3.4 Impervious Surface Disconnection

Definition. This strategy involves managing runoff close to its source by intercepting, infiltrating, filtering, treating or reusing it as it moves from an impervious surface to the drainage system. Disconnection practices can be used to reduce the volume of runoff that enters the combined or separate sewer systems. Two kinds of disconnection are allowed: (1) simple disconnection, whereby rooftops and/or on-lot residential impervious surfaces are directed to pervious areas (compacted cover) or conservation areas (natural cover) or soil amended filter paths, and (2) disconnection leading to an alternative retention practice(s) adjacent to the roof (see Figure 3.11). Alternative practices can use less space than simple disconnection and can enhance retention. Applicable practices include:

D-1 Simple disconnection to pervious areas with the compacted cover designation

D-2 Simple disconnection to conservation areas with the natural cover designation

D-3 Simple disconnection to a soil compost amended filter path

D-4 Infiltration by small infiltration practices (dry wells or French drains) (see Section 3.8 Stormwater Infiltration)

D-5 Filtration by rain gardens or stormwater planters (see Section 3.6 Bioretention)

D-6 Storage and reuse with a cistern or other vessel (rainwater harvesting) (see Section 3.3 Rainwater Harvesting)

Disconnection practices reduce a portion of the Stormwater Retention Volume (SWRv). In order to meet requirements for larger storm events, disconnection practices must be combined with additional practices.

