APPLICATION FOR MS4 PERMIT (0 – 1000 S.F.) OVER 1000 S.F. REQUIRES A GRADING PERMIT

Fill in all information completely

Section 1.0 **Property Location**: _____

Property Owner – Name & Address	**Engineer – Name & Address**	**Applicant** – Name & Address
Phone Number	**Phone Number**	**Phone Number**
Email Address	**Email Address**	**Email Address**

Section 2.0

Total S.F. of proposed project _____
Total S.F. from previous projects since December 1, 2012 _____
Total S.F. of all projects _____

Three (3) copies of a sealed engineered plan must be submitted with each application.
Such plan shall include :(§9-301)

Simplified Approach to Stormwater Management for Small Projects

For Rain Barrels / Cisterns (Page B-2 & B-3)

Step 1. Total area of all proposed impervious surfaces. _____S.F.

Step 2. Value in Column 1 of Table B-1. _____S.F.

Step 3. Volume in cubic feet and gallons from Column 2 & 3 in Table B – 1 _____ FT3 , _____ gallons

Step 4. Total number of Rain Barrels _____ Cistern _____

**** Excess volume leftover from any BMP measures* _____

Rain Gardens/Bioretention or Dry Well #1 (Page B4&B5)

Step 1. Impervious area in Column 1 in Table B-2_____S.F.

Step 2. Determine volume Column 2 in Table B-2_____

Step 3. Using volume from step 2, select depth (D) of proposed BMP, then determine surface area needed for that depth from Column 3 in Table B-2 _____S.F.

******For Infiltration Trench or Dry Well #2 follow pages B-7 – B-11 in handout provided by Thornbury Township**

THORNBURY TOWNSHIP CANNOT ISSUE AN OCCUPANCY PERMIT IF THERE ARE OUTSTANDING VIOLATIONS ON THE PROPERTY. BUILDING PERMIT FEES WILL BE DOUBLED IF WORK BEGINS BEFORE PERMITS ARE ISSUED

Section 3.0

Applicant's Signature **Date**

_____ _____

I hereby certify that the statements contained herein are true to the best of my knowledge and belief.
I understand that this permit will be issued only for that work listed.
I have read and understand Chapter 22 and Chapter 27 Article 15 of the Thornbury Township Code of Ordinances
I understand that additional information or permits may be required.
I understand that I shall give Thornbury Township 24 hours notice prior to commencing work.

ORDINANCE APPENDIX A

WATERSHED STORMWATER MANAGEMENT DISTRICT MAPS

ORDINANCE APPENDIX B

Simplified Approach to Stormwater Management for Small Projects

Applicability: Stormwater management procedures for projects with between five hundred (500) square feet and (2,000) square feet of proposed impervious area.

SIMPLIFIED APPROACH TO STORMWATER MANAGEMENT FOR SMALL PROJECTS

Introduction

The following procedures have been developed to allow homeowners to comply with stormwater management criteria for new projects to meet the requirements of the Act 167 Stormwater Management Ordinance of the Municipality including sizing, designing, locating, and installing on-lot measures, referred to herein as "Best Management Practices" (BMPs). Pennsylvania Act 167 was authorized on October 4, 1978 (32 P.S., P.L. 864) and gave Pennsylvania municipalities the power to regulate activities that affect stormwater runoff and surface and groundwater quantity and quality.

Individual home construction projects on single-family lots which result in between 500 square feet and 999 square feet of impervious area (including the building footprint, driveway, sidewalks, and parking areas) are not required to submit formal drainage plans to the Municipality or County; however, they are still required to address water quality and infiltration goals as outlined in this Simplified Approach document. If the guidelines presented in this brochure are followed, the individual homeowner will not require professional services to comply with these water quality and infiltration goals.

Section B.1 describes requirements and a simplified method for designing a suitable BMP, and a description of what needs to be included on the simple sketch plan. Section B.2 presents definitions of key terms. Section B.3 presents options of BMPs that can be considered for on-lot stormwater management. An example of how to obtain the size and dimensions of a BMP is explained in Section B.4. Section B.5 describes the requirements to be met for the modified Operation, Maintenance, and Inspection Plan.

The Simplified Approach requires:

- The first 1" of rainfall runoff from new impervious surfaces to be captured (see definition in Section B.2).

The purpose of this 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 sent to the Municipality?

Even though a formal drainage plan is not required for individual lot owners, the Simplified Method worksheet found in Table B-4 and a simple sketch plan containing the features described in Step 5 of Section B.1 needs to be submitted to the Municipality, and if applicable, the contractor prior to construction. The Operation and Maintenance Agreement found in Section B.5 needs to be signed and submitted with the simple sketch plan to the Municipality for approval.

