

**WEST GOSHEN TOWNSHIP
STORMWATER MANAGEMENT
ORDINANCE**

APPENDIX A

**SIMPLIFIED APPROACH TO
STORMWATER MANAGEMENT
FOR SMALL PROJECTS**

Appendix A

Simplified Approach to Stormwater Management for Small Projects

**Appendix A.1 –
Applicability, Submittal and Approval Requirements**

**Appendix A.2 –
*“Simplified Approach to Stormwater Management for Small
Projects – Handbook” (Revised June 10, 2012)***

**Appendix A.3 –
*“Simplified Approach – Stormwater Best Management Practices
Operation, Maintenance and Inspection Plan and Agreement” –
Sample Agreement (Revised October 12, 2012)***

Appendix A.1

Applicability, Submittal and Approval Requirements

**West Goshen Township
Chester County, Pennsylvania**

Applicability:

- Small projects with less than 2,000 square feet of Proposed Impervious Surfaces (as defined in the Municipality's Stormwater Management Ordinance) and with less than 5,000 square feet of proposed Earth Disturbance (as defined in the Municipality's Ordinance) may apply the "Simplified Approach to Stormwater Management for Small Projects" (Simplified Approach).
- Only projects that meet the above size thresholds as specified in the Municipality's Stormwater Management Ordinance may use this Simplified Approach and are then not required to submit a formal Stormwater Management Site plan to the Municipality. However, these projects are still required to address water quality and infiltration requirements as outlined in this Simplified Approach "Handbook".
- Any project with more than 2,000 square feet of Proposed Impervious Surface or more than 5,000 square feet of proposed Earth Disturbance can NOT apply this Simplified Approach.
- The Applicant should first review the planned project with the Municipal Engineer prior to initiating the Simplified Approach to confirm the following:
 - That the proposed project is not otherwise exempt from the stormwater management control and the engineered Stormwater Management Site Plan requirements of the Municipality's Stormwater Management Ordinance;
 - That the proposed project is eligible to use this Simplified Approach;
 - To determine which components of the proposed project must be included in the calculation of "impervious surfaces (areas)"; and,
 - Whether any local conditions are known to the Municipal Engineer that would preclude the use of any of the techniques included in this Simplified Approach.

Submittal and Approval Requirements:

Use of the Simplified Approach requires:

- The applicant to submit the following to the Municipality for review and approval prior to beginning construction:
 - A Simplified Stormwater Management Site Plan (i.e. sketch plan) and accompanying Worksheet; and
 - A completed, signed and notarized "Simplified Operation, Maintenance and Inspection Plan and Agreement".
- The first 1-inch of rainfall runoff from Proposed Impervious Surfaces (as defined by the Municipality's Ordinance) must be captured and removed on the applicant's property.
- The applicant to record the "Simplified Approach – Stormwater Best Management Practices Operation, Maintenance and Inspection Plan and Agreement" at the Chester County Office of the Recorder of Deeds after signature by the Municipality.
- A final inspection conducted by the Municipality after completion of construction.

Appendix A.2 –

“Simplified Approach to Stormwater Management for Small Projects – Handbook” (Revised June 10, 2012)

**Simplified Approach to
Stormwater Management
for Small Projects**

Handbook

Errata Notes:

The following corrections are noted for Figure 6:

1. Label for BMP #1 Cistern – should read “(166 Gallons)”
2. Label for BMP #2 Infiltration Trench – should read “(20’L x 3’W x 3.5’D)”

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Revised June 10, 2012

Further revised by:

West Goshen Township

as part of the

County-wide Act 167 Stormwater Management Plan for Chester County, PA

Revised Date: October 28, 2013

All revisions made by West Goshen Township were completed without consultation with Borton-Lawson and were completed at the sole discretion of West Goshen Township.

STORMWATER MANAGEMENT PROCEDURES FOR MEETING THE SIMPLIFIED APPROACH REQUIREMENTS

Introduction

This Handbook has been developed to allow homeowners or applicants for small projects to comply with stormwater management requirements of the Stormwater Management Ordinance of the Municipality, including sizing, designing, locating and installing on-lot measures, referred to herein as “Best Management Practices” (BMPs). **Only projects that meet the size thresholds specified in the Municipality’s Stormwater Management Ordinance may use this Simplified Approach** and are then not required to submit a formal Stormwater Management Site plan to the Municipality. However, these projects are still required to address certain requirements, such as stormwater quality, infiltration, rate and volume management goals as outlined in this Simplified Approach Handbook.

Pennsylvania Act 167 (PA Stormwater Management Act) was authorized on October 4, 1978 (32 P.S., P.L. 864) and gave Pennsylvania Municipalities the power to regulate activities that affect flooding, streambank erosion, stormwater runoff and surface and groundwater quantity and quality. The Municipality’s Stormwater Management Ordinance was prepared to comply with the PA Act 167 requirements and includes provisions allowing this Simplified Approach to be used for small projects as specified in their Ordinance.

If the guidelines presented in this Handbook are followed, the applicant may not require professional engineering services to comply with these stormwater management goals. This Handbook is organized into five sections:

- **Section 1** describes requirements and a simplified approach for designing a suitable BMP, and a description of what needs to be included on the simplified stormwater management (SWM) site plan (i.e. sketch plan).
- **Section 2** presents definitions of key terms.
- **Section 3** presents options of BMPs that can be considered for on-lot stormwater management.
- **Section 4** illustrates an example of how to obtain the size and dimensions of a BMP(s) for a sample project.
- **Section 5** describes the requirements to be met for a “Simplified Approach Operation, Maintenance and Inspection Plan and Agreement”.

The Simplified Approach requires:

- The applicant to submit the following to the Municipality for review and approval prior to beginning construction:
 - A Simplified Stormwater Management (SWM) Site Plan (i.e. sketch plan), and accompanying Worksheet, and
 - A completed and signed “Simplified Approach Operation, Maintenance and Inspection Plan and Agreement”.

- The first 1-inch of rainfall runoff from proposed impervious surfaces (as defined by the Municipality's Ordinance) must be captured and removed from the stormwater runoff leaving the applicant's property.
- The applicant to record the "Simplified Approach Operation, Maintenance and Inspection Plan and Agreement" at the County's Recorder of Deeds after signature by the Municipality.

The purpose of requiring effective stormwater management from small projects is to help reduce stormwater runoff in the community, to maintain groundwater recharge, to prevent degradation of surface and groundwater quality, and to otherwise protect water resources and public safety.

What needs to be submitted to the Municipality?

- Simplified Approach Worksheet (Table 4)
- Simplified SWM site plan (i.e. sketch plan), containing the features described in Section 1, Step 1
- "Simplified Approach Operation, Maintenance and Inspection Plan and Agreement" must be signed, notarized and (after approval and signature by the Municipality) recorded at the County Recorder of Deeds.

If the applicant is using a contractor to construct the project, the worksheet and sketch plan must be shared with the contractor to ensure the BMP(s) are properly installed.

