

3.0 Techniques to Reduce Impervious Cover:

As described in the previous section, both the water quality and quantity sizing equations are related to the amount of impervious cover and land surface type. It is encouraged to use thoughtful site planning techniques that include: protecting and utilizing existing site features, clustering and concentrating development, minimizing impact of disturbance, and reducing the impervious cover to be managed.

In many cases, alternative configurations for streets and parking lots can provide the same function as traditional designs with reduced impervious area. In addition, using “cupped” vs. traditional “mounded” landscaped islands, will allow for maximum use of land. Minimizing the area of rooftop and pavement and utilizing the landscaped areas at the site to be multifunctional will assist in reducing the cost of “grey” infrastructure. Two conceptual site design examples (redevelopment and new development) demonstrating alternative configurations and multifunctional landscape areas are provided as Appendix 5 and Appendix 6. The conceptual site design examples provide a detailed analysis consisting of: site layouts, water quality and quantity calculations for both a traditional site layout and an alternative layout using the above techniques.

3.1 Rooftop Disconnection

An adjustment to the total impervious surface area is permitted when the downspout is disconnected and then directed to a pervious area which allows for infiltration, filtration and increases time of concentration. Minimizing the impervious area will reduce the size and cost of structural BMPs that must be constructed. Depending on the configuration, all or a portion of the disconnected impervious area may be deducted from total impervious cover. Disconnected impervious cover may be treated as pervious when calculating storm water quantity and quality volumes. A rooftop is considered to be completely or partially disconnected if it meets the requirements below:

- The contributing area of rooftop to each disconnected discharge is 500 sqft or less, and
- The soil is not designated as a hydrologic soil group “D” or equivalent, and
- The overland flow path has a positive slope of 5% or less.
- Appropriate CN must be utilized when calculating the water quantity requirement.

For designs that meet these requirements, the portion of the roof that may be considered disconnected depends on the length of the overland path as designated in Table 3.1.1.

Table 3.1.1: Partial Rooftop Disconnection

Partial Rooftop Disconnection	
Length of Pervious Flow Path*	Roof Area Treated as Disconnected
(ft)	(% of contributing roof area)
0-14	0
15-29	20
30-44	40
45-59	60
60-74	80
75 or more	100

*Flow path cannot include impervious surfaces and must be at least 15 feet from any impervious surface

(City of Philadelphia Storm Water Management Guidance Manual, 2006)

For example, consider a 1,000 sqft roof with two roof leaders each draining an area of 500 sqft. Both roof leaders discharge to a lawn. The lawn has type B soils and a slope of 3%. The distance from building to street is 70 ft, and the designer determines that roof runoff must be discharged 5 ft from the building foundation to avoid basement seepage. Therefore, the flow path is 65 ft in length. 80% of the roof area may be considered disconnected and treated as pervious cover when calculating storm water management requirements. Disconnection of the roof leaders will significantly reduce the size and cost of storm water management facilities at this site.

3.2 Pavement Disconnection

An adjustment to the total impervious surface area is permitted when pavement runoff is directed to a pervious area which allows for infiltration, filtration and increased time of concentration. This method is generally applicable to small or narrow pavement structures such as driveways and narrow pathways through otherwise pervious areas (e.g., a bike path through a park). For structures that meet the requirements, all of the disconnected impervious area may be deducted from the total impervious cover. Appropriate CN values must be used when performing water quantity calculations. Pavement is disconnected if it meets the requirements below:

- The contributing flow path over impervious cover is no more than 75 feet, and
- The length of overland flow is greater than or equal to the contributing length, and
- The soil is not designated as hydrologic soil group “D” or equivalent, and
- The slope of the contributing impervious area is 5% or less, and
- The slope of the overland flow path is 5% or less.

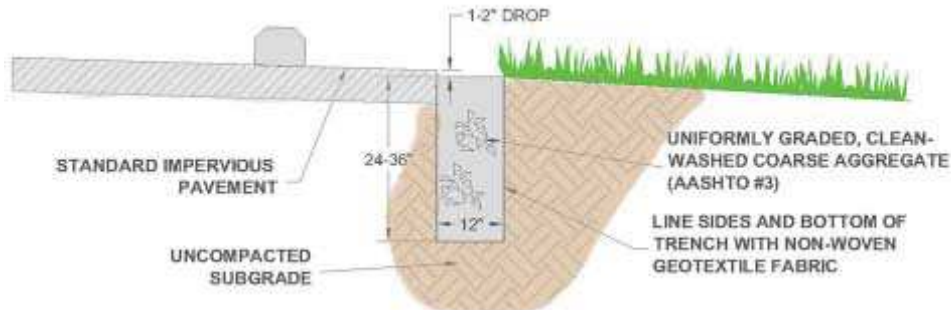
If discharge is concentrated at one or more discrete points, no more than 1,000 sqft may discharge to any one point. In addition, a gravel strip or other spreading device is required for concentrated discharges. For non-concentrated discharges along the entire

edge of pavement, this requirement is waived; however, there must be provisions for the establishment of vegetation along the pavement edge and temporary stabilization of the area until vegetation becomes established.

For example, in Figure 3.1.1, concentrated runoff from a small parking lot drainage area is directed towards a gravel level spreader which is connected to a filter strip that is part of a larger overall storm water treatment system. The level spreader ensures that the runoff entering the filter strip has sheet flow characteristics which aids in the filter strip's effectiveness. Since a flow spreader was installed to handle concentrated runoff, this small parking lot would be considered disconnected.

Note: Filter strips are recommended as only a viable storm water management pretreatment option. Filter strips are recommended for use as pretreatment for many intensive structural controls.