B.1 Determination of Simplified Approach Volume Requirements

All proposed impervious areas must be included in the determination of the amount of new impervious areas and the size of proposed BMPs needed to control stormwater. Proposed impervious areas on an individual residential lot include: roof area, pavement, sidewalks, driveways, patios, porches, permanent pools, or parking areas. Sidewalks, driveways, or patios that are constructed with gravel or pervious pavers that will not be converted to an impervious surface in the future need not be included in this calculation. Therefore, the amount of proposed impervious area can 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; no runoff can be directed to storm sewers, inlets, or other impervious areas (i.e., street).

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 impervious cover, disconnecting gutters and directing runoff to vegetated areas to infiltrate, and redirecting the flow of runoff from impervious driveways to vegetated areas instead of to the street or gutter.

Below are the steps that must be undertaken to meet the Ordinance requirements. The results obtained for each step must be included in the Simplified Method Worksheet found in Table B-4:

STEP 1 – Determine the total area of all proposed impervious surfaces that will need to drain to one or more BMPs. Determine locations where BMPs need to be placed so that runoff from all of the proposed impervious surfaces can be captured. Select the BMPs to be used and determine the requirements of each from Section B.3. For instance, the back half of a garage may drain 200 square feet of roof to a rain barrel, and the front half of a garage may drain 200 square feet of roof and 540 square feet of driveway to a bioretention area. Then, obtain the required storage volume and surface area needed for each of the proposed BMPs from the appropriate heading below.

For Rain Barrels/Cisterns

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

STEP 3 – Determine the volume that needs to be provided in cubic feet and gallons to satisfy the volume requirements using Columns 2 and 3 in Table B-1.

Table B-1: Simplified Method - Calculating Rain Barrel/Cistern Storage Volume for 1" Rainfall[1]

Column 1	Column 2	Column 3	
Proposed Impervious Area (square feet)	**Volume of Rain Barrel/Cistern[2] (cubic feet)**	**Volume of Rain Barrel/Cistern (gallons)**	
I	V_{RBcf}	V_{RBgal}	
Sum of all Proposed Impervious Areas	$(1*(1/12)*I)/0.75=V_{RBcf}$	VRBcf * 7.48=VRBgal	
50	6	42	
100	11	83	
150	17	125	Rain Barrel
200	22	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	

[1]The typical volume of a rain barrel is between 50-200 gallons, so more than 1 rain barrel may be needed Larger volumes may require a cistern

[2]Assume that the rain barrel/cistern is 25% full

For Rain Gardens/Bioretention or Dry Well #1:

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

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

STEP 4 – Using the value from Column 2 determined above, select the depth (D) of the proposed BMP, and then simply determine the surface area needed for that depth from Column 3 of Table B-2.

Note: The arrows under Column 3 in Table B-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 that 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.

Table B-2: Simplified Method - Calculating Rain Garden/Bioretention and Dry Well #1 Storage Volume and Surface Area for 1" Rainfall

Column 1	Column 2	Column 3							
Proposed Impervious Area (square feet)	Volume of Rain Garden/Bioretention or Dry Well #1[1] (cubic feet)	Surface Area of Rain Garden/Bioretention 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'*
		← Rain Garden /Bioretention (0.5'-1.0') →		← Dry Well #1 (1.5'-4.0') →					
I	V	*A(sf)*							
Sum of all Proposed Impervious Areas	I*(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]Assume that the rain garden/bioretention or the dry well #1 are 0% full

For Infiltration Trench or Dry Well #2:

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

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

STEP 4 – Using the value from Column 2 determined above, select the depth (D) of the proposed BMP, and then simply determine the surface area needed from Column 3 of Table B-3.

Note: The arrows under Column 3 in Table B-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 that 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 5 - Sketch a simple site plan as shown in Figure B-1 that includes:

- Name and address of the owner of the property, and or name and address of the individual preparing the plan, along with the date of submission.
- Location of proposed structures, driveways, or other paved areas with approximate size in square feet.
- 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-site septic system and/or potable water wells showing rough proximity to infiltration facilities.
- Location of any existing waterbodies such as; streams, lakes, ponds, wetlands, or other waters of the Commonwealth within fifty (50) feet of the project site, and the distance to the project site and/or BMPs. The project or BMPs cannot be located less than fifty (50) feet away from a perennial or intermittent stream. If an existing buffer is legally prescribed (i.e., deed, convenant, easement, etc.) and it exceeds the requirements of this Ordinance, the existing buffer shall be maintained.
- Location of all existing structures including buildings, driveways, and roads within fifty (50) feet of the project site.

Fill in the simplified method worksheet found in Table B-4, then submit the worksheet and the simple site sketch to the Municipality. Additionally, the operation and maintenance agreement found in Section B.5 must be signed and submitted to the Municipality.