1. Determination of Simplified Approach Volume Requirements

All proposed impervious areas (as required by the Municipality's Ordinance) must be included in the determination of the amount of new impervious areas and the size of proposed BMPs needed to manage stormwater. Proposed impervious areas on an individual residential lot generally include, but are not limited to: roof area, pavement, sidewalks, driveways, patios, porches, permanent pools, or parking areas, etc. See the definitions provided in Section 2 and check with the Municipal Engineer to confirm what features of the proposed project must be included in the calculation of new impervious areas. Sidewalks, driveways, or patios that are constructed with gravel or pervious pavers and will not be disturbed or altered in the future may not need to be included in this calculation (check with the Municipal Engineer). In these cases, the amount of proposed impervious area may be reduced for proposed driveways, patios, and sidewalks through the use of gravel, pervious pavement, and turf pavers. All proposed impervious areas must be constructed so that runoff is conveyed to a BMP(s); no runoff may be directed to storm sewers, inlets or other impervious areas (i.e. street) without effective stormwater management from a site.

In addition, the use of low impact development is recommended to further minimize the effect of the new construction on water, land, and air. Low impact development is a method of development that incorporates design techniques that include: minimizing the amount of land disturbance, reducing the amount of impervious cover, disconnecting gutters and directing stormwater runoff to vegetated areas to infiltrate, and redirecting the flow of stormwater runoff from impervious surfaces to vegetated areas instead of the street or gutter.

Below are the steps that must be undertaken to meet the Ordinance requirements. The size and description of the proposed construction as well as important aspects related to the design of the BMP(s) must be documented in the Simplified Approach Worksheet found in Table 4. All individuals planning on using the Simplified Approach are encouraged to review the planned project with the Municipal Engineer prior to initiating the Simplified Approach to confirm the following:

- That the proposed project is not otherwise exempt from the stormwater management control and engineered Stormwater Management Site Plan requirements of the Municipality's Stormwater Management Ordinance;
- That the proposed project size is within the range eligible to use this Simplified Approach;
- To determine which components of the proposed project must be included in the calculation of "impervious areas"; and
- Whether any local conditions are known to the Municipal Engineer that would preclude the use of any of the techniques included in this Simplified Approach.

Step 1 - Prepare the Simplified SWM Site Plan (i.e. sketch plan) that includes:

- Name and address of the owner of the property, and name and address of individual preparing the plan (if different than the property owner), along with the date of submission.
- Location of all existing structures including buildings, driveways, and roads within fifty (50) feet of the project site.

- Location of proposed structures, driveways, or other paved areas with approximate size in square feet.
- Location, and distance, of any existing surface water features, such as streams, lakes, ponds, wetlands or other natural waterbodies, within fifty (50) feet of the project site and/or BMPs. Depending upon the Municipality's requirements, the following may also be required (check with the Municipal Engineer):
 - The project and/or BMPs cannot cause earth disturbance within fifty (50) feet from a perennial or intermittent stream, wetland or waterbody. Protecting this area from non-disturbance along the aforementioned features helps protect the applicant's land from erosion, the flood carrying capacity of streams, and the water quality of the waterbody. Where the applicant cannot meet the 50-foot non-disturbance width, the applicant should work with the Municipal Engineer to determine if a reduced width is acceptable, however a minimum of at least a 10 foot non-disturbance area width should be maintained.
 - If an existing buffer is legally prescribed (i.e., deed, covenant, easement, etc.) and it exceeds this requirements, the existing buffer must be maintained.
- Location, orientation, and dimensions of all proposed BMPs. For all rain gardens/bioretention, infiltration trenches, and dry wells the length, width, and depth must be included on the plan. For rain barrels or cisterns the volume must be included.
- Location of any existing or proposed on-lot septic system and potable water wells showing rough proximity to infiltration facilities. See Section 3. Description of BMPs, for the appropriate setbacks for on-lot septic systems and potable water wells.

Step 2 –Determine the Impervious Area to be Managed

- Determine the total area of all proposed impervious surfaces that will need to drain to one or more BMP(s).
- Also determine the total area for proposed earth disturbance to complete the project and install the BMP(s). The total earth disturbance to complete a project is often greater than the project area to allow for access from construction vehicles, stock piling of materials and excavation. The total area of earth disturbance must account for all of the construction activities necessary to construct the project.
- Determine locations where BMP(s) need to be placed so that the appropriate amount of stormwater runoff from the proposed impervious surfaces can be captured and managed.

Step 3 – Select the BMP(s) to be Used and Determine Appropriate Sizing Criteria

- Select the BMP(s) to be used and determine the requirements of each from Section 3, Description of BMPs.
 - For instance, the back half of a garage may drain to a dry well and the front half of the garage and a driveway may drain to a bioretention area. Each BMP will be sized differently, manage stormwater runoff and will need to be designed to be consistent with Section 3.
- Then obtain the required storage volume and surface area needed for each of the proposed BMP(s) from the appropriate heading below.
- Complete Table 4 Simplified Approach Worksheet.

For Rain Gardens/Bioretenention or Dry Well #1:

Step 3A – Select the proposed impervious area value in Column 1 of Table 2 that is closest to, but not less than the determined value.

Step 3B - Determine the volume that needs to be provided in cubic feet to satisfy the volume requirements using Column 2 in Table 2.

Step 3C – Using the value from Column 2 determined above, and the depth (D) of the proposed BMP, simply determine the surface area needed from Column 3 of Table 2.

Note: The arrows under Column 3 in Table 2 indicate which range of depths is appropriate for each BMP. To determine the depth based on the area, select an area that corresponds to the required volume, and is closest to, but not more than the area to be used. To determine the area based on the depth, select a depth that is closest to, but not less than the depth that is to be used.

For Infiltration Trench or Dry Well #2:

Step 3A – Select the proposed impervious area value in Column 1 of Table 3 that is closest to, but not less than the determined value.

Step 3B - Determine the volume that needs to be provided in cubic feet to satisfy the volume requirements using Column 2 in Table 3.

Step 3C – Using the value from Column 2 determined above, and the depth (D) of the proposed BMP, simply determine the surface area needed from Column 3 of Table 3.

Note: The arrows under Column 3 in Table 3 indicate which range of depths is appropriate for each BMP. To determine the depth based on the area, select an area that corresponds to the required volume, and is closest to, but not less than the area to be used. To determine the area based on the depth, select a depth that is closest to, but not less than the depth that is to be used.

Step 4 – Submit the final SWM Site Plan, Simplified Approach Worksheet, and signed and notarized “Simplified Approach Operation, Maintenance and Inspection Plan and Agreement” (a sample document is provided in the accompanying appendix) to the Municipality for review and approval prior to beginning construction. After the Municipality has signed the “Simplified Approach Operation, Maintenance and Inspection Plan and Agreement”, record the Agreement at the County’s Office of Recorder of Deeds. Construction can begin only after the Municipality has issued its approval of the proposed project to the applicant.