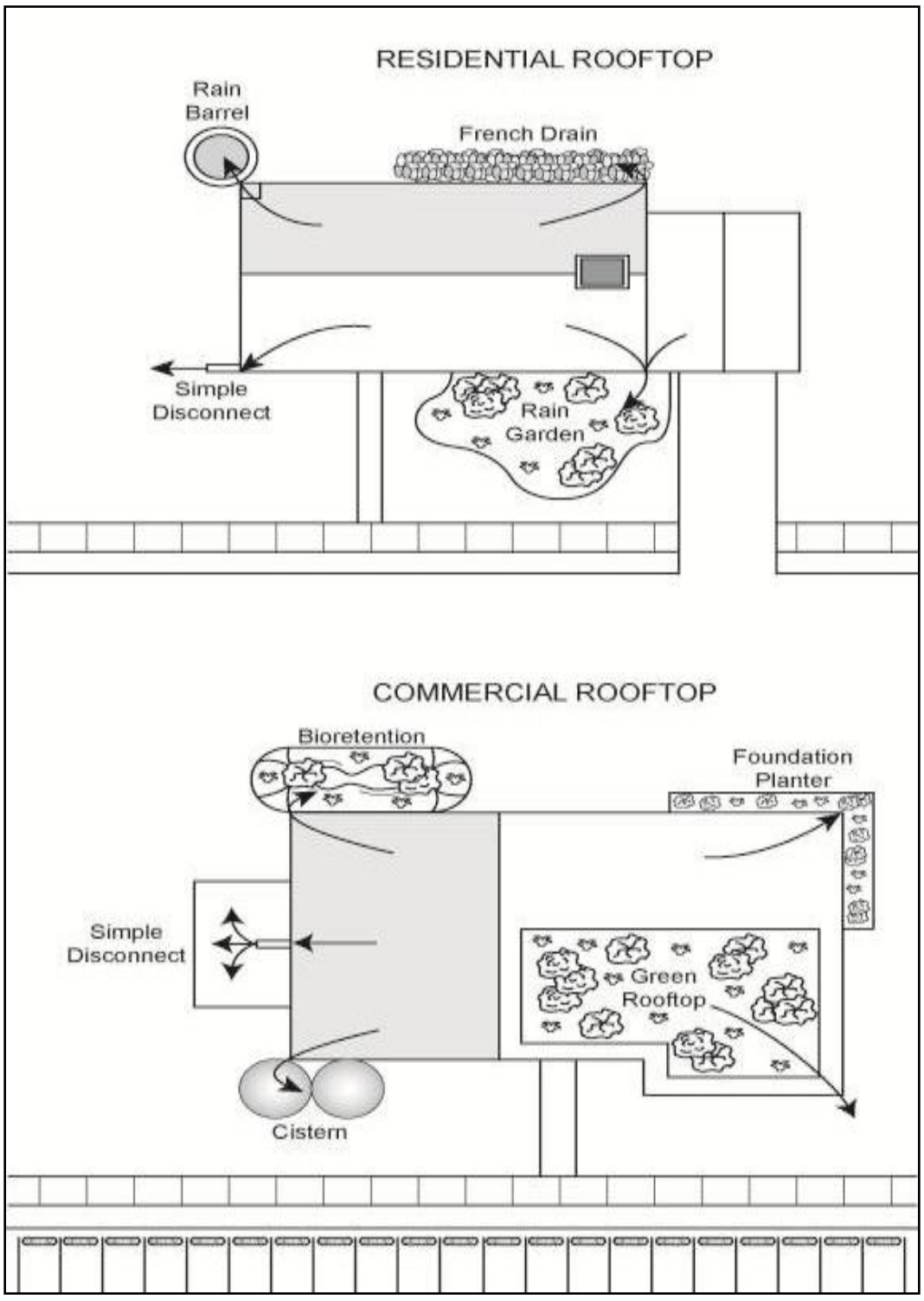

Figure 3.11 Roof disconnection with alternative retention practices

3.4.1 Impervious Surface Disconnection Feasibility Criteria

Impervious surface disconnections are ideal for use on commercial, institutional, municipal, multi-family residential and single-family residential buildings. Key constraints with impervious surface disconnections include available space, soil permeability, and soil compaction.

For disconnection to alternative practices (D-4, D-5, and D-6) consult Sections 3.8, 3.6, and 3.3, respectively. For simple disconnection to compacted cover (D-1) or natural cover (D-2) or soils compost amended filter paths (D-3) the following feasibility criteria exist (also see Table 3.8):

- **Contributing Drainage Area.** For rooftop impervious areas, the maximum impervious area treated cannot exceed 1,000 square feet per disconnection. For impervious areas other than rooftop, the longest contributing impervious area flow path cannot exceed 75 feet.
- **Required Space.** Minimum 150 square feet of disconnection area.
- **Sizing.** The available disconnection area must be at least 10 feet wide and 15 feet long. The disconnection width is limited to 25 feet unless the contributing runoff is conveyed via sheetflow or a level spreader. The disconnection length can be extended up to 100 feet to increase the retention value.
- **Site Topography.** Simple disconnection is best applied when the grade of the receiving pervious area is less than 2 percent, or less than 5 percent with turf reinforcement. The slope of the receiving areas must be graded away from any building foundations. Turf reinforcement may include erosion control matting or other appropriate reinforcing materials that are confirmed by the designer to be erosion resistant for the specific characteristics and flow rates anticipated at each individual application, and acceptable to the plan approving authority.
- **Soils.** Impervious surface disconnection can be used on any post-construction Hydrologic Soil Group. The disconnection area must be kept well-vegetated with minimal bare spots—at least 95 percent soil cover (Section J – Vegetative Stabilization of DDOE's Soil Erosion and Sediment Control Handbook).
- **Building Setbacks.** If the grade of the receiving area is less than 1 percent, downspouts must be extended 5 feet away from building. 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 requires an effective water-proofing system (e.g., foundation drains).

Table 3.8 Feasibility Criteria for Simple Disconnection

Design Factor	Disconnection Design
Contributing Drainage Area	1,000 square feet per rooftop disconnection. For impervious areas other than rooftop, the longest contributing impervious area flow path cannot exceed 75 feet.
Required Space	Minimum 150 square feet of disconnection area.
Sizing	The available disconnection area must be at least 10 feet wide and 15 feet long. Maximum disconnection width is 25 feet unless the contributing runoff is conveyed via sheetflow or a level spreader. Maximum disconnection length is 100 feet.
Site Topography	Grade of the receiving pervious area is less than 2%, or less than 5% with turf reinforcement. The slope of the receiving areas must be graded away from any building foundations.
Soils	Impervious surface disconnection can be used on any post-construction Hydrologic Soil Group. The disconnection area must be kept well-vegetated with minimal bare spots.
Building Setbacks	5 feet away from building if the grade of the receiving area is less than 1%

3.4.2 Impervious Surface Disconnection Conveyance Criteria

Receiving areas in simple disconnection practices (D-1, D-2, and D-3) require a design that safely conveys the 2-year and 15-year storm events over the receiving area without causing erosion. In some applications, erosion control matting or other appropriate reinforcing materials may be needed to control flow rates anticipated for these larger design storms.

For disconnection to alternative practices, consult the appropriate specifications for information on ensuring proper conveyance of the 2-year and 15-year storm events through the practices.

3.4.3 Impervious Surface Disconnection Pretreatment Criteria

Pretreatment is not needed for simple impervious surface disconnection. For disconnection to alternative practices, external downspout pretreatment is recommended (e.g., leaf screens).