Table B-3: Simplified Method - Calculating Infiltration Trench and Dry Well #2 Storage Volume and Surface Area for 1" 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'*
		← Dry Well #2 (1.5'-4.0') →				← Infiltration Trench (2.0'-5.0') →			
I	V	A(s)							
Sum of all Proposed Impervious Areas	(1*(1/12)*I)/Void Ratio (0.4)*=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]Assume a void ratio of 40%

Figure B-1: Typical Dry Well Configuration filled with Stone Fill (Left) and Structural Prefabricated Chamber (Right)

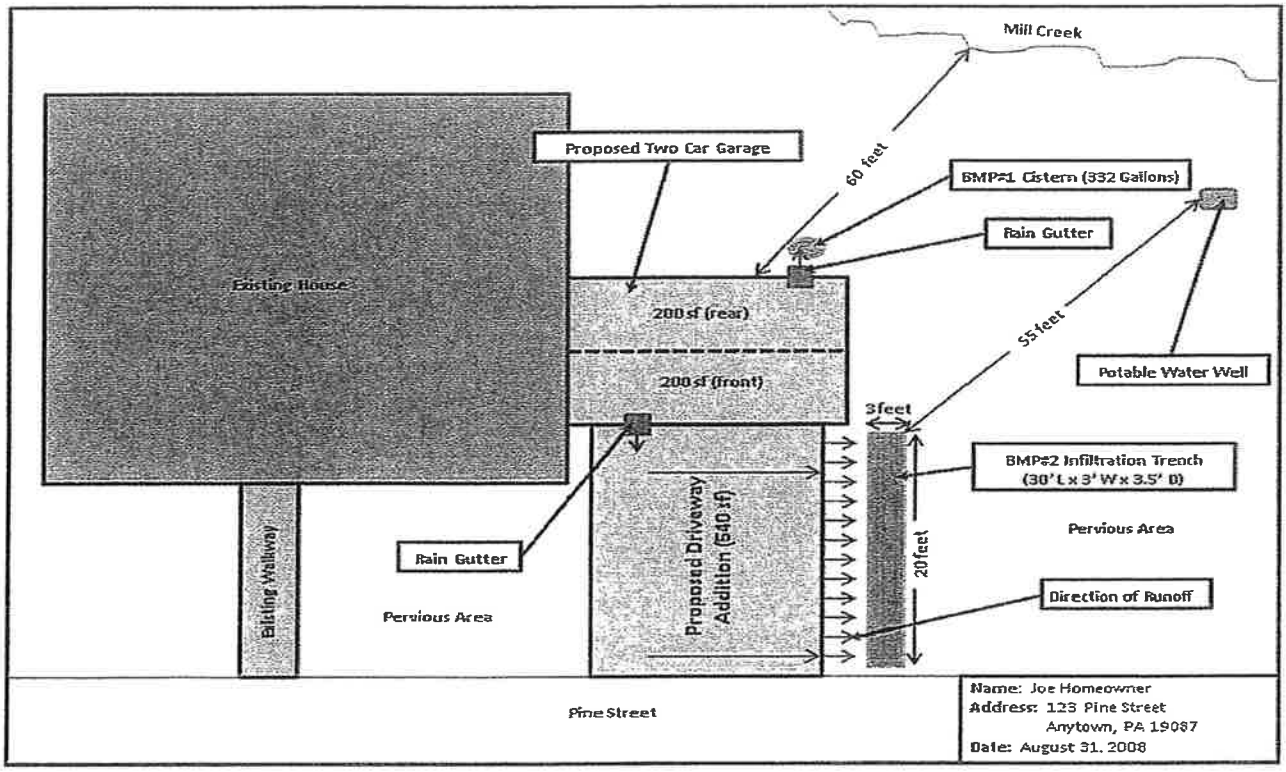


Table B-2: Simplified Method - Calculating Rain Garden/Bioretention and Dry Well #1 Storage Volume and Surface Area for 1" Rainfall

Column 1	Column 2	Column 3							
Proposed Impervious Area (square feet)	Volume of Rain Garden/Bioretention or Dry Well #1[1] (cubic feet)	Surface Area of Rain Garden/Bioretention 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'*
		← Rain Garden /Bioretention (0.5'-1.0') →		← Dry Well #1 (1.5'-4.0') →					
I	V	*A(sf)*							
Sum of all Proposed Impervious Areas	I*(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]Assume that the rain garden/bioretention or the dry well #1 are 0% full

Table B-4: Simplified Method Worksheet

Simplified Method Worksheet				
STEP 1				
Proposed Impervious Surface for BMP #1	Proposed Impervious Surface for BMP #2	Proposed Impervious Surface for BMP #3		
STEPS 2&3				
Rain Barrel or Cistern				
Proposed Impervious Surface from Column 1 in Table B-1	Volume from Column 2 or 3 in Table B-1			
Rain Garden/Bioretention or Dry Well #1				
Proposed Impervious Surface from Column 2 in Table B-2	Volume of BMP from Column 2 in Table B-2	Area of BMP from Column 3 in Table B-2	Depth of BMP from Column 3 in Table B-2	Types of Material to Be Used
Infiltration Trench or Dry Well #2				
Proposed Impervious Surface from Column 2 in Table B-3	Volume of BMP from Column 2 in Table B-3	Area of BMP from Column 3 in Table B-3	Depth of BMP from Column 3 in Table B-3	Types of Material to Be Used
Note: For additional BMPs, use additional sheets				

B.2 Definitions

Best Management Practice (BMP) - Activities, facilities, designs, measures, or procedures used to manage stormwater impacts from land development, to protect and maintain water quality and groundwater recharge and to otherwise meet the purposes of the Municipal Stormwater Management Ordinance, including but not limited to infiltration trenches, dry wells, bioretention, rain gardens, permeable paving, rain barrels, and cisterns.