Table 1: Simplified Approach - Calculating Rain Garden/Bioretenion and Dry Well #1 Storage Volume and Surface Area for 1 Inch Rainfall

Column 1	Column 2	Column 3							
Total Proposed Impervious Area (square feet)	Volume of Rain Garden/Bioretenion or Dry Well #1 ¹ (cubic feet)	Surface Area of Rain Garden/Bioretenion or Dry Well #1 Acceptable Depths for Each BMP are indicated by the arrows below (square feet)							
		Area Required for a BMP with a Depth(D) of 0.5'	Area Required for a BMP with a Depth(D) of 1.0'	Area Required for a BMP with a Depth(D) of 1.5'	Area Required for a BMP with a Depth(D) of 2.0'	Area Required for a BMP with a Depth(D) of 2.5'	Area Required for a BMP with a Depth(D) of 3.0'	Area Required for a BMP with a Depth(D) of 3.5'	Area Required for a BMP with a Depth(D) of 4.0'
<i>I</i>	<i>V</i>	<i>A(sf)</i>							
Sum of all Proposed Impervious Areas	$1*(1/12)*I= V$	$V/D=A$							
50	4	8	4	3	2	2	1	1	1
100	8	17	8	6	4	3	3	2	2
150	13	25	13	8	6	5	4	4	3
200	17	33	17	11	8	7	6	5	4
250	21	42	21	14	10	8	7	6	5
300	25	50	25	17	13	10	8	7	6
350	29	58	29	19	15	12	10	8	7
400	33	67	33	22	17	13	11	10	8
450	38	75	38	25	19	15	13	11	9
500	42	83	42	28	21	17	14	12	10
550	46	92	46	31	23	18	15	13	11
600	50	100	50	33	25	20	17	14	13
650	54	108	54	36	27	22	18	15	14
700	58	117	58	39	29	23	19	17	15
750	63	125	63	42	31	25	21	18	16
800	67	133	67	44	33	27	22	19	17
850	71	142	71	47	35	28	24	20	18
900	75	150	75	50	38	30	25	21	19
950	79	158	79	53	40	32	26	23	20
999	83	167	83	56	42	33	28	24	21

¹ It is assumed that the rain garden/bioretenion or the dry well #1 are empty prior to receiving runoff (i.e. 0% full)

Table 2: Simplified Approach - Calculating Infiltration Trench and Dry Well #2 Storage Volume and Surface Area for 1 Inch of Rainfall

Column 1	Column 2	Column 3							
Total Proposed Impervious Area (square feet)	Volume of Infiltration Trench or Dry Well #2 ¹ (cubic feet)	Surface Area of Infiltration Trench or Dry Well #2 Acceptable Depths for Each BMP are indicated by the arrows below (square feet)							
		Area Required for a BMP with a Depth(D) of 1.5'	Area Required for a BMP with a Depth(D) of 2.0'	Area Required for a BMP with a Depth(D) of 2.5'	Area Required for a BMP with a Depth(D) of 3.0'	Area Required for a BMP with a Depth(D) of 3.5'	Area Required for a BMP with a Depth(D) of 4.0'	Area Required for a BMP with a Depth(D) of 4.5'	Area Required for a BMP with a Depth(D) of 5.0'
<i>I</i>	<i>V</i>	<i>A(sf)</i>							
Sum of all Proposed Impervious Areas	$(1*(1/12)*I)/(0.4)^1 = V$	$V/D=A$							
50	10	7	5	4	3	3	3	2	2
100	21	14	10	8	7	6	5	5	4
150	31	21	16	13	10	9	8	7	6
200	42	28	21	17	14	12	10	9	8
250	52	35	26	21	17	15	13	12	10
300	63	42	31	25	21	18	16	14	13
350	73	49	36	29	24	21	18	16	15
400	83	56	42	33	28	24	21	19	17
450	94	63	47	38	31	27	23	21	19
500	104	69	52	42	35	30	26	23	21
550	115	76	57	46	38	33	29	25	23
600	125	83	63	50	42	36	31	28	25
650	135	90	68	54	45	39	34	30	27
700	146	97	73	58	49	42	36	32	29
750	156	104	78	63	52	45	39	35	31
800	167	111	83	67	56	48	42	37	33
850	177	118	89	71	59	51	44	39	35
900	188	125	94	75	63	54	47	42	38
950	198	132	99	79	66	57	49	44	40
999	208	139	104	83	69	59	52	46	42

¹ Assumes a percent void volume of 40%

2. Definitions

These definitions apply only to this Simplified Approach to Stormwater Management for Small Projects Handbook. The definitions included in the Municipality's Stormwater Management Ordinance also apply.

Best Management Practice (BMP) – As defined in the Municipality's Stormwater Management Ordinance, but generally including activities, facilities, designs, measures or procedures used to manage stormwater impacts from land development and earth disturbance activities to meet stormwater quality, runoff control and groundwater recharge protection requirements. BMPs include, but are not limited to, a wide variety of practices and devices such as: infiltration facilities (dry wells and infiltration trenches), filter strips, low impact design, bioretention (rain gardens), permeable paving, grassed swales, and manufactured devices (cisterns and rain barrels). Structural stormwater BMPs are permanent appurtenances to the project site.

Geotextile - A fabric manufactured from synthetic fibers which provides a separation between different types of media (i.e., soil and stone), and is used to achieve specific objectives, including infiltration or filtration.

Hotspot - Areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants that are higher than those that are typically found in stormwater (e.g. vehicle salvage yards, recycling facilities, vehicle fueling stations, fleet storage areas, vehicle equipment and cleaning facilities, and vehicle service and maintenance facilities).

Impervious Surface - As defined in the Municipality's Stormwater Management Ordinance, but generally including any surface that prevents the infiltration of water into the ground. Impervious surfaces generally include, but are not limited to, streets, sidewalks, pavements, driveway areas, or roofs. The applicant should review the Municipality's Stormwater Management Ordinance or consult with the Municipal Engineer to confirm what components of the proposed project are considered "impervious surfaces". Decks, swimming pools, compacted soils or stone surfaces (such as for vehicle movement or parking), among other features, may be included in the Municipality's definition of "impervious surfaces".

Infiltration - Movement of surface water into the soil, where it is absorbed by plant roots, transpired or evaporated into the atmosphere, or percolated downward to recharge groundwater.

Low Impact Development - A land development and construction approach that uses various land planning, design practices, and technologies to simultaneously conserve and protect natural resource systems, and reduce infrastructure costs.

Percent Void Volume – The volume of void space, expressed as a percentage, of the total volume of the storage facility (void volume + volume of solid materials providing structural support for the storage facility).

Pervious Surface - Any area not defined as impervious surface.

Potable – A water supply that is either absent of contaminants or contains contaminant levels that are below a given threshold level that makes the water as suitable for drinking.

Runoff - Any part of precipitation that flows over the land surface.

Stormwater - Drainage runoff from the surface of the land resulting from precipitation, or snow or ice melt.