3.4.4 Impervious Surface Disconnection Design Criteria

The following design criteria apply to each disconnection practice:

(D-1) Simple Disconnection to a Pervious Area with the Compacted Cover Designation. Disconnection to pervious areas with the compacted cover designation is required to meet the feasibility criteria presented above in Section 3.4.1.

During site construction, care must be taken not to compact the receiving pervious area. To prevent soil compaction, heavy vehicular and foot traffic must be kept out of the receiving pervious area both during and after construction. This can be accomplished by clearly delineating the receiving pervious areas on all development plans and protecting them with temporary fencing prior to the start of land-disturbing activities (see Appendix N for guidance on protecting

natural and compacted cover designations during construction). If compaction occurs, soil amendments or post-construction aeration will be required (see Appendix J on soil amendments).

(D-2) Simple Disconnection to a Conservation Area with Natural Cover Designation. Disconnection to conservation areas is required to meet the feasibility criteria presented in Section 3.4.1, with the following additional additions/exceptions:

- Minimum disconnection length is 40 feet.
- Maximum slope of the receiving area is 6 percent. (2 percent for the first 10 feet).
- Inflow must be conveyed via sheet flow or via a level spreader.
- If inflow is conveyed via sheet flow, the maximum flow path is 75 feet when the runoff is conveyed from an impervious area and 150 feet when the runoff is conveyed from a pervious area.
- If inflow is conveyed via a level spreader, the maximum flow path is 150 feet, and the level spreader must be designed with an appropriate width as specified below.
- Retention value applies only to areas directly receiving sheet flow or directly perpendicular to the level spreader.

A level spreader can be used to disperse or "spread" concentrated flow thinly over a vegetated or forested area to promote greater runoff infiltration in the receiving area. A level spreader consists of a permanent linear structure constructed at a 0 percent grade that transects the slope. The influent concentrated runoff must be spread over an area wide enough area so that erosion of the receiving area does not result. Detailed information on the design and function of level spreaders can be found in Hathaway and Hunt, 2006 and NCDWQ, 2010.

The minimum required width of the level spreader is

- 13 linear feet per each 1 cubic foot/second of inflow if the receiving conservation area (natural cover designation) has a minimum 90 percent ground cover
- 40 linear feet per 1 cubic foot/second of inflow if the receiving conservation area (natural cover designation) is forested

(D-3) Simple Disconnection to a Soil Compost-Amended Filter Path. Consult Appendix J for detailed information on the design and function of soil compost amendments. The incorporation of compost amendments must meet the design criteria in the specification and include the following design elements:

- Flow from the downspout must 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 must be a minimum 15 feet in length.
- Installation of a pea gravel or river stone diaphragm, or other accepted flow spreading device is required at the downspout outlet to distribute flows evenly across the filter path.

- The strip requires 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 must 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.

(D-4) Infiltration by Small Infiltration Practices. Depending on soil properties, roof runoff may be infiltrated into a shallow dry well or French drain. The design for this alternative must meet the requirements of infiltration practices, as described in Section 3.8 and summarized in Table 3.9 below. 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 (e.g., foundation drains), or avoided altogether.

Table 3.9 Design Criteria for Disconnection to Small-Scale Infiltration

Design Factor	Infiltration Design
Roof Area Treated	250 to 2,500 square feet
Typical Practices	Dry well and French drain
Recommended Maximum Depth	3 feet
Sizing	See Section 3.8 Stormwater Infiltration
Observation Well	No
Type of Pretreatment	External (leaf screens, grass strip, etc.)
UIC Permit Needed	Not typically[1]
Head Required	Nominal, 1 to 3 feet
Required Soil Test	One per practice
Building Setbacks	10 feet from structure[2], unless an impermeable liner is used

[1] Infiltration practice must be wider than it is deep. See Section 3.8 Stormwater Infiltration for more information.
[2] Note that the building setback 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 (e.g., foundation drains), or avoided altogether.

In general, micro-infiltration areas will require a surface area up to 3 percent of the contributing roof area. An on-site soil test is needed to determine if soils are suitable for infiltration.

(D-5) Filtration by Rain Gardens or Stormwater Planters. For some residential applications, front, side, and/or rear yard bioretention may be an attractive option used to filter roof runoff (see Figure 3.12). Stormwater planters are also a useful option to disconnect and treat rooftop runoff, particularly in ultra-urban areas. The designs for these options must meet the requirements of stormwater planters (B-4) or rain gardens (B-5), as described in Section 3.6 and summarized in Table 3.10 below.