Capture - Collecting runoff to be stored for reuse or allowed to slowly infiltrate into the ground.

Geotextile - A fabric manufactured from synthetic fiber that is used to achieve specific objectives, including infiltration, separation between different types of media (i.e., between soil and stone), 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 and recycling facilities, vehicle fueling stations, fleet storage areas, vehicle equipment and cleaning facilities, and vehicle service and maintenance facilities).

Impervious Surface - A surface that prevents the infiltration of water into the ground. Impervious surfaces include, but are not limited to, streets, sidewalks, pavements, swimming pools, driveway areas or roofs.

Infiltration - Movement of surface water into the soil, where it is absorbed by plant roots, 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.

Pervious Surface - Any surface that is not impervious.

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.

Void Ratio - The ratio of the volume of void space to the volume of solid substance in any material.

B.3 Description of BMPs

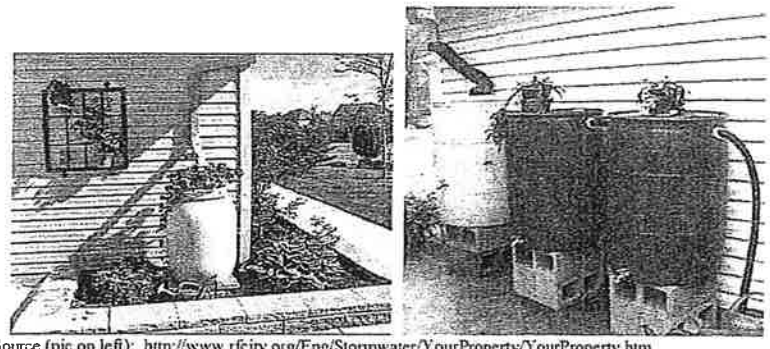
The following is a description of several types of BMPs that could be implemented. The requirements of each BMP as described below are taken directly from the PA BMP Manual. Refer to the PA BMP Manual which can be found on the PA Department of Environmental Protection's website.

Rain Barrels/Cisterns

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. The stored water can also be used as a non-potable water supply. Cisterns are larger than rain barrels having volumes of 200 gallons or more, and can be placed on the surface or underground. Figures B-2 and B-3 show examples of rain barrels and cisterns, respectively, that could be used. Rain barrels and cisterns are manufactured in a variety of shapes and sizes. All of these facilities must make provisions for the following items:

- There must be a means to release the water stored between storm events in order for the necessary storage volume to be available for the next storm.
- Stormwater must be kept from entering other potable systems, and pipes and storage units must be clearly marked "Do Not Drink."
- An overflow outlet should be placed a few inches below the top with an overflow pipe to divert flow away from structures.
- Use screens to filter debris, and covers (lids) to prevent mosquitoes.
- Make sure cisterns are watertight and do not leak.
- Rain barrels are typically assumed to be 25% full to calculate volume since they are not always emptied before each storm.*

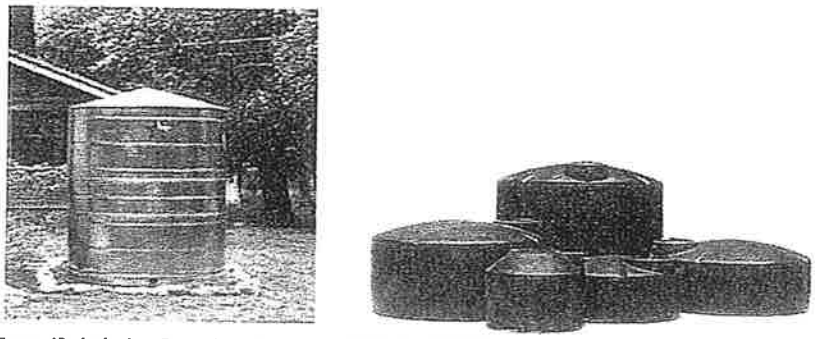
Figure B-2: Rain Barrels



Source (pic on left): http://www.rfcity.org/Eng/Stormwater/YourProperty/YourProperty.htm
Source (pic on right): :http://www.floridata.com/tracks/transplantedgardener/Rainbarrels.cfm

*This 25% has already been taken into account in Table 3.