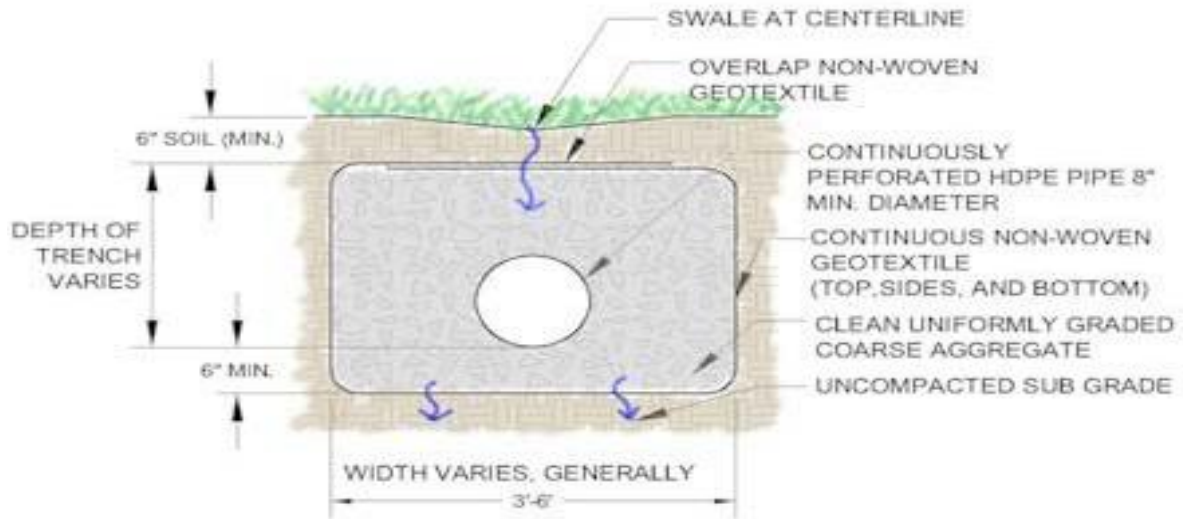
3. Description of BMPs

The following is a description of several types of BMPs that could be implemented. The requirements of each BMP as described below are taken directly from the PA Stormwater BMP Manual (December, 2006). Refer to the PA BMP Manual (latest version) which can be found on the PA Department of Environmental Protection's website.

Infiltration Trench

An infiltration trench is a long, narrow, rock-filled trench, with or without a perforated pipe placed within the rock to distribute water evenly along the trench, that receives stormwater runoff, and has no outlet. Runoff is stored in the void space between the stones and in the pipe, and infiltrates through the bottom of the trench into the underlying soil matrix. Figure 3 shows a typical cross-section of an infiltration trench configuration. Infiltration trenches shall incorporate or make provisions for the following elements:

- These facilities should be located a minimum of ten (10) feet (or as otherwise required by the Municipality) from the building foundation to avoid foundation seepage problems, and are not recommended if their installation would create a risk of flooding other structures constructed at or below grade.
- Perforated pipe placed within the rock is to be set level.
- The width is limited to between **3 to 8 feet**, and the depth ranges from **2 to 5 feet**.
- Trench should be wrapped in nonwoven geotextile (top, sides, and bottom).
- There should be a positive overflow that allows stormwater that cannot be stored or infiltrated to be discharged into a nearby vegetated area.
- Roof downspouts may be connected to infiltration trenches, but should contain a cleanout to collect sediment and debris before entering the infiltration area.
- Infiltration testing is recommended to ensure soil is capable of infiltrating stormwater.
- It is recommended that there be a 2 foot clearance above the regularly occurring seasonal high water table, and have a minimum depth to bedrock of 2 feet.
- The infiltration trench should be at least 50 feet from individual water supply wells, 100 feet from community or municipal water supply wells, and 50 feet from any septic system component. It should not be located near stormwater Hotspots (refer to B.2 Definitions).
- The infiltration trench should be located so that it presents no threat to sub-surface structures such as building foundations and basements.
- Protect infiltration areas from compaction by heavy equipment during and after construction.
- Infiltration trenches should be constructed after all earth disturbance associated with a given project or site is stabilized to avoid clogging.
- The ratio of the drainage area which stormwater runoff is collected from to the area of the footprint (bottom area) of the infiltration portion of the facility should be as small as possible with a ratio of less than 5:1 preferred.



Source: Pennsylvania Stormwater BMP Manual (PADEP, 2006)

Figure 1: Cross-Section of Typical Infiltration Trench



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Stormwater Management Quality Controls

Provide infiltration capacity for the equivalent of one inch of runoff from all new impervious surfaces. The infiltration volume does not have to be provided in one location. However, if site conditions preclude capture of runoff from portions of the impervious area, the infiltration volume for the remaining area should be increased an equivalent amount to offset the loss. In no case should the portion of the new impervious area flowing to an infiltration facility be less than 70% of the total new impervious area.

How to Size Infiltration facility for one inch of runoff

Take the new Impervious areas square footage (Ia) and divided by twelve (12) to get the volume of water per cubic feet (Wv) required for storage for one inch of runoff. Times the volume of water per cubic feet (Wv) by the void ratio of the stone (#4 Ballast) which is two point five (2.5) to get the required size of the infiltration bed.

$$Ia / 12 = Wv$$

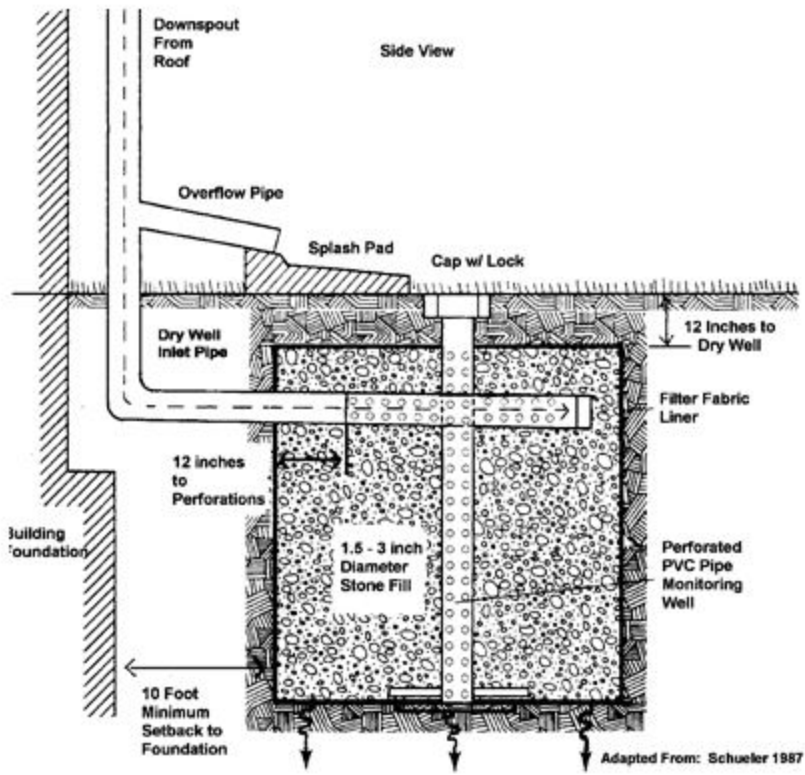
$$Wv \times 2.5 = \text{size of bed}$$

Sq. Ft. of Impervious	Bed size using #4 stone	Sq. Ft. of Impervious	Bed size using #4 stone
100	21 cubic feet	1100	229 cubic feet
200	42 cubic feet	1200	250 cubic feet
300	63 cubic feet	1300	271 cubic feet
400	83 cubic feet	1400	292 cubic feet
500	104 cubic feet	1500	313 cubic feet
600	125 cubic feet	1600	333 cubic feet
700	146 cubic feet	1700	354 cubic feet
800	167 cubic feet	1800	375 cubic feet
900	188 cubic feet	1900	396 cubic feet
1000	208 cubic feet	2000	417 cubic feet

Two sets of plans for underground infiltration facility detailing the following:

- Showing all new impervious and building coverage on site
- Size of the infiltration facility(s) including calculations
- Location of the infiltration facility(s) (All Facilities shall be positioned a minimum of twenty-five feet away from foundations with basements and a minimum of fifteen feet away from all other foundations)
- Material details (stone, fabric, pipe, overflow, etc.)
- Details of overflow and clean-out capability

All submittals with new impervious and building coverage more than 10% of the total site area, or more than 2000 square feet require a Soil Erosion and Sediment Control Permit.



