alternative runoff reduction practices (e.g., compost-amended filter path, rain garden, rainwater harvesting) can boost the runoff reduction rate. Also, erodibility of soils must be considered when designing simple disconnection.
- Maintenance of disconnected downspouts usually involves the regular lawn or landscaping maintenance in the filter path from the roof to the street. In some cases, runoff from a simple disconnection may be directed to a more natural, undisturbed setting (i.e., where lot grading and clearing is “fingerprinted” and the proposed filter path is protected).

Table 1.2: Simple Rooftop Disconnection Design Criteria ¹

DESIGN FACTOR	SIMPLE DISCONNECTION
Maximum impervious (Rooftop) Area Treated	1,000 sq. ft. per disconnection
Longest flow path (roof/gutter)	75 feet
Disconnection Length	Equal to longest flow path, but no less than 40 feet ²
Disconnection slope	< 2%, or < 5% with turf reinforcement ³
Distance from buildings or foundations	Extend downspouts 5 ft. ⁴ (15 ft. in karst areas) away from building <i>if grade is less than 1%</i> .
Type of Pretreatment	External (leaf screens, etc)
¹ For alternative runoff reduction practices, see the applicable specification for design criteria. See Table 1 in this specification for eligible practices and associated specification numbers. ² An alternative runoff reduction practice must be used when the disconnection length is less than 40 feet. ³ Turf reinforcement may include EC-2, EC-3, or other appropriate reinforcing materials that are confirmed by the designer to be non-erosive for the specific characteristics and flow rates anticipated at each individual application, and acceptable to the plan approving authority. ⁴ Note that the downspout extension of 5 feet is intended for simple foundations. The use of a dry well or french drain adjacent to an in-ground basement or finished floor area should be carefully designed and coordinated with the design of the structure’s water-proofing system (foundation drains, etc.), or avoided altogether.	

3.2. Soil Compost-Amended Filter Path

The incorporation of compost amendments should conform to Stormwater Design Specification No. 4 (Soil Compost Amendments), and include the following design elements:

- Flow from the downspout should be spread over a 10-foot wide strip extending down-gradient along the flow path from the building to the street or conveyance system.
- The filter path should be at least 20 feet in length.
- A pea gravel or river stone diaphragm, or other accepted flow spreading device should be installed at the downspout outlet to distribute flows evenly across the filter path.
- The strip should have adequate “freeboard” so that flow remains within the strip and is not diverted away from the strip. In general, this means that the strip should be lower than the surrounding land area in order to keep flow in the filter path. Similarly, the flow area of the filter strip should be level to discourage concentrating the flow down the middle of the filter path.
- Use 2 to 4 inches of compost and till to a depth of 6 to 10 inches within the filter path.

3.3. Dry Wells and French Drains (Micro-Infiltration)

Depending on soil properties, roof runoff may be infiltrated into a shallow dry well or french drain. The design for this alternative should meet the requirements of micro-infiltration, as described in Stormwater Design Specification No. 8 (Infiltration), and summarized in **Table 1.3**. Note that the building setback of 5 feet is intended for simple foundations. The use of a dry well or french drain adjacent to an in-ground basement or finished floor area should be carefully designed and coordinated with the design of the structure’s water-proofing system (foundation drains, etc.), or avoided altogether.

Table 1.3. Micro-Infiltration Design Criteria

DESIGN FACTOR	MICRO-INFILTRATION DESIGN
Roof Area Treated	250 to 2,500 sq. ft.
Typical Practices	Dry Well and French Drain
Recommended Maximum Depth	3 feet
Runoff Reduction Sizing	See Specification No. 8: Infiltration
Minimum Soil Infiltration Rate	0.5 inches/hour
Observation Well	No
Type of Pretreatment	External (leaf screens, grass strip, etc)
UIC Permit Needed	No
Head Required	Nominal, 1 to 3 feet
Required Soil Test	One per practice
Building Setbacks	5 ft. down-gradient ¹ , 25 ft. up-gradient
¹ Note that the building setback of 5 feet is intended for simple foundations. The use of a dry well or french drain adjacent to an in-ground basement or finished floor area should be carefully designed and coordinated with the design of the structure’s water-proofing system (foundation drains, etc.), or avoided altogether.	

In general, micro-infiltration areas will require a surface area up to 3% of the contributing roof area. An on-site soil test is needed to determine if soils are suitable for infiltration. It is recommended that the micro-infiltration facility be located in an expanded right-of-way or stormwater easement so that it can be accessed for maintenance.