Figure B-3: Cisterns



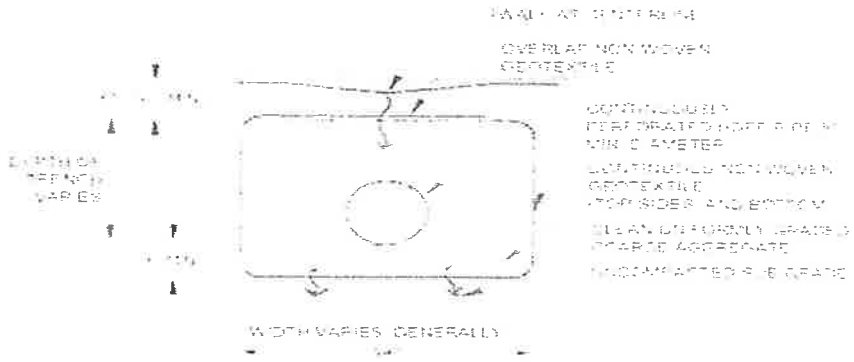
Source (for both pics): Pennsylvania Stormwater BMP Manual (2006)

Infiltration Trench

An infiltration trench is a long, narrow, rock-filled trench with or without a perforated pipe 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 and into the underlying soil matrix. Infiltration trenches perform well for removal of fine sediment and associated pollutants. Figure B-4 shows a typical infiltration trench configuration. Infiltration trenches shall incorporate or make provisions for the following elements:

- Perforated pipe is to be set level.
- The width is limited to between **3 and 8 feet**, and the depth ranges from **2 to 6 feet**.
- Trench should be wrapped in nonwoven geotextile (see definition in Section B.2) on the 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 that the soil is capable of infiltrating stormwater. A description of how an infiltration test is performed is found in Appendix C of the PA BMP Manual.
- It is recommended that there be a 2-foot clearance above the regularly occurring seasonal high water table and 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 hotspots (see definition in Section B.2).
- 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.
- The ratio of the collected area to the footprint of the facility should be as small as possible with a ratio of less than 5:1 preferred.

Figure B-4: Typical Infiltration Trench



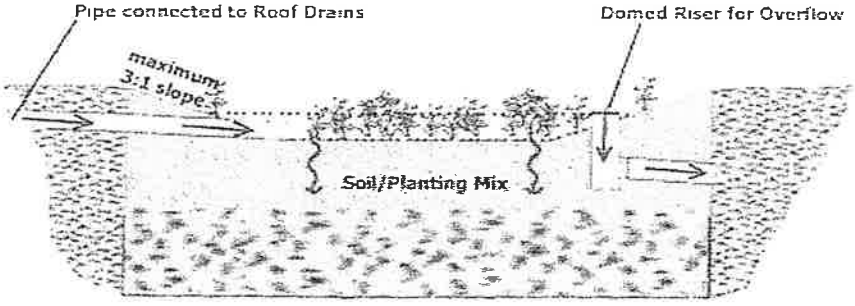
Source: Pennsylvania Stormwater BMP Manual (2006)

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 below the surface where plants can use the water to grow. Bioretention also improves water quality, vegetation filters the water, and the root systems encourage or promote infiltration. Figure B-5 shows a typical rain garden. Key elements of a rain garden include:

- Ponding depths of **1 foot** or less (recommended).
- Native vegetation that can tolerate dry and wet weather.
- An overflow area where, if the bioretention area were to overflow, the water would flow over pervious area (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 substantial infiltration areas or pervious areas.
- Typical side slopes of 3:1 are recommended, with 2:1 being the maximum.
- The soil/planting mix depth should be between 1.5 feet and 6 feet deep.

Figure B-5: Typical Rain Garden/Bioretention Area



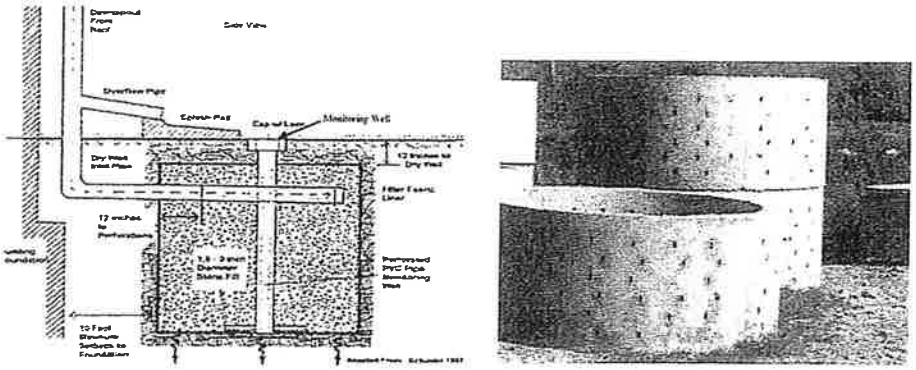
Source: Pennsylvania Stormwater BMP Manual (2006)

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 B-6 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 from the building foundation to avoid foundation seepage problems and are not recommended if their installation would create a risk for basement flooding.
- Construction of a dry well should be performed after surface soils in all other areas of the site are 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.
- Depth of a dry well should be between **1.5 feet and 4 feet**. Gravel fill should consist of stone of an average of one and one half to three (1.5 – 3.0) inches in diameter with the gravel fill wrapped in a nonwoven geotextile that separates the stone fill from the surrounding soil.
- At least 1 foot of soil needs to 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 connect to other on-site substantial infiltration areas or pervious areas.
- Every dry well needs to have at least one monitoring well.
- Infiltration testing is recommended to ensure that the underlying soil is capable of infiltrating the needed volume of stormwater.