Rain Garden/Bioretention Area

A Rain Garden (Bioretention Area) is an excavated depression area on the surface of the land in which native vegetation is planted to filter and use stormwater runoff. Runoff ponds on top of the surface of the rain garden and then infiltrates into an enhanced soil/planting mix below the surface where plants can use the water to grow. Bioretention improves water quality, with the vegetation planted in the facility filtering the water, and the root systems encouraging or promoting infiltration. Figure 4 shows a cross-section of a typical rain garden. Key elements of a rain garden include:

- Recommended ponding depths not exceeding **1 foot**.
- Native vegetation that can tolerate dry and wet weather.
- An overflow area where, if the bioretention area were to overflow, the overflow would flow over pervious surfaces (i.e. grass, meadow), and would not cause harm to property, or;
- An overflow, such as a domed riser, to allow excess flow from large storms to travel to other infiltration areas, pervious areas, or connected storm systems designed to receive the excess runoff.
- For most areas, slopes should be limited to 3:1, maximum; however, where space is limited, 2:1 side slopes may be acceptable with approval from the municipal engineer.
- The soil/planting mix depth should not be less than 1.5 feet deep and typically consist of a mixture of topsoil, sand and compost (i.e. mulch). The topsoil, sand and compost should be uniformly mixed by volume in a 50%, 30%, 20% mixture, respectively.



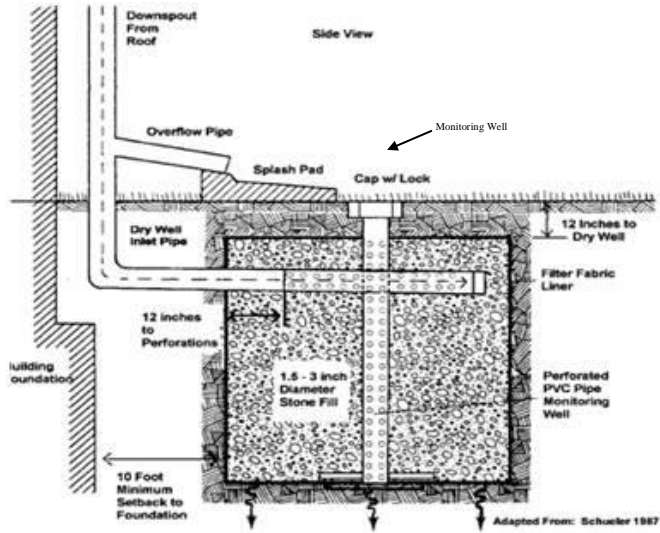
Source: Pennsylvania Stormwater BMP Manual (PADEP, 2006)

Figure 2: Cross-Section of Typical Rain Garden/Bioretention Area

Dry Wells

A dry well, also referred to as a seepage pit, is a subsurface storage facility that temporarily stores and infiltrates runoff from the roofs of buildings or other impervious surfaces. A dry well can be either a structural prefabricated chamber (Dry Well #1) or an excavated pit filled with stone fill (Dry Well #2). Dry Wells discharge the stored runoff via infiltration into the surrounding or underlying soils. Figure 5 shows a typical prefabricated dry well and a typical dry well configuration with stone fill. The following elements shall be incorporated into all dry well designs:

- These facilities should be located a minimum of ten (10) feet (or as otherwise required by the Municipality) from the building foundation to avoid foundation seepage problems, and are not recommended if their installation would create a risk of flooding other structures constructed at or below grade.
- Dry well should be constructed after all earth disturbance associated with a given project or site is stabilized to avoid clogging.
- During construction, compaction of the subgrade soil in the bottom of the dry well should be avoided, and construction should be performed only with light machinery.
- For Dry Well #2 designs, the depth of dry well should be between **1.5 feet to 4 feet**. Gravel fill should consist of uniformly graded stone with an average diameter of between one and one half and two (1.5 –2.0) inches with the gravel fill wrapped in a nonwoven geotextile to separate the stone fill from the surrounding soil.
- At least 1 foot of soil must be placed over the top of the dry well.
- Dry wells should be inspected at least four (4) times annually as well as after large storm events.
- Dry wells should have overflow pipes to allow high volumes of runoff to overflow the facility and flow into a connected infiltration area, pervious area, or other connected storm sewer designed to receive the excess runoff.
- Every dry well must have at least one monitoring well to assist in the inspection of the dry well to determine how much water is retained within the well during dry weather periods.
- Infiltration testing is recommended to ensure the underlying soil is capable of infiltrating the needed volume of stormwater.



Source (for picture on left): <http://www.seagrant.sunysb.edu/pages/BMPsForMarinas.htm>

Source (for picture on right): <http://www.copelandconcreteinc.net/1800652.html>

Figure 3: Typical Dry Well Configuration filled with Stone Fill (DRY WELL #2) (Left) and Structural Prefabricated Chamber (DRY WELL #1) (Right)

4. Example

Simplified Approach to Stormwater Management for a Residential Garage and Driveway addition

Joe Homeowner wants to build a 400 square foot two car garage, and a 540 square foot (30' long x 18' wide) impervious driveway that is graded so that the stormwater runoff drains to the grassy area along one edge of the driveway. (An annotated copy of Table 1 is provided below as Table 5 and an annotated copy of Table 3 is provided below as Table 6, and outlines the steps of this example) and a completed Table 4 is provided as Table 7.

STEP 1 – Make a sketch of the site plan as shown in Figure 6.

STEP 2 - Determine the total area of all proposed impervious surfaces to drain to each BMP:

Garage Roof (Front)	10 ft. x 20 ft.	=	200 sq. ft
Garage Roof (Rear)	10 ft. x 20 ft.	=	200 sq. ft.
Driveway	30 ft. x 18 ft.	=	540 sq. ft.

Total Proposed Impervious Surface			940 sq. ft.
Total Proposed Earth Disturbance Area			2,500 sq. ft. (estimated)

Note: If the driveway used pervious pavement (i.e. paving blocks), then the total impervious area would only be 400 square feet, and no stormwater management practices would need to control runoff from the project.

STEP 3 – Select the BMP(s) to be Used and Appropriate Sizing Criteria

Select a BMP or combination of BMPs from Section 3 to be used to satisfy the volume requirement. Determine the length, width, depth and other requirements for the BMPs in Section 3. A BMP needs to be placed to catch runoff from the back of the garage, and a BMP needs to be placed to capture runoff from the front of the garage and the driveway. Figure 6 shows the direction the runoff flows and the locations where the BMPs are to be placed.

Joe Homeowner would like to use a rain barrel (BMP #1) to capture the runoff from the rear of the garage and an infiltration trench (BMP #2) to capture runoff from the front of the garage and the driveway.

BMP #1 (Rain Barrel/Cistern) – Steps 3A and 3B

STEP 3A - Select the proposed impervious area value for BMP #1, the rain barrel or cistern, in Column 1 that is closest to, but not less than 200 in Table 1:

The value in Column 1 that is closest to but is not less than 200 is 200.