3.4. Rain Gardens and Front Yard Bioretention (Micro-Bioretention)

Depending on soil properties, roof runoff may be filtered through a shallow bioretention area. The design for this option should meet the requirements of micro-bioretention (or Rain Garden), as described in Stormwater Design Specification No. 9 (Bioretention) and summarized in **Table 1.4**.

For some residential applications, front, side, and/or rear yard bioretention may be an attractive option. This form of bioretention captures roof, lawn, and driveway runoff from low- to medium-density residential lots in a depressed area (3 to 6 inches) between the home and the primary stormwater conveyance system (roadside ditch or pipe system). The bioretention area connects to the drainage system with an underdrain (connection to the drainage system must comply with the appropriate regulatory criteria). The concept is to take advantage of the drop from the roof leader to the conveyance system, by creating a 10-foot wide (minimum) bioretention corridor from roof to the street with a shallow (6 to 12 inch deep) temporary ponding area. The bioretention corridor must have a minimum effective length of at least 20 feet. The ponding area may have a turf or landscape cover, depending on homeowner preference. (The advantage of using micro-bioretention over a soil compost-amended filter path is the additional pollutant removal credit provided by bioretention.)

Table 1.4: Micro-Bioretention Design Criteria

DESIGN FACTOR	MICRO BIORETENTION (I.E., RAIN GARDEN)
Impervious Area Treated ¹	1,000 ft ²
Type of Inflow	Sheetflow or roof leader
Runoff Reduction Sizing ¹	Surface Area= 5% of roof area (Level 1); 6% of roof area (Level 2)
Minimum Soil Infiltration Rate	0.5 inches/hour (or use underdrain)
Observation Well/ Cleanout Pipes	No
Type of Pretreatment	External (leaf screens, etc)
Underdrain and gravel layer	Level 1: Yes; Level 2: Optional per soils ¹
Minimum Filter Media Depth	18 inches (Level 1); 24 inches (Level 2)
Media Source	Mixed on-site
Head Required	Nominal, 1 to 3 feet
Required Soil Borings	One, only when an underdrain is not used
Building Setbacks	5 ft down-gradient, 25 ft up-gradient
¹ Refer to Design Specification No. 9, Table 2, Micro-Bioretention for Level 1 and Level 2 Design Criteria, and sizing criteria for individual and multiple downspout applications.	

The bioretention media is 18 to 24 inches deep, and is located over a 12 to 24 inch deep stone reservoir (as required by the Micro-Bioretention design criteria – refer to Design Specification No. 9). A perforated underdrain is located above the stone reservoir, to promote storage and recharge, even on poorly draining soils. In urban settings, the underdrain is directly connected into the storm drain pipe running underneath the street or in the street right-of-way. A trench needs to be excavated during construction to connect the underdrain to the street storm drain system. Appropriate approvals are required for making any connections to a common (or public) drainage system.

Construction of the remainder of the front yard bioretention system is deferred until after the lot has been stabilized. The front yard design should reduce the risk of homeowner conversion because it allows the owners to choose whether they want turf or landscaping. Front yard bioretention requires regular mowing and/or landscape maintenance to perform effectively. It is recommended that the practice be located in an expanded right-of-way or stormwater easement so that it can be accessed in the event that it fails to drain properly.

3.5. Rain Tanks and Cisterns

This form of disconnection must conform to the design requirements outlined in Stormwater Design Specification No. 6 (Rain Tanks and Cisterns). The runoff reduction rates for rain tanks and cisterns depends on their storage capacity and ability to draw down water in between storms for reuse as potable water, grey-water or irrigation use. The actual runoff reduction rate for a particular design can be ascertained using the design spreadsheet referenced in Specification No. 6. All devices should have a suitable overflow area to route extreme flows into the next treatment practice or the stormwater conveyance system.

3.6. Stormwater Planter (Urban Bioretention)

This form of disconnection must conform to the design requirements for stormwater planters, as outlined in Appendix A of Stormwater Design Specification No. 9 (Urban Bioretention). Foundation planters are a useful option to disconnect and treat rooftop runoff, particularly in ultra-urban areas. They consist of confined planters that store and/or infiltrate runoff in a soil bed to reduce runoff volumes and pollutant loads. Stormwater planters combine an aesthetic landscaping feature with a functional form of stormwater treatment. Stormwater planters generally receive runoff from adjacent rooftop downspouts and are landscaped with plants that are tolerant to periods of both drought and inundation. The two basic design variations for stormwater planters are the infiltration planter and the filter planter.