Figure 3.1.1: Gravel Level Spreader Connected to Filter Strip



(City of Philadelphia Storm Water Management Guidance Manual, 2006)

3.3 Maximize Tree Canopy Over Impervious Cover

An adjustment to the total impervious surface area is permitted when new or existing tree canopy, appropriate for the site, extends over the impervious cover. Under these circumstances, a portion of impervious cover under tree canopy may be treated as disconnected and deducted from total impervious cover. Appropriate CN values must be used when calculating the water quantity requirements. The tree species must be appropriate for the site. To be eligible for the reduction:

- New trees planted must be planted within 10 feet of ground level impervious area within the limits of earth disturbance.
- New deciduous trees must be at least 2-inch caliper and new evergreen trees must be at least 6 feet tall to be eligible for the reduction.
- A 100 sqft impervious area reduction is permitted for each new tree.
- The maximum reduction permitted, including new and existing trees is 25% of ground level impervious area within the limits of earth disturbance, unless the width of impervious surface area is 10 ft. Up to 100% of narrow impervious areas (i.e. sidewalks and paths) may be disconnected through the application of tree credits.

For further information on specific strategies to incorporate trees into the design of development sites refer to Appendix 4, Urban Watershed Forestry Manual; Part 2: Conserving and Planting Trees at Development Sites.

3.4 Install Green Roofs to Reduce Impervious Area

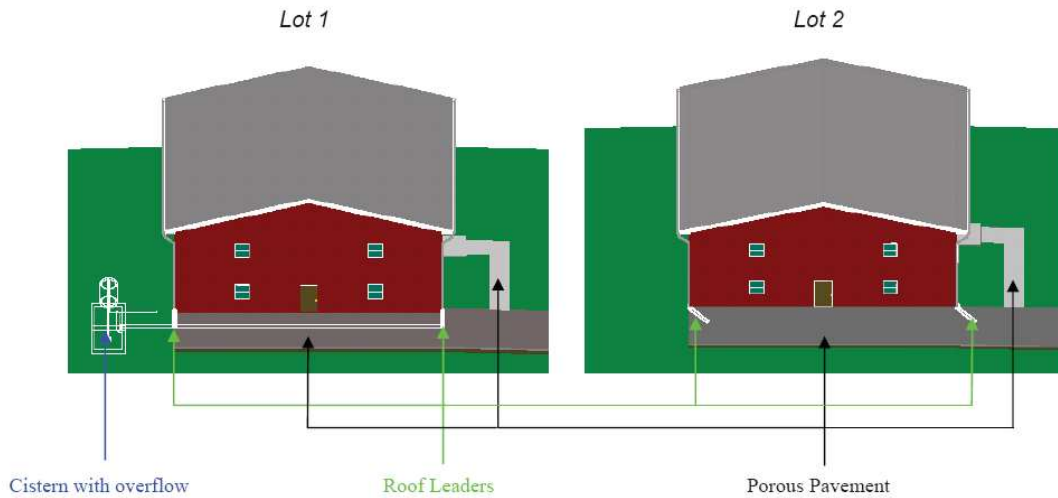
An adjustment to the total impervious surface area is permitted when a green roof is installed on a building. The design, construction, and operation and maintenance agreement must meet the requirements specified by Fact Sheet 4.1. To encourage this emerging technology, the impervious area reduction is permitted equal to the entire area of the green roof. However, since a green roof is not a zero discharges system, the remaining site design must safely convey roof runoff to a designated location. Appropriate CN values must be utilized when performing water quantity calculations.

3.5 Install Permeable Pavement Systems to Reduce Impervious Area

An adjustment to the total impervious surface area may be permitted when a permeable pavement system is properly designed and installed on the site such that it does not create any areas of concentrated infiltration. Permeable pavement systems, including pervious concrete, porous asphalt, and permeable pavers with at least 40% void space; and other approved porous structural surfaces can be considered to be disconnected if they receive direct rainfall only and are underlain by a crushed stone infiltration bed that is at least 8 inches deep. Permeable pavement systems must meet the requirements specified by the following permeable pavement system Fact Sheet 4.2, including completion of field verified permeability rates by a licensed engineer, geologist, or soil scientist. If the porous surface receives runoff from adjacent conventional pavement surfaces or if the roof or other runoff is directed into the subsurface storage bed, the porous pavement/infiltration bed system will be considered a structural BMP and the porous surface will be considered to be impervious surface this is demonstrated in Figure 3.1.2. Appropriate CN values must be utilized when performing water quantity calculations.

Figure 3.1.2: Example Permeable Pavement System Impervious Area Reduction Technique

(City of Philadelphia Storm Water Management Guidance Manual, 2006)



Roof Area (same for both houses): $25 \times 20 \times 2 = 1,000 \text{ ft}^2$
 Driveway and Sidewalk Area (same for both houses): $(60 \times 90) + (4 \times 19.5) + (5 \times 5) = 643 \text{ ft}^2$
 Impervious Area before Disconnection (same for both houses): (Roof Area + Driveway and Sidewalk Area) = $1,643 \text{ ft}^2$

(City of Philadelphia Storm Water Management Guidance Manual, 2006)

The home on lot 1 has disconnected both the roof, by the use of a cistern with an overflow for larger precipitation events, and the pavement, by use of the porous pavement. The home on lot 2 has also disconnected the roof. However, the roof was disconnected by the use of the porous pavement, since the downspouts run directly into the gravel storage bed of the porous pavement; the porous pavement is considered a structural BMP and is still considered to be impervious area.

Impervious Area of Lot 1 After Disconnection: 0 ft^2 (since roof leaders are disconnected to a cistern)
 Impervious Area of Lot 2 After Disconnection: 643 ft^2 (since roof leaders discharge directly into porous pavement)

(City of Philadelphia Storm Water Management Guidance Manual, 2006)