STEP 3B - Determine the volume that BMP #1 must be to satisfy the volume requirements using Columns 2 and 3 in Table 1:

The volume in gallons of the rain barrel/cistern to be used as BMP #1, assuming the rain barrel/cistern is 25% full, is determined by finding the value in Column 3 for the same row that corresponds to the impervious area value determined in Step 1. Therefore, the volume of BMP #1, the rain barrel/cistern must be ≥ 166 gallons. Depending on the size of the rain barrel(s), a combination of rain barrels could be used in succession as shown in Figure 1, or a cistern could be used.

BMP #2 (Infiltration Trench) - Steps 3A through 3C

STEP 3A - Select the proposed impervious area value for BMP #2, the infiltration trench, using Column 1 in Table 6:

Find the row in Column 1 that is closest to but not less than 740 (200 from the front of the garage + 540 from the driveway). Therefore, the value selected is 750.

STEP 3B - Determine the volume that BMP #2, the infiltration trench must be to satisfy the volume requirements using Column 2 in Table 6:

The volume of the infiltration trench to be used as BMP #2, assuming a percent void volume of 40%, is determined by finding the value Column 2 that is in the same row as 750 square feet from Column 1 as described in Step 2. Therefore, the volume of BMP #2 must be 156 cubic feet.

STEP 3C - Utilizing the value from Column 2 determined above, and the surface area that the proposed BMP will occupy, determine the depth needed using Column 3 in Table 6:

Joe Homeowner would like to place the infiltration trench along the edge of the driveway so it would have a length of 20 feet. The smallest width that can be used, as stated in the infiltration trench requirements in Section 3, is 3 feet. Therefore, the area of the infiltration trench is:

$$20 \text{ feet} * 3 \text{ feet} = 60 \text{ square feet}$$

To find the minimum depth of the trench move toward the right side of the table from 156 cubic feet in Column 2 to Column 3, and find the column with a value of as close to but not more than 60 square feet, which is 52 square feet. Then obtain the minimum depth of the

facility by reading the depth from the column heading at the top of the table. Therefore, the depth of the trench would need to be 3 feet.

Selected BMPs:

BMP #1: Rain barrel(s) that provides for at least 166 gallons, and

BMP #2: A 20' long x 3' wide x 3' deep infiltration trench

Table 5: Example – Calculating Storage Volume for Rain Barrel/Cistern

Column 1	Column 2	Column 3	
Proposed Impervious Area (square feet)	Volume of Rain Barrel/Cistern ¹ (cubic feet)	Volume of Rain Barrel/Cistern (gallons)	
<i>I</i>	V_{RBcf}	V_{RBgal}	
Sum of all Proposed Impervious Areas	$(1*(1/12)*I)/0.75=V_{RBcf}$	$V_{RBcf} * 7.48=V_{RBgal}$	
50	6	42	↑
100	11	83	Rain Barrel
150	17	125	↓
2 200	22	3 166	↓
250	28	208	↑
300	33	249	
350	39	291	
400	44	332	
450	50	374	
500	56	416	
550	61	457	
600	67	499	Cistern
650	72	540	
700	78	582	
750	83	623	
800	89	665	
850	94	706	
900	100	748	
950	106	790	
999	111	830	↓

¹Assume that the rain barrel/cistern is 25% full

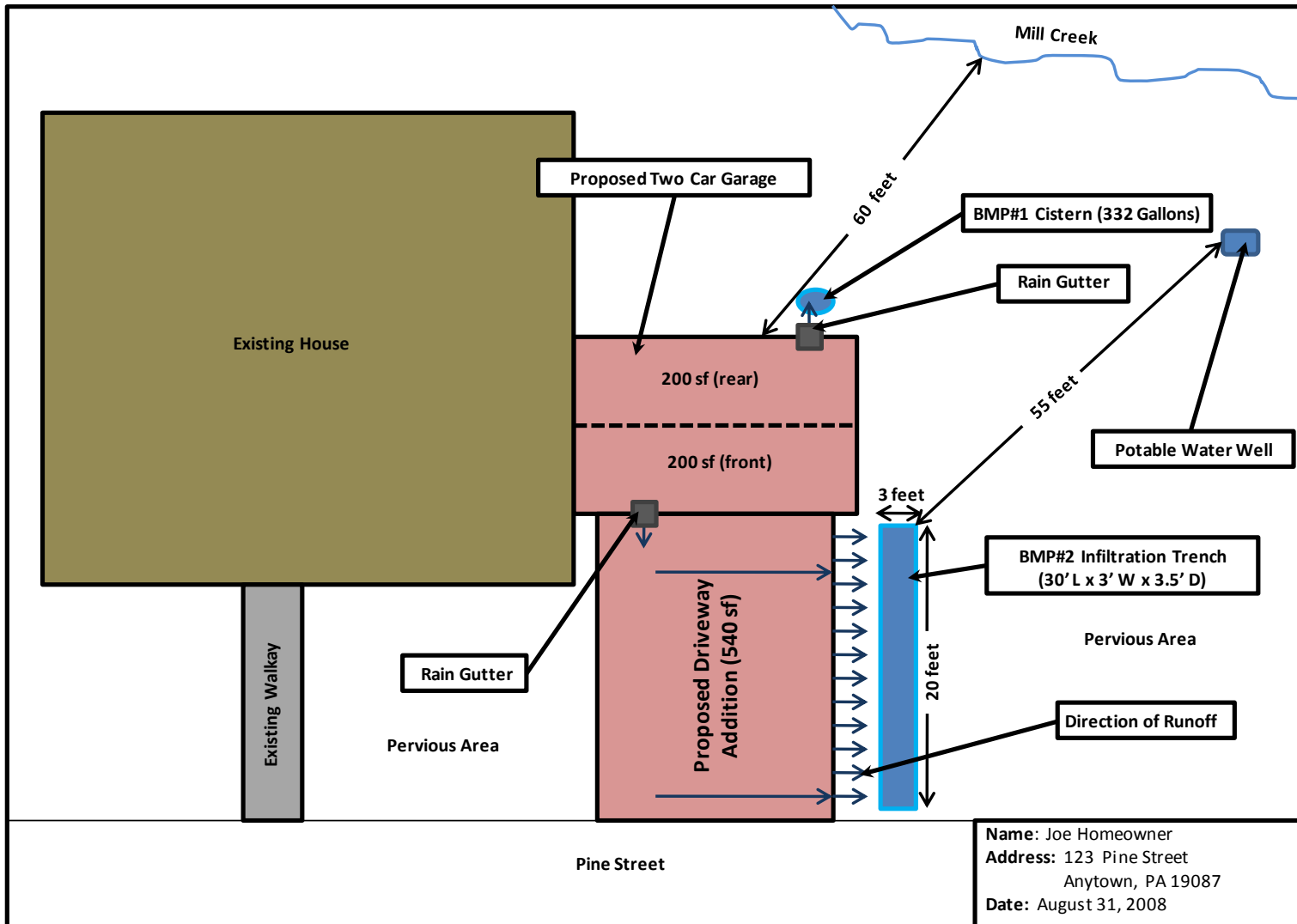


Figure 4: Example of Simplified Stormwater Management Site Plan for Joe Homeowner

Table 6: Example – Calculating Storage Volume Surface Area and Depth for Infiltration Trench