An *infiltration planter* filters rooftop runoff through soil in the planter followed by infiltration into soils below the planter. The recommended minimum depth is 30 inches, with the shape and length determined by architectural considerations. The planter should be sized to temporarily store at least 1/2-inch of runoff from the contributing rooftop area in a reservoir above the planter bed. Infiltration planters should be placed at least 10 feet away from a building to prevent possible flooding or basement seepage damage.

A *filter planter* has an impervious liner on the bottom. The minimum planter depth is 18 inches, with the shape and length determined by architectural considerations. Runoff is temporarily stored in a reservoir located above the planter bed. Overflow pipes are installed to discharge runoff when maximum ponding depths are exceeded, to avoid water spilling over the side of the planter. In addition, an underdrain is used to carry runoff to the storm sewer system. Since a filter planter is self-contained and does not infiltrate into the ground, it can be installed right next to a building.

All planters should be placed at grade level or above ground. They should be sized to allow captured runoff to drain out within four hours after a storm event. Plant materials should be capable of withstanding moist and seasonally dry conditions. Planting media should have an infiltration rate of at least 2 inches per hour. The sand and gravel on the bottom of the planter should have a minimum infiltration rate of 5 inches per hour. The planter can be constructed of stone, concrete, brick, wood or other durable material. If treated wood is used, care should be taken so that trace metals and creosote do not leach out of the planter.

SECTION 4: MAINTENANCE

The rooftop disconnection and supplementary treatment device must be covered by a drainage easement to allow inspection and maintenance. When the disconnection occurs on a private residential lot, its existence and purpose must be noted on the deed of record. Homeowners must be provided a simple document that explains their purpose and routine maintenance needs. A deed restriction or other mechanism, enforceable by the qualifying local program, must be in place to help ensure that downspouts remain disconnected, treatment units are maintained and filtering/infiltrating areas are not converted or disturbed. The legal mechanism should, if possible, grant authority for local agencies to access the property for inspection or corrective action.

An example maintenance inspection checklist for Rooftop Disconnection can be accessed in Appendix C of Chapter 9 of the *Virginia Stormwater Management Handbook* (2010), and both construction phase and maintenance inspection checklists can be found on the Center for Watershed Protection website at:

http://www.cwp.org/Resource_Library/Controlling_Runoff_and_Discharges/sm.htm
(scroll to Tool6: Plan Review, BMP Construction, and Maintenance Checklists)

SECTION 5: REGIONAL AND SPECIAL CASE DESIGN ADAPTATIONS

5.1 Karst Terrain

Rooftop disconnection is strongly recommended for most residential lots greater than 6,000 square feet, particularly if it can be combined with a secondary micro-practice to increase small scale runoff reduction. The discharge point from the disconnection should extend at least 15 feet from any building foundations. Rooftop disconnection is also recommended for commercial sites that are not likely to be stormwater hotspots.

5.2 Coastal Plain Terrain

Rooftop disconnection is strongly recommended in the coastal plain for roof or other impervious areas on most residential lots greater than 6,000 square feet, particularly if it can be combined with a secondary micro-practice to increase small-scale runoff reduction. The disconnection corridor should have a minimum slope of 1% and 2 feet of vertical separation from the water table.

SECTION 6: REFERENCES

City of Portland, Environmental Services. 2004. *Portland Stormwater Management Manual*. Portland, OR. <http://www.portlandonline.com/bes/index.cfm?c=dfbbh>

CWP. 2007. *National Pollutant Removal Performance Database Version 3.0*. Center for Watershed Protection, Ellicott City, MD.

Northern Virginia Regional Commission. 2007. *Low Impact Development Supplement to the Northern Virginia BMP Handbook*. Fairfax, Virginia.

Philadelphia Stormwater Management Guidance Manual. Available online at:
<http://www.phillyriverinfo.org/Programs/SubprogramMain.aspx?Id=StormwaterManual>

Schueler, T., D. Hirschman, M. Novotney and J. Zielinski. 2007. *Urban stormwater retrofit practices*. Manual 3 in the Urban Subwatershed Restoration Manual Series. Center for Watershed Protection, Ellicott City, MD.

Schueler, T. 2008. Technical Support for the Baywide Runoff Reduction Method. Chesapeake Stormwater Network. Baltimore, MD. www.chesapeakestormwater.net