132 Attachment 4

Township of Towamencin

APPENDIX 132D
Small Project Stormwater Management

Source: Neshaminy Creek Watershed Act 167 Model Stormwater Management Ordinance

Small Project Stormwater Management has been developed to assist those proposing certain residential projects to meet the requirements of the Township Stormwater Management Ordinance without having to hire professional services to draft a formal Drainage Plan. Small Project Stormwater Management is only permitted for residential projects conforming to exemption requirements of § 132-5.B of the Stormwater Management Ordinance (Chapter 132 of the Towamencin Township Code) and where the Regulated Development Activity results in less than 1 acre of earth disturbance.

1. What is an applicant required to submit?

A brief description of the proposed stormwater facilities, including types of materials to be used, total square footage of proposed impervious surface areas, total square footage of existing impervious surface area to be removed (if any), volume calculations, and a simple sketch plan showing the following information:

- Location of proposed structures, driveways, or other paved areas with approximate surface area in square feet.
- Location of any existing or proposed onsite septic system and/or potable water wells showing proximity to proposed infiltration facilities.
- Written Erosion Control Plan if disturbed ground area is to exceed 5,000 square feet. It should be noted that erosion control facilities are required with all land disturbance activities.
- Montgomery County Conservation District erosion and sediment control "Adequacy" letter if applicable.

2. Determination of Required Volume Control and Sizing of Stormwater Facilities

By following the simple steps outlined below in the provided example, an applicant can determine the runoff volume that is required to be controlled and how to choose the appropriate stormwater facility to permanently remove the runoff volume from the site. Impervious area calculations must include all areas on the lot proposed to be covered by roof area or pavement which would prevent rain from naturally percolating into the ground, including impervious surfaces such as sidewalks, driveways, parking areas, patios, swimming pools, and gravel areas. Semi-pervious hardscaping surfaces designed and constructed to allow for infiltration (as approved by the Township) do not have to be included in this calculation.

Site Plan Example: Controlling runoff volume from a proposed home site

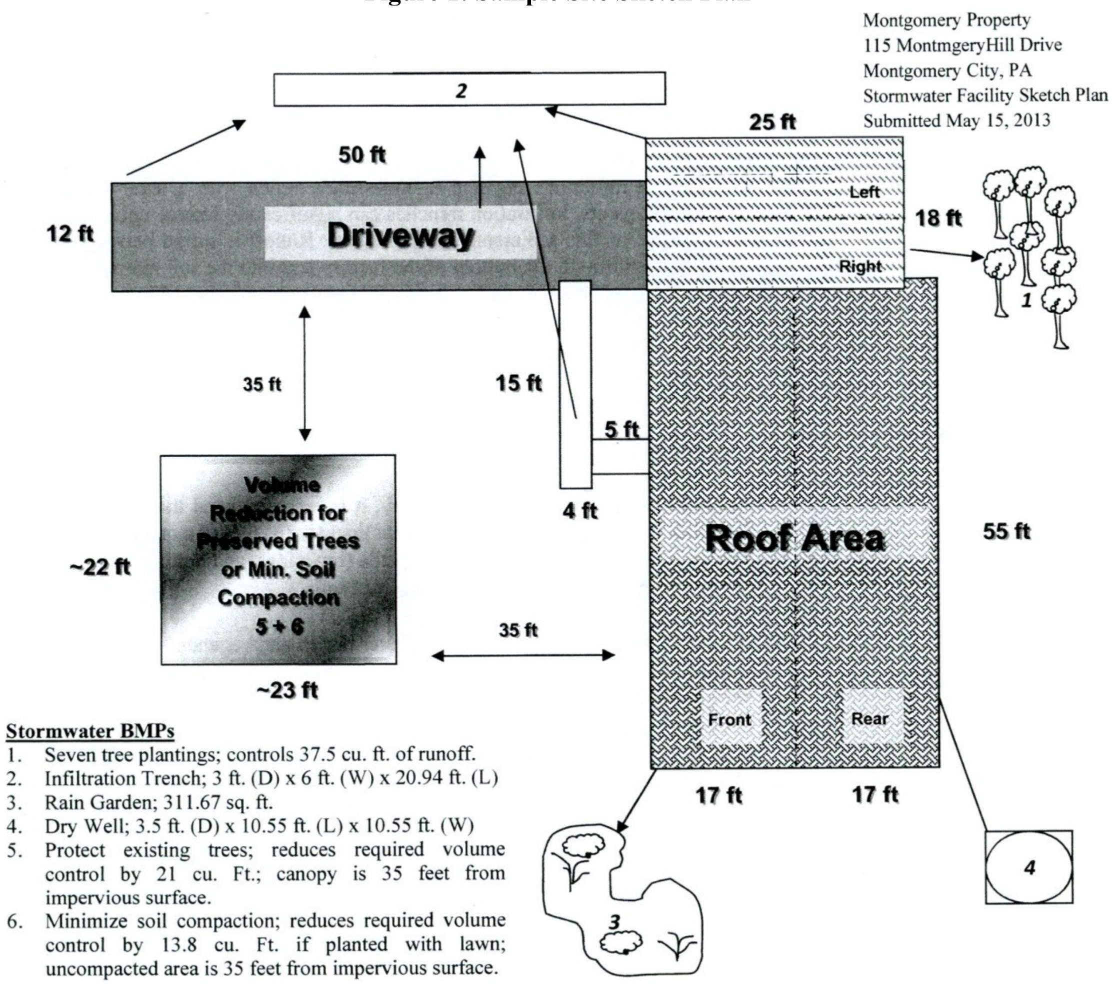
Step 1: Determine Total Impervious Surfaces (Refer to Figure 1)