Figure 3.12 Demonstration sites exist throughout the District to promote downspout disconnection, removing impervious pavement, and promoting native plants.

Table 3.10 Design Criteria for Disconnection to Small-scale Bioretention (D-5)

Design Factor	Bioretention Design
Impervious Area Treated	1,000 square feet (see Section 3.6 Bioretention)
Type of Inflow	Sheetflow or roof leader
Observation Well/ Cleanout Pipes	No
Type of Pretreatment	External (e.g., leaf screens)
Underdrain	Optional per soils (see Section 3.6 Bioretention)
Gravel Layer	12 inches
Minimum Filter Media Depth	18 inches
Media Source	Can be mixed on site
Head Required	Nominal, 1 to 3 feet
Sizing	(See Section 3.6 Bioretention)
Required Soil Test	One per practice
Building Setbacks	10 feet from structure unless an impermeable liner is used

(D-6) Storage and Reuse with a Cistern. This form of disconnection must conform to the design requirements outlined in Section 3.3. Cisterns can be sized for commercial as well as residential purposes. Residential cisterns are commonly called rain barrels.

The retention value for cisterns depends on their storage capacity and ability to draw down water in between storms for reuse as potable water, gray water, or irrigation. The actual retention rate

for a particular design can be ascertained using the Rainwater Harvesting Retention Calculator referenced in Section 3.3. All devices must have a suitable overflow area to route extreme flows into the next treatment practice or the stormwater conveyance system.

3.4.5 Impervious Surface Disconnection Landscaping Criteria

All receiving disconnection areas must be stabilized to prevent erosion or transport of sediment to receiving practices or drainage systems. Several appropriate types of grasses for disconnection practices area are listed in Table 3.11. Designers must ensure that the maximum flow velocities do not exceed the values listed in the table for the selected grass species and the specific site slope. If using vegetation outside of this table, the designer must provide documentation to ensure excessive erosion will not occur. Additionally, see the DDOE Soil Erosion and Sediment Control Handbook (Section J – Vegetative Stabilization) for vegetation suggestions.

Table 3.11 Recommended Vegetation for Pervious Disconnection Areas

Vegetation Type	Slope (%)	Maximum Velocity (ft/s)	
		Erosion resistant soil	Easily Eroded Soil
Bermuda Grass	< 5	8	6
	5–10	7	5
	> 10	6	4
Kentucky Bluegrass	< 5	7	5
	5–10	6	4
	> 10	5	3
Tall Fescue Grass Mixture	< 5	6	4
	5–10	4	3
Annual and Perennial Rye	0–5	4	3
Sod	0–5	4	3

Source: USDA, TP-61, 1954; City of Roanoke Virginia Stormwater Design Manual, 2008.

3.4.6 Impervious Surface Disconnection Construction Sequence

Construction Sequence for Disconnection to Pervious Areas. For simple disconnection to a pervious area, the pervious area can be within the limits of disturbance (LOD) during construction. The following procedures should be followed during construction:

- Before site work begins, the receiving pervious disconnection area boundaries should be clearly marked.
- Construction traffic in the disconnection area should be limited to avoid compaction. The material stockpile area shall not be located in the disconnection area.
- Construction runoff should be directed away from the proposed disconnection area, using perimeter silt fence, or, preferably, a diversion dike.
- If existing topsoil is stripped during grading, it shall be stockpiled for later use.

- The disconnection area may require light grading to achieve desired elevations and slopes. This should be done with tracked vehicles to prevent compaction.
- Topsoil and or compost amendments should be incorporated evenly across the disconnection area, stabilized with seed, and protected by biodegradable erosion control matting or blankets.
- Stormwater must not be diverted into any compost amended areas until the area is stabilized, which is defined as having groundcover of 95 percent or greater by the DDOE Soil Erosion and Sediment Control Handbook (Section J – Vegetative Stabilization).

Construction Sequence for Disconnection to Conservation Areas with Natural Cover Designation. For simple disconnection to a conservation area, the conservation area must be fully protected during the construction stage of development and kept outside the LOD on the soil erosion and sediment control plan (SESCP).