Column 1	Column 2	Column 3							
Total Proposed Impervious Area (square feet)	Volume of Infiltration Trench or Dry Well #2 ¹ (cubic feet)	Surface Area of Infiltration Trench or Dry Well #2 Acceptable Depths for Each BMP are indicated by the arrows below (square feet)							
		Area Required for a BMP with a Depth(D) of 1.5'	Area Required for a BMP with a Depth(D) of 2.0'	Area Required for a BMP with a Depth(D) of 2.5'	Area Required for a BMP with a Depth(D) of 3.0'	Area Required for a BMP with a Depth(D) of 3.5'	Area Required for a BMP with a Depth(D) of 4.0'	Area Required for a BMP with a Depth(D) of 4.5'	Area Required for a BMP with a Depth(D) of 5.0'
<i>I</i>	<i>V</i>	<i>A(sf)</i>							
Sum of all Proposed Impervious Areas	$(1*(1/12)*I)/(0.4)^1 = V$	$V/D=A$							
50	10	7	5	4	3	3	3	2	2
100	21	14	10	8	7	6	5	5	4
150	31	21	16	13	10	9	8	7	6
200	42	28	21	17	14	12	10	9	8
250	52	35	26	21	17	15	13	12	10
300	63	42	31	25	21	18	16	14	13
350	73	49	36	29	24	21	18	16	15
400	83	56	42	33	28	24	21	19	17
450	94	63	47	38	31	27	23	21	19
500	104	69	52	42	35	30	26	23	21
550	115	76	57	46	38	33	29	25	23
600	125	83	63	50	42	36	31	28	25
650	135	90	68	54	45	39	34	30	27
700	146	97	73	58	49	42	36	32	29
Step 3A 750	Step 3B 156	104	78	67	52	45	39	35	31
800	167	111	83	71	56	48	42	37	33
850	177	118	89	75	59	51	44	39	35
900	188	125	94	79	63	54	47	42	38
950	198	132	99	83	66	57	49	44	40
999	208	139	104	87	69	59	52	46	42

¹ Assumes a percent void volume of 40%

	740 sq. feet	156 cubic feet	20 ft by 3 ft	3 ft	Infiltration trench, uniformly graded aggregate, 8" HDPE pipe, geotextile, grass planted on top.
<input checked="" type="checkbox"/>	Step 4: Complete, Sign & have Operation, Maintenance and Inspection Agreement Notarized and Recorded at the County Recorder of Deeds (when signed by the Municipality)				

Note: For additional BMPs, use additional sheet(s).

5. Simplified Approach Operation, Maintenance and Inspection Plan and Agreement

It is the property owner’s responsibility to properly maintain BMPs. It is also the property owner’s responsibility to inform any future buyers of the function, operation, and maintenance needed for any BMPs on the property prior to the purchase of the property. The accompanying sample “Simplified Approach Operation, Maintenance and Inspection Plan and Agreement” (see accompanying appendix) outlines the maintenance required for each type of BMP, the responsibilities of the property owner, and the rights of the Municipality in regards to inspection and enforcement of the maintenance requirements.

The “Simplified Approach Operation, Maintenance and Inspection Plan and Agreement” must be signed, notarized and submitted to the Municipality. Following the signature by the Municipality, the property owner must have the Agreement recorded at the County Recorder of Deeds, so that the Agreement will be applicable to future property owners.

Appendix A.3 Simplified Approach – Stormwater Best Management Practices Operation, Maintenance, and Inspection Plan and Agreement

SAMPLE AGREEMENT

A.3 Simplified Approach - Stormwater Best Management Practices Operation, Maintenance, and Inspection Plan and Agreement

SAMPLE AGREEMENT

It is the Landowner's responsibility to properly maintain BMPs. It is also the Landowner's responsibility to inform any future buyers of the function, operation, and maintenance needed for any BMPs on the property prior to the purchase of the property. The following maintenance agreement outlines the inspection and maintenance required for each type of BMP, the responsibilities of the Landowner, and the rights of the Municipality in regards to inspection and enforcement of the maintenance requirements.

The Operation, Maintenance and Inspection Plan and Agreement must be signed, notarized and submitted to the Municipality. Following approval and signature by the Municipality, the Landowner must have the Agreement recorded at the Chester County Office of the Recorder of Deeds, so that the Agreement will be applicable to future landowners.

**SIMPLIFIED APPROACH
STORMWATER BEST MANAGEMENT PRACTICES
OPERATION, MAINTENANCE, AND INSPECTION PLAN AND
AGREEMENT**

THIS AGREEMENT, made and entered into this _____ day of _____, 20____, by and between _____, (hereinafter the “Landowner”), and West Goshen Township, Chester County, Pennsylvania, (hereinafter “Municipality”).

WITNESSETH

WHEREAS, the Landowner is the owner of certain real property by virtue of a deed of conveyance recorded in the land records of Chester County, Pennsylvania, at Deed Book _____ and Page _____, (hereinafter “Property”); and

WHEREAS, the Landowner recognizes that the stormwater management best management practices or BMPs (hereinafter referred to as “BMP” or “BMP(s)”) located on the Property at

_____ (address of Property where BMP is located) must be inspected and maintained; and

WHEREAS, the Municipality and the Landowner, for itself and for its administrators, executors, successors, heirs, and assigns, agree that the health, safety, and welfare of the residents of the Municipality and the protection and maintenance of water quality require that on-site BMP(s) be constructed and maintained on the Property; and

WHEREAS, for the purposes of this Agreement, the following definitions shall apply:

BMP – “Best Management Practice;” activities, facilities, designs, measures or procedures used to manage stormwater impacts from land development, to protect and maintain water quality and ground water recharge and to otherwise meet the purposes of the Municipality’s Stormwater Management Ordinance,

including, but not limited to infiltration trenches, dry wells, bioretention, rain gardens, permeable paving, etc.

The BMP(s) are permanent appurtenances to the Property; and

Conveyance – As specifically identified in the Simplified Stormwater Management Site Plan (herein after “Plan”), a man-made, existing or proposed facility, structure or channel used for the transportation or transmission of stormwater from one place to another, including pipes, drainage ditches, channels and swales (vegetated and other), gutters, and like facilities or features. The conveyances identified in the Plan are permanent appurtenances to the Property; and

WHEREAS, the Municipality requires that the BMP(s) and conveyances as shown on Plan and in accordance with the sizing calculations found on the Simplified Method Worksheet (herein after “Worksheet”) be constructed by the Landowner; the BMP(s) shall further be maintained by the Landowner, its administrators, executors, successors, heirs, and assigns in accordance with the associated operation and maintenance requirements included herein. The Plan and Worksheet are attached hereto and incorporated herein together as Exhibit “A” hereto; and

WHEREAS, the Municipality requires that stormwater management BMP(s) be constructed and adequately inspected, operated and maintained by the Landowner, its administrators, executors, successors, heirs, and assigns, in accordance with the following maintenance requirements:

1. Infiltration Trenches

- a. At least twice a year and after significant rainfall events the Landowner is to inspect the infiltration trench and remove any accumulated debris, sediment and invasive vegetation.
- b. Vegetation along the surface of an infiltration trench is to be maintained in good condition, and any bare spots are to be revegetated as soon as possible.
- c. Vehicles are not to be parked or driven on an infiltration trench, and care is to be taken to avoid excessive compaction by mowers.
- d. Any debris, such as leaves blocking flow from reaching an infiltration trench, is to be routinely removed.