Figure B-6: Typical Dry Well Configuration filled with Stone Fill (DRY WELL #2) (Left) and Structural Prefabricated Chamber (DRY WELL #1) (Right)



Source (for pic on left): http://www.seagrant.sunysb.edu/pages/BMPsForMarinas.htm
Source (for pic on right): http://www.conelandconcreteinc.net/1800652.html

B.4 Example

Simplified Approach Volume Determination:

Joe Homeowner wants to build a 400 square foot two car garage, and a 540 square foot (30' L x 18' W) impervious driveway that is graded so that the stormwater runoff drains to the grassy area along one edge of the driveway. (A duplicate of Table B-1 is provided below in Table B-5, a duplicate of Table B-3 is provided below in Table B-6 and outlines the steps of this example) a duplicate of Figure B-1 (Figure B-7) and a duplicate of Table B-4 are provided in Table B-7.

STEP 1 - 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 (Front)	30 ft. x 18 ft.	=	540 sq. ft.

Total Proposed Impervious Surface			**940 sq. ft.**

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 driveway.

Select a BMP or combination of BMPs from Section B.3 to be used to satisfy the volume requirement. Determine the length, width, depth and other requirements for the BMPs in Section B.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 B-7 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.

STEP 2 and 3 for BMP #1 (Rain Barrel/Cistern)

STEP 2 - 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 B-5:

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

STEP 3 - Determine the volume that BMP #1 must be to satisfy the volume requirements using Columns 2 and 3 in Table B-5:

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 row in Column 3 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. A combination of rain barrels could be used in succession as shown in Figure B-2, or a cistern could be used.

Table B-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	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	

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

STEPS 2 through 4 for BMP #2 (Infiltration Trench)

STEP 2 - Select the proposed impervious area value for BMP #2, the infiltration trench, using Column 1 in Table B-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 3 - Determine the volume that BMP #2, the infiltration trench must be to satisfy the volume requirements using Column 2 in Table B-6:

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

STEP 4 - Utilizing the value from Column 2 determined above, and the surface area that the proposed BMP will occupy, identify the proposed depth and corresponding surface area needed using Column 3 in Table B-6:

Joe Homeowner would like to place the infiltration trench along the edge of the driveway that the runoff drains to, 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 B.3, is 3 feet. Therefore, the area of the infiltration trench is:

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

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: Rain barrel(s) ≥ 166 gallons and a 20' L x 3' W x 3' D infiltration trench

STEP 5 – Make a sketch of the site plan as shown in Figure B-7, and fill in the simplified method worksheet found as shown in Table B-7.

Table B-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* (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'*
		Dry Well #2 (1.5'-4.0')				Infiltration Trench (2.0'-5.0')			
I	V	*A(sf)*							
Sum of all Proposed Impervious Areas	(I*(1/12)*I)/Void Ratio (0.4)*=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
2 750	→ 3 156	104	78	63	→ 4 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

*Assume a void ratio of 40%

Figure B-7: Typical Dry Well Configuration filled with Stone Fill (Left) and Structural Prefabricated Chamber (Right)