Impervious Surface			Area (sq. ft.)
House Roof (Front)	17 ft. x 55 ft.	=	935 sq. ft.
House Roof (Rear)	17 ft. x 55 ft.	=	935 sq. ft.
Garage Roof (Left)	9 ft. x 25 ft.	=	225 sq. ft.
Garage Roof (Right)	9 ft. x 25 ft.	=	225 sq. ft.

Impervious Surface			Area (sq. ft.)
Driveway	12 ft. x 50 ft.	=	600 sq. ft.
Walkway	4 ft. x 20 ft.	=	80 sq. ft.

	Total Impervious		3000 sq. ft.

Figure 1: Sample Site Sketch Plan



Step 2: Determine Required Volume Control (cubic feet) using the following equation:

Volume (cu. ft.) = (Total impervious surface area in square feet x 2 inches of runoff) ÷ 12 inches
(3,000 sq. ft. x 2 inches of runoff) ÷ 12 inches = 500 cu. ft.

Step 3: Sizing the Selected Volume Control BMP

Several Best Management Practices (BMPs), as described below, are suitable for Small Stormwater Management Projects. However, their application depends on the volume required to be controlled, how much land is available, and the site constraints. Proposed residential development activities can apply both non-structural and structural BMPs to control the volume of runoff from the site. A number of different volume control BMPs are described below. Note that Figure 1 is an example of how these BMPs can be utilized in conjunction to control the total required volume on one site.

3. Determination of Suitable BMPs for Small Stormwater Management Projects.

A. Structural BMPs

1. Infiltration Trench

An Infiltration Trench is a linear stormwater BMP consisting of a continuously perforated pipe at a minimum slope in a stone-filled trench with a level bottom. During small storm events, infiltration trenches can significantly reduce volume and serve in the removal of fine sediments and pollutants. Runoff is stored between the stones and infiltrates through the bottom of the facility and into the soil matrix. Prior to entering the basin, runoff should be pretreated using vegetative buffers strips or swales and filter inlets to limit the amount of coarse sediment entering the trench which can clog and render the trench ineffective. In all cases, an infiltration trench should be designed with a positive (emergency) overflow so that water does not pool in the basin less than 12 inches from the ground surface.