2. Bioretention/Rain Garden

- a. Any debris, such as leaves blocking flow from reaching a bioretention/rain garden, is to be routinely removed.
- b. Pruning and weeding are required as needed including removal of invasive species, especially while vegetation is being established for a bioretention/rain garden.

- c. Mulch cover is to be maintained in a bioretention/rain garden, re-spread and replaced as needed to prevent erosion, reduce weed growth and assist with plant survival, without restricting the infiltration of stormwater.
- d. At least twice a year the Landowner is to inspect the bioretention/rain garden for sediment buildup, ground cover and vegetative conditions and make any repairs as needed.
- e. Watering is required as needed, including during periods of extended dry weather and drought.
- f. Trees and shrubs in a bioretention/rain garden are to be inspected at least twice per year by the Landowner to evaluate their health. If they are in poor health they are to be replaced.

3. Dry Wells

- a. Dry wells are to be inspected by the landowner at least four (4) times a year and after significant rainfalls, and debris, trash, sediment, and any other waste material need to be removed and disposed of at suitable disposal or recycling sites and in compliance with local, state, and federal waste regulations.
- b. For dry wells, gutters are to be regularly cleaned out and ensure that proper connections are maintained to facilitate the effectiveness of the dry well.
- c. The filter screen for downspouts or roof gutters which intercepts roof runoff and conveys it to the dry well must be cleaned and replaced as necessary.
- d. Dry wells that are damaged are to be fixed or replaced within two (2) weeks of being damaged.
- e. If an intermediate sump box exists in conjunction with a dry well, it must be cleaned out at least once per year.

NOW, THEREFORE, in consideration of the foregoing promises, the mutual covenants contained herein, and the following terms and conditions, the parties hereto, intending to be legally bound hereby, agree as follows:

- 1. The foregoing recitals to this Agreement are incorporated as terms of this Agreement and obligations of the Landowner as if fully set forth in the body of this Agreement.
- 2. The Landowner shall construct the BMP(s) in accordance with the specifications identified in the Plan and Worksheet.
- 3. The Landowner shall inspect, operate and maintain the BMP(s) as shown on the Plan in good working order acceptable to the Municipality and in accordance with the specific inspection and maintenance requirements outlined in this Agreement.

4. The Landowner hereby grants permission to the Municipality, its authorized agents and employees, to enter upon the Property from the public right-of-way or roadway, at reasonable times and upon presentation of proper identification, to inspect the BMP(s) whenever it deems necessary for compliance with this Agreement and the Municipality's Stormwater Ordinance. Whenever possible, the Municipality shall notify the Landowner prior to entering the Property.

5. The Landowner acknowledges that, per the Municipality's Stormwater Ordinance, it is unlawful, without written approval of the Municipality, to:

- a. Modify, remove, fill, landscape, alter or impair the effectiveness of any BMP or conveyance that is constructed as part of the Plan;
- b. Place any structure, fill, landscaping, additional vegetation, yard waste, brush cuttings, or other waste or debris into a BMP or conveyance that would limit or alter the functioning of the BMP or conveyance;
- c. Allow the BMP or conveyance to exist in a condition which does not conform to the Plan or this Agreement; and
- d. Dispose of, discharge, place or otherwise allow pollutants including, but not limited to, deicers, pool additives, household chemicals and automotive fluids to directly or indirectly enter any BMP or conveyance.

6. In the event the Landowner fails to operate and maintain the BMP(s) as shown on the Plan in good working order acceptable to the Municipality the Landowner shall be in violation of this Agreement and the Landowner agrees that the Municipality or its representatives may, in addition to and not in derogation or diminution of any remedies available to it under the Stormwater Ordinance or other statutes, codes, rules or regulations, or this Agreement, enter upon the Property and take whatever action is deemed necessary to maintain said BMP(s). It is expressly understood and agreed that the Municipality is under no obligation to maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the Municipality.

7. In the event the Municipality, pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner shall reimburse the Municipality for all expenses (direct and indirect) incurred within 30 days of delivery of an invoice from the Municipality. Failure of the Landowner to make prompt payment to the Municipality may result in enforcement proceedings, which may include the filing of a lien against the Property, which filing is expressly authorized by the Landowner.

8. The intent and purpose of this Agreement is to ensure the proper maintenance of the onsite BMP(s) by the Landowner; provided, however, that this Agreement shall not be deemed to create or effect any additional liability of any party for damage alleged to result from or be caused by stormwater runoff.

9. The Landowner, its executors, administrators, assigns, heirs, and other successors in interests, hereby release and shall release the Municipality, its employees, agents and designated representatives from all damages, accidents, casualties, occurrences or claims which might arise or be asserted against the Municipality and/or its said employees, agents or representatives, arising out of the construction, presence, existence, or maintenance of the BMP(s) either by the Landowner or Municipality. In the event that a claim is asserted or threatened against the Municipality, its employees, agents or designated representatives, the Municipality shall notify the Landowner and the Landowner shall defend, at his own expense, any claim, suit, action or proceeding, or threatened claim, suit, action or proceeding against the Municipality or, at the request of the Municipality, pay the cost, including attorneys' fees, of defense of the same undertaken on behalf of the Municipality. If any judgment or claims against the Municipality, its employees, agents or designated representatives shall be allowed, the Landowner shall pay all damages, judgments or claims and any costs and expenses incurred by the Municipality, including attorneys fees, regarding said damages, judgment or claims.

10. The Municipality may enforce this Agreement in accordance with its Stormwater Ordinance, at law or in equity, against the Landowner for breach of this Agreement. Remedies may include fines, penalties, damages or such equitable relief as the parties may agree upon or as may be determined by a Court of competent jurisdiction. Recovery by the Municipality shall include its reasonable attorneys fees and costs incurred in seeking relief under this Agreement.

11. Failure or delay in enforcing any provision of this Agreement shall not constitute a waiver by the Municipality of its rights of enforcement hereunder.

12. The Landowner shall inform future buyers of the Property about the function of, operation, inspection and maintenance requirements of the BMP(s) prior to the purchase of the Property by said future buyer, and upon purchase of the Property the future buyer assumes all responsibilities as Landowner and must comply with all components of this Agreement.

13. This Agreement shall inure to the benefit of and be binding upon, the Municipality and the Landowner, as well as their heirs, administrators, executors, assigns and successors in interest.

This Agreement shall be recorded at the Office of the Recorder of Deeds of the County of Chester, Pennsylvania, and shall constitute a covenant running with the Property and/or equitable servitude, in perpetuity.

ATTEST:

WITNESS the following signatures and seals:

(SEAL)

For the Municipality:

(SEAL)

For the Landowner:

ATTEST:

_____ Township Secretary
County of Chester, Pennsylvania

I, _____, a Notary Public in and for the County and State aforesaid,
whose commission expires on the _____ day of _____, 20__, do hereby certify that
_____ whose name(s) is/are signed to the foregoing Agreement
bearing date of the _____ day of _____, 20__, has acknowledged the same before me
in my said County and State.

GIVEN UNDER MY HAND THIS _____ day of _____, 20__.

NOTARY PUBLIC

(SEAL)