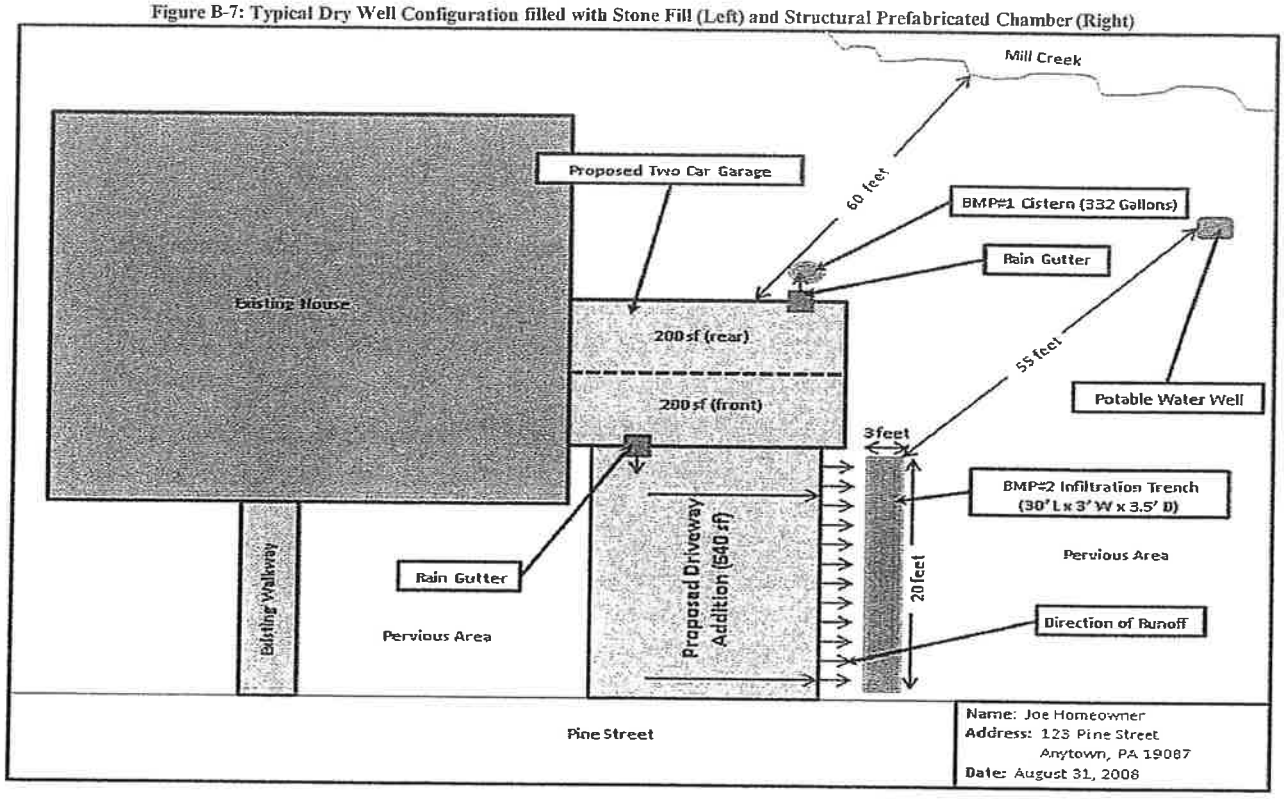


Table B-7: Example – Simplified Method Worksheet with Results

Simplified Method Worksheet			
STEP 1			
Proposed Impervious Surface for BMP #1	**Proposed Impervious Surface for BMP #2**	**Proposed Impervious Surface for BMP #3**	
200	740		
STEPS 2&3			
Rain Barrel or Cistern			
Proposed Impervious Surface from Column 1 in Table B-5	**Volume from Column 2 or 3 in Table B-5**		
200	166 gallons		

Rain Garden/Bioretention or Dry Well #1				
Proposed Impervious Surface from Column 2 in Table B-2	**Volume of BMP from Column 2 in Table B-2**	**Area of BMP from Column 3 in Table B-2**	**Depth of BMP from Column 3 in Table B-2**	**Types of Material to Be Used**

Infiltration Trench or Dry Well #2				
Proposed Impervious Surface from Column 2 in Table B-6	**Volume of BMP from Column 2 in Table B-6**	**Area of BMP from Column 3 in Table B-6**	**Depth of BMP from Column 3 in Table B-6**	**Types of Material to Be Used**
740	156	52	3	Infiltration Trench, Uniformly Graded Aggregate, HDPE 8" pipe, geotextile material, grass planted on top

Note: For additional BMPs, use additional sheets

B.5 Simplified Operation, Inspection, and Maintenance Plan

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 following maintenance agreement 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 Operation and Maintenance Agreement must be signed and submitted to the Municipality.

STORMWATER BEST MANAGEMENT PRACTICES
OPERATIONS, MAINTENANCE, AND INSPECTION AGREEMENT

THIS AGREEMENT, made and entered into this _____ day of _____, 200__, by and between _____, (hereinafter the "Landowner"), and _____, _____ (County, Township, or Borough) Pennsylvania, (hereinafter "Municipality");

WITNESSETH

WHEREAS, the Landowner is the owner of certain real property as recorded by deed in the land records of _____ County, Pennsylvania, Deed Book _____ at Page _____, (hereinafter "Property"); and,

WHEREAS, the Landowner _____

recognizes that the stormwater management best management practices or BMPs (hereinafter referred to as "the BMP" or "BMPs") must be maintained for the development called,

_____, located at _____

_____ (address of property where BMP is located); and,

WHEREAS, the Municipality and the Landowner, its administrators, executors, successors, heirs, or 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 stormwater Best Management Practices be constructed and maintained on the property; and,

WHEREAS, the Landowner is required to inform future buyers of the property about the function of, operation, and maintenance requirements of the BMP or BMPs 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.

WHEREAS, for the purposes of this agreement, the following definition 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 groundwater recharge, and to otherwise meet the purposes of the Municipal Stormwater Management Ordinance, including, but not limited to, infiltration trenches, dry wells, bioretention, rain gardens, permeable paving, rain barrels, and cisterns.