Design Considerations:

- Although the width and depth can vary, it is recommended that Infiltration Trenches be limited in depth to not more than six (6) feet of stone.
- Trench is wrapped in nonwoven geotextile (top, sides, and bottom).
- Trench needs to be placed on uncompacted soils.
- Slope of the Trench bottom should be level.
- A minimum of 6” of topsoil is placed over trench and vegetated.
- The discharge or overflow from the Infiltration Trench should be properly designed for anticipated flows.
- Cleanouts or inlets should be installed at both ends of the Infiltration Trench and at appropriate intervals to allow access to the perforated pipe for inspection and maintenance.
- Volume of facility = Depth x Width x Length x Void Space of the gravel bed (assume 40%).
- Filter inlets should have a sump condition of at least 24". Outflow pipe to trench should be fitted with a 90 degree elbow, turned downward towards the bottom of the inlet. The elbow should also be fitted with a non-degradable screen. All runoff must be collected by or discharge to a filter inlet before entering the infiltration trench. An example of a filter inlet is shown in Figure 6.
- Trench may be no closer than thirty (30) feet from a building foundation and fifty (50) feet from septic system drainfields and wellheads.

Maintenance:

- Catch basins and inlets should be inspected and cleaned at least two times a year.
- The vegetation along the surface of the infiltration trench should be maintained in good condition and any bare spots should be re-vegetated as soon as possible.

- Vehicles should not be parked or driven on the trench and care should be taken to avoid soil compaction by lawn mowers.

Figure 3: Infiltration Trench Diagram
Source: PA BMP Guidance Manual, Chapter 6, page 42.