- No clearing, grading or heavy equipment access is allowed in the conservation area except temporary disturbances associated with incidental utility construction, restoration operations or management of nuisance vegetation.
- Any conservation areas shall be protected by super silt fence, chain link fence, orange safety fence, or other measures to prevent sediment discharge.
- The LOD must be clearly shown on all construction drawings and identified and protected in the field by acceptable signage, silt fence, snow fence, or other protective barrier.
- If a level spreader is to be used in the design, construction of the level spreader shall not commence until the contributing drainage area has been stabilized and perimeter soil erosion and sediment control measures have been removed and cleaned out. Further, stormwater must not be diverted into the disconnection area until the level spreader is installed and stabilized.

Construction Supervision. Construction supervision is recommended to ensure compliance with design standards. A qualified professional should evaluate the performance of the disconnection after the first big storm to look for evidence of gullies, outflanking, undercutting or sparse vegetative cover. Spot repairs should be made, as needed.

DDOE's construction phase inspection checklist for impervious cover disconnection can be found in Appendix K.

3.4.7 Impervious Surface Disconnection Maintenance Criteria

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). Typical maintenance activities include erosion control of the receiving area and ensuring the receiving area remains uncompacted and pervious.

DDOE's maintenance inspection checklists for disconnection can be found in Appendix L.

Declaration of Covenants. A declaration of covenants that includes all maintenance responsibilities to ensure the continued stormwater performance for the BMP is required. The declaration of covenants specifies the property owner's primary maintenance responsibilities, and authorizes DDOE staff to access the property for inspection or corrective action in the event the proper maintenance is not performed. The declaration of covenants is attached to the deed of the property. A template form is provided at the end of Chapter 5 (see Figure 5.4), although variations will exist for scenarios where stormwater crosses property lines. The covenant is between the property and the Government of the District of Columbia. It is submitted through the Office of the Attorney General. All SWMPs have a maintenance agreement stamp that must be signed for a building permit to proceed. A maintenance schedule must appear on the SWMP. Additionally, a maintenance schedule is required in Exhibit C of the declaration of covenants.

Covenants are not required on government properties, but maintenance responsibilities must be defined through a partnership agreement or a memorandum of understanding.

Waste Material. Waste material from the repair, maintenance, or removal of a BMP or land cover shall be removed and disposed of in compliance with applicable federal and District law.

3.4.8 Disconnection Stormwater Compliance Calculations

Disconnection practices receive the following retention values:

D-1 Simple disconnection to a pervious compacted cover area: retention value of 2 cubic feet (15 gallons) per 100 square foot of receiving pervious area (compacted cover).

D-2 Simple disconnection to a conserved natural cover area: retention value of 6 cubic feet (45 gallons) per 100 square foot of receiving pervious conservation area (natural cover).

D-3 Simple disconnection to a soil compost amended filter path: retention value of 4 cubic (30 gallons) feet per 100 square foot of receiving pervious conservation area (soil amended).

D-4 Infiltration by small infiltration practices (dry wells or French drains): see compliance criteria for Section 3.8.

D-5 Filtration by rain gardens or stormwater planters: see compliance criteria for Section 3.6.

D-6 Storage and reuse with a cistern or other vessel (rainwater harvesting): see compliance criteria for Section 3.3.

Note: The surface areas for practices D-1 and D-3 are considered compacted cover for purposes of retention calculations, and the surface area of practice D-2 is considered natural cover.

Simple disconnection practices are not accepted total suspended solids (TSS) treatment practices (see Table 3.12).

Table 3.12 Disconnection Retention Value and Pollutant Removal

Type of Simple Disconnection	Retention Value cubic feet (gallons) per 100 ft^2 of pervious receiving area	Accepted TSS Treatment Practice
To a pervious compacted cover area	2 (15)	No
To a conserved natural cover area	6 (45)	No
To a soil compost amended filter path	4 (30)	No

Impervious surface disconnection also contributes to peak flow reduction. This contribution can be determined in several ways. One method is to subtract the Retention Value from the total runoff volume for the 2-year, 15-year, and 100-year storms. The resulting reduced runoff volumes can then be used to calculate a Reduced Natural Resource Conservation Service Curve Number for the site or drainage area. The Reduced Curve Number can then be used to calculate peak flow rates for the various storm events. Other hydrologic modeling tools that employ different procedures may be used as well.

3.4.9 References

City of Roanoke Virginia. 2007. Stormwater Design Manual. Department of Planning and Building and Development. Available online at: http://www.roanokeva.gov/85256A8D0062AF37/vwContentByKey/47E4E4ABDDC5DA16852577AD0054958C/$File/Table%20of%20Contents%20%26%20Chapter%201%20Design%20Manual%2008.16.10.pdf

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