WHEREAS, it is required that the BMP or BMPs as shown on the simple sketch plan further referred to as the "Plan" and in accordance with the sizing calculations found on the simplified method worksheet further referred to as the "Calculation Worksheet" be constructed and maintained by the Landowner, its administrators, executors, successors, heirs, or assigns.

WHEREAS, the Municipality requires that stormwater management BMPs be constructed and adequately operated and maintained by the Landowner, its administrators, executors, successors, heirs, or assigns, in accordance with the following maintenance requirements.

- Vegetation along the surface of an infiltration trench should be maintained in good condition, and any bare spots should be revegetated as soon as possible.

- Vehicles shouldn't be parked or driven on an infiltration trench, and care should be taken to avoid excessive compaction by mowers.
- Any debris such as leaves blocking flow from reaching an infiltration trench or bioretention/rain garden should be routinely removed.
- While vegetation is being established, pruning and weeding may be required for a bioretention/rain garden.
- Mulch in a bioretention/rain garden needs to be re-spread when erosion is evident. Once every two to three years or after major storms the entire area may require mulch replacement.
- At least twice a year the landowner needs to inspect the bioretention/rain garden for sediment buildup and vegetative conditions.
- During periods of extended drought, the bioretention/rain garden requires watering.
- Trees and shrubs in a bioretention/rain garden need to be inspected at least twice per year by the landowner to evaluate their health. If they are in poor health, they need to be replaced.
- Dry wells need to be inspected by the landowner at least four 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/recycling sites and in compliance with local, state, and federal waste regulations.
- For dry wells, gutters need to be regularly cleaned out, and proper connections must be maintained to facilitate the effectiveness of the dry well.
- The filter screen for the dry well that intercepts roof runoff must be replaced as necessary.
- Dry wells that are damaged need to be fixed or replaced within two weeks of being damaged.
- If an intermediate sump box exists in conjunction with a dry well, it must be cleaned out at least once per year.
- Rain barrels and cisterns need to be cleared of debris routinely at least every three months and after significant storms to allow stormwater from gutters to enter them.

- Gutters that directly convey rain water to dry wells, rain barrels, and cisterns need to be routinely cleared of trash and debris at least every three months and after significant storms.
- Rain barrels and cisterns must be kept covered.
- Rain barrels and cisterns should be routinely emptied so that they are only ¼ of the way full to allow for storage of additional rainwater.
- Overflow outlets from rain barrels and cisterns must be kept free and clear of debris.
- Rain barrels and cisterns that are damaged need to be fixed or replaced within two weeks of being damaged.

NOW, THEREFORE, in consideration of the foregoing promises, the mutual covenants contained herein, and the following terms and conditions, the parties hereto agree as follows:

1. The BMPs shall be constructed by the Landowner in accordance with specifications identified in the Plan and Calculation Worksheet.

2. The Landowner shall 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 maintenance requirements outlined in this agreement.

3. The Landowner hereby grants permission to the Municipality, its authorized agents, and employees to enter upon the property at reasonable times and upon presentation of proper identification, to inspect the BMP(s) whenever it deems necessary. Whenever possible, the Municipality shall notify the Landowner prior to entering the property.

4. In the event that the Landowner fails to operate and maintain the BMP(s) as shown on the Plan in good working order acceptable to the Municipality, the Municipality or its representatives may enter upon the property and take whatever action is deemed necessary to maintain said BMP(s). This provision shall not be construed to allow the Municipality to erect any permanent structure on the land of the Landowner. 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.

5. In the event that 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 ten days of receipt of an invoice from the Municipality.

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

7. The Landowner, its executors, administrators, assigns, heirs, and other successors in interests, shall release the Municipality's employees and designated representatives from all damages, accidents, casualties, occurrences, or claims which might arise or be asserted against said employees and representatives from the construction, presence, existence, or maintenance of the BMP(s) by the Landowner or Municipality. In the event that a claim is asserted against the Municipality, its designated representatives, or employees, the Municipality shall promptly notify the Landowner and the Landowner shall defend, at his own expense, any suit based on the claim. If any judgment or claims against the Municipality's employees or designated representatives shall be allowed, the Landowner shall pay all costs and expenses regarding said judgment or claim.

This Agreement shall be recorded at the Office of the Recorder of Deeds of _____ County, Pennsylvania, and shall constitute a covenant running with the Property and/or equitable servitude, and shall be binding on the Landowner, his administrators, executors, assigns, heirs, and any other successors in interests, in perpetuity.

ATTEST:

WITNESS the following signatures and seals:

(SEAL) For the Municipality:

_____

(SEAL) For the Landowner:

_____

ATTEST:

_____ (City, Borough, Township)

County of _____, 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 _____, 200_.

_____ _____

NOTARY PUBLIC **(SEAL)**