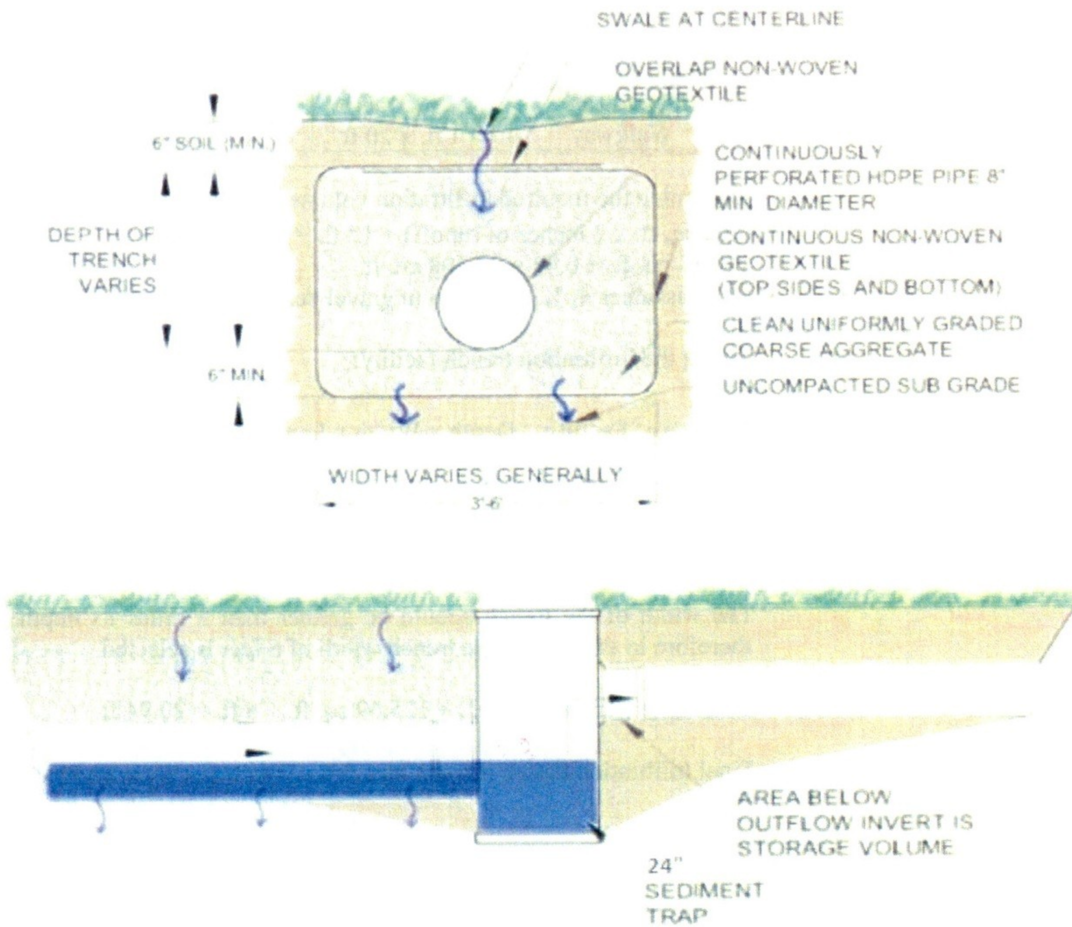


Figure 4: Example of Infiltration Trench Installation
Source: PA BMP Guidance Manual, Chapter 6, Page 46.

Sizing Example for Infiltration Trench (Based on Example in Figure 1)

a. Determine Total Impervious Surface to drain to Infiltration Trench:

Garage Roof (Left)	9 ft. x 25 ft.	=	225 sq ft
Driveway	12 ft. x 50 ft.	=	600 sq ft
Walkway	4 ft. x 20 ft.	=	80 sq ft

b. Determine the required infiltration volume:
(905 sq. ft. x 2 inches of runoff) ÷ 12 ft. = 150.83 cu. ft.
150.83 cu. ft. ÷ 0.4* = 377.08 cu. ft.
(*0.4 assumes 40% void ratio in gravel bed)

c. Sizing the infiltration trench facility:

Volume of Facility = Depth x Width x Length

Set Depth to 3 feet and determine required surface area of trench.

377.08 cu. ft ÷ 3 ft = 125.69 sq ft.

The width of the trench should be greater than 2 times its depth (2 x D), therefore in this example a trench width of 6 feet is selected.

Determine trench length: L = 125.69 sq. ft. ÷ 6 ft. = 20.94 ft.

Final infiltration trench dimensions: 3 ft. (D) x 6 ft. (W) x 20.94 ft. (L)

2. **Rain Garden**

A Rain Garden is a planted shallow depression designed to catch and filter rainfall runoff. The garden captures rain from a downspout or a paved surface. The water sinks into the ground, aided by deep rooted plants that like both wet and dry conditions. The ideal location for a rain garden is between the source of runoff (roofs and driveways) and the runoff destination (drains, stream, low spots, etc).

Design Considerations:

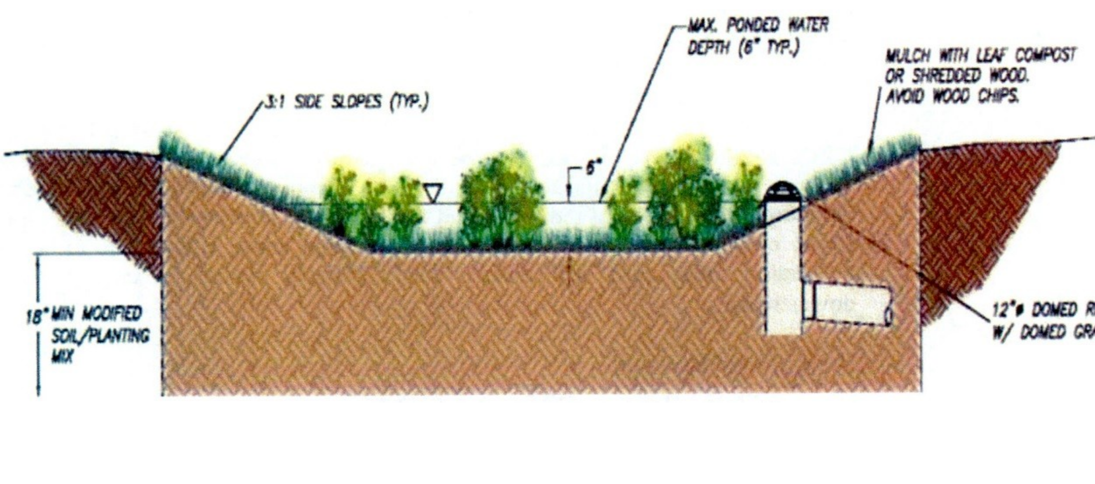
- A maximum of 3:1 side slope is recommended.
- The depth of a rain garden can range from 6 - 8 inches.
- The rain garden should drain within 72 hours.
- The garden should be at least 30 feet from a building's foundation and 50 feet from septic system drainfields and wellheads.
- If the site has clay soils, soil should be amended with compost or organic material.
- Choose native plants. See http://pa.audubon.org/habitat/PDFs/RGBrochure complete.pdf for a native plant list. To find native plant sources go to www.pawildflower.org.
- At the rain garden location, the water table should be at least 2 feet below the soil level. If water stands in an area for more than one day after a heavy rain you can assume it has a higher water table and is not a good choice for a rain garden.

Maintenance:

- Water plants regularly until they become established.
- Inspect twice a year for sediment buildup, erosion and vegetative conditions.
- Mulch with hardwood when erosion is evident and replenish annually.
- Prune and remove dead vegetation in the spring season.
- Weed as you would any garden.
- Move plants around if some plants would grow better in the drier or wetter parts of the garden.

Figure 5: Rain Garden Diagram

Source: PA BMP Guidance Manual, Chapter 6 Page 50.



Sizing Example for Rain Garden

a. Pick a site for the rain garden between the source of runoff and between a low-lying area, a.k.a., a drainage area.

b. Perform an infiltration test to determine the depth of the rain garden:

- Dig a hole 8" x 8" and saturate hole with water.
- Fill hole with water to top and put a popsicle stick at the top of the water level.
- Measure how far it drains down after a few hours (ideally in 4 hrs.).
- Calculate the depth of water that will drain out over 24 hours.

c. Determine total impervious surface area to drain to rain garden:

House Roof (Front)	17 ft. x 55 ft.	=	935 sq ft

d. Sizing the rain garden:

For this example the infiltration test determined 6" of water drained out of a hole in 24 hours. The depth of the rain garden should be set to the results of the infiltration test so 6" is the depth of the rain garden. The sizing calculation below is based on controlling 1" of runoff. First divide the impervious surface area by the depth of the rain garden.

(935 sq. ft. ÷ 6) = 155.83 sq. ft.

In order to control 2" of runoff volume, the rain garden area needs to be multiplied by 2.

155.83 sq. ft. * 2 = 311.67 sq. ft.

The rain garden should be about 311.67 sq. ft. in size and 6" deep.

3. Dry Well (a.k.a., Seepage Pit)

A Dry Well, sometimes called a Seepage Pit, is a subsurface storage facility that temporarily stores and infiltrates stormwater runoff from the roofs of structures. By capturing runoff at the source, Dry Wells can dramatically reduce the increased volume of stormwater generated by the roofs of structures. Roof leaders connect directly into the Dry Well, which may be either an excavated pit filled with uniformly graded aggregate wrapped in geotextile, or a prefabricated storage chamber or pipe segment. Dry Wells discharge the stored runoff via infiltration into the surrounding soils. In the event that the Dry Well is overwhelmed in an intense storm event, an overflow mechanism (surcharge pipe, connection to a larger infiltration area, etc.) will ensure that additional runoff is safely conveyed downstream.

Design Considerations:

- Dry Wells typically consist of 18 to 48 inches of clean washed, uniformly graded aggregate with 40% void capacity (AASHTO No. 3, or similar).

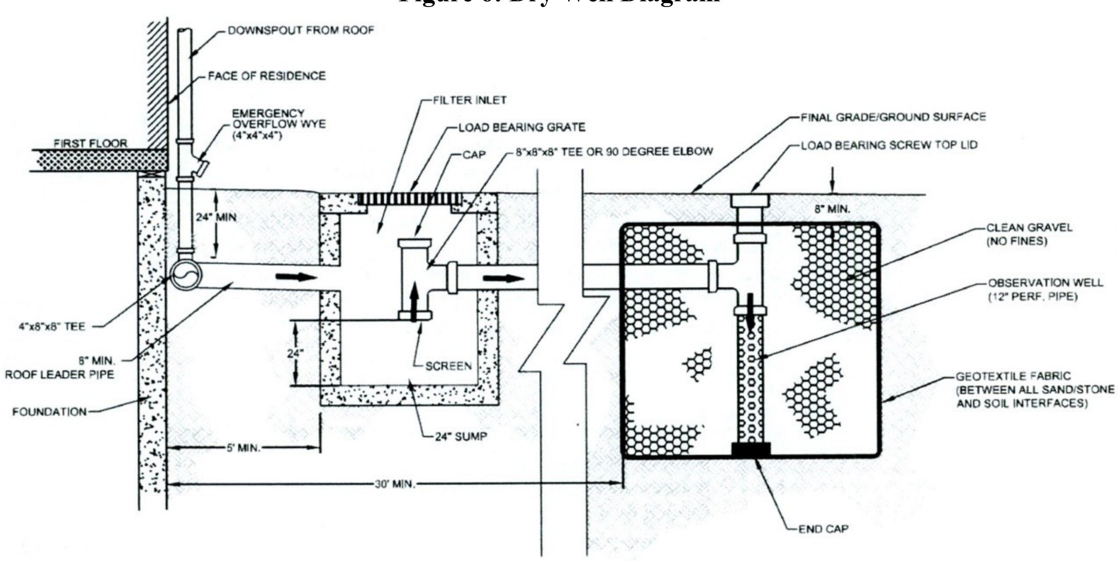
"Clean" gravel fill should average one and one-half to three (1.5 - 3.0) inches in nominal diameter.

- Dry Wells are not recommended when their installation would create a significant risk for basement seepage or flooding. Thirty (30) feet of separation is required between Dry Wells and building foundations and 50 feet from septic system drainfields and wellheads.
- The facility may be either a structural prefabricated chamber or an excavated pit filled with aggregate.
- Depth of dry wells in excess of three-and-a-half (3.5) feet should be avoided unless warranted by soil conditions.
- Stormwater dry wells must never be combined with existing, rehabilitated, or new septic system seepage pits. Discharge of sewage to stormwater dry wells is strictly prohibited.
- Trench is wrapped in nonwoven geotextile (top, sides, and bottom).
- Filter inlet with access lid should have a sump condition of at least 24 inches. Outflow pipe to dry well should be fitted with a 90 degree elbow, turned downward towards the bottom of the inlet. The elbow should also be fitted with a non-degradable screen. Roof leaders must discharge to a filter inlet.

Maintenance:

- Dry wells should be inspected at least four (4) times annually as well as after large storm events.
- Remove sediment, debris/trash, and any other waste material from a dry well.
- Regularly clean out gutters and ensure proper connections to the dry well.
- Replace the filter screen that intercepts the roof runoff as necessary.

Figure 6: Dry Well Diagram



Sizing Example for Dry Wells:

a. Determine contributing impervious surface area:

House Roof (Rear)	17 ft. x 55 ft.	=	935 sq. ft.

b. Determine required volume control:

(935 sq. ft. * 2 inches of runoff) ÷ 12 inches = 155.83 cu. ft.

155.83 cu. ft. ÷ 0.4* = 389.58 cu. ft.
(*assuming the 40% void ratio in the gravel bed)

c. Sizing the dry well:

Set depth to 3.5 ft;
Set width equal to length for a square chamber.

389.58 cu. ft. = 3.5 ft. x L x L; L = 10.55 ft.

Dimensions = 3.5 ft. (D) x 10.55 ft. (L) x 10.55 ft. (W)

B. Non-Structural BMPs

Note: The cumulative volume reduction permitted for non-structural BMP credits shall not exceed 25% of the total stormwater volume required to be captured in conjunction with the Small Project Stormwater Management design (Refer Chapter 8 of the Pennsylvania Stormwater Best Management Practices Manual, 2006, as amended).

1. Tree Plantings and Preservation

Trees and forests reduce stormwater runoff by capturing and storing rainfall in the canopy and releasing water into the atmosphere through evapotranspiration. Tree roots and leaf litter also create soil conditions that promote the infiltration of rainwater into the soil. In addition, trees and forests reduce pollutants by taking up nutrients and other pollutants from soils and water through their root systems. A development site can reduce runoff volume by planting new trees or by preserving trees which existed on the site prior to the development. The volume reduction calculations either determine the cubic feet to be directed to the area under the tree canopy for infiltration or determine a volume reduction credit which can be used to reduce the size of any one of the planned structural BMPs on the site.

Tree Considerations:

- Existing trees must have at least a 4" trunk caliper or larger.
- Existing tree canopy must be within 100 ft. of impervious surfaces.
- A tree canopy is classified as the continuous cover of branches and foliage formed by a single tree or collectively by the crowns of adjacent trees.
- New tree plantings must be at least 6 ft. in height and have a 2-inch caliper trunk size as measured 4 feet above the ground surface.

- All existing and newly planted trees must be native to Pennsylvania. Refer http://www.dcnr.state.pa.us/forestry/commontr/commontrees.pdf for a guide book titled Common Trees of Pennsylvania for a native tree list.
- When using trees as volume control BMPs, runoff from impervious areas should be directed to drain under the tree canopy.

Determining the required number of planted trees to reduce the runoff volume:

A. Determine contributing impervious surface area:

Garage Roof (Right)	9 ft. x 25 ft.	=	225 sq. ft.

B. Calculate the required control volume:

(225 sq. ft. x 2 inches of runoff) ÷ 12 inches = 37.50 cu. ft.

C. Determine the number of tree plantings:

- Pursuant to Chapter 8 of the Pennsylvania Stormwater Best Management Practices Manual (2006, as amended), a newly planted deciduous tree (2 inch minimum caliper at 4 feet above ground) can reduce runoff volume by 6 cu. ft.
- Pursuant to Chapter 8 of the Pennsylvania Stormwater Best Management Practices Manual (2006, as amended), a newly planted evergreen tree (6 feet minimum height) can reduce runoff volume by 10 cu. ft.

37.5 cu. ft. ÷ 6 cu. ft. = 6.25 = 7 Deciduous Trees

This volume credit (7 trees x 6 cu. ft per tree = 42 cu. ft) can be utilized in reducing the size of any one of the structural BMPs planned on the site.

Determining the volume reduction for preserving existing trees:

A. Calculate approximate area of the existing tree canopy:

~22 sq. ft. x ~23 sq. ft = 500 sq. ft.

B. Measure distance from impervious surface to tree canopy: 35 ft. (example)

C. Calculate the volume reduction credit by preserving existing trees:

- For Trees within 20 feet of impervious cover:
  Volume Reduction cu.ft.=(Existing Tree Canopy sq. ft. x 1 inch)/12
- For Trees beyond 20 feet but not farther than 100 feet from impervious cover:
  Volume Reduction cu.ft.=(Existing Tree Canopy sq. ft. x 0.5 inch)/12

(500 sq. ft. x 0.5 inches)/12 = 21 cu. ft.

This volume credit can be utilized in reducing the size of any one of the structural BMPs planned on the site.

2. Minimize Soil Compaction and Replant with Lawn or Meadow

When soil is overly compacted during construction it can cause a drastic reduction in the permeability of the soil and rarely is the soil profile completely restored. Runoff from vegetative areas with highly compacted soils similarly resembles runoff from an impervious surface. Minimizing soil compaction and re-planting with a vegetative cover like meadow or lawn, not only increases the infiltration on the site, but also creates a friendly habitat for a variety of wildlife species.

Design Considerations:

- Area shall not be stripped of topsoil.
- Vehicle movement, storage, or equipment/material lay down shall not be permitted in areas preserved for minimum soil compaction.
- The use of soil amendments and additional topsoil is permitted.
- Meadow should be planted with native grasses. Refer to Meadows and Prairies: Wildlife-Friendly Alternatives to Lawn at http://pubs.cas.psu.edu/FreePubs/pdfs/UH128.pdf for reference on how to properly plant the meadow and for a list of native species.

Determining the volume reduction by minimizing soil compaction and planting a meadow:

A. Calculate approximate area of preserved meadow:

~22 sq. ft. x ~23 sq. ft = 500 sq. ft.

B. Calculate the volume reduction credit by minimizing the soil compaction and planting a lawn/meadow:

- For Meadow Areas: Volume Reduction (cu. ft.) = (Area of Min. Soil Compaction (sq. ft.) x 1/3 inch of runoff)/12

(500 sq. ft. x 1/3 inch of runoff)/12 = 13.8 cu. ft.

- For Lawn Areas: Volume Reduction (cu. ft.) = (Area of Min. Soil Compaction (sq. ft.) x 1/4 inch of runoff)/12

(500 sq. ft. x 1/4 inch of runoff)/12 = 10.4 cu. ft.

This volume credit can be used to reduce the size of any one of the structural BMPs on the site.

3. Rain Barrels

Rain barrels are large containers that collect drainage from roof leaders and temporarily store water to be released to lawns, gardens, and other landscaped areas after the rainfall has ended. Rain barrels are typically between 50 and 200 gallons in size. Although residents may wish to utilize rain barrels for capture and reuse of stormwater runoff, they shall not be used as a volume control BMP because infiltration is not guaranteed after each storm event. A rain barrel is not utilized in this small Projects Stormwater Management example.

4. Summary

Based on the sample residential Regulated Activity shown in Figure 1, a total of 3,000 square feet of impervious surface area is proposed, resulting in a total volume of 500 cubic feet of stormwater runoff that must be controlled/mitigated using structural and non-structural BMPs. As noted in this Appendix, no greater than 25% of the required runoff volume of 500 cubic feet may be managed using nonstructural BMPs (500 cubic feet x 25% = 125 cubic feet, maximum). Using a combination of tree plantings, tree preservation, minimizing soils compaction and planting un-compacted areas with meadow ground cover condition results in nonstructural control of 76.8 cubic feet of runoff (42 cubic feet + 21 cubic feet + 13.8 cubic feet). Since this amount is less than 25% of the total required volume to be managed, the full volume of these non-structural BMPs may be accounted for. Structural BMPs of infiltration trench, rain garden, and dry well are shown to control 462.4 cubic feet of volume with this sample improvement project (150.8 cubic feet + 155.3 cubic feet + 155.3 cubic feet). Therefore, since structural and non-structural BMPs control 539.7 cubic feet of runoff volume, the design in this example satisfies the Small Projects Stormwater Management requirement to control at least 500 cubic feet of stormwater runoff volume.