ADAMS COUNTY
STORMWATER MANAGEMENT PLAN

Act 167 County-Wide Stormwater Management Plan

PREPARED BY:

ADAMS COUNTY CONSERVATION DISTRICT

and

ADAMS COUNTY OFFICE OF PLANNING & DEVELOPMENT

November 2011

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Adams County, Pennsylvania

Adopted:

November 23, 2011

Adams County Commissioners:

George Weikert, Chairman

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Approved by DEP:

January 27, 2012

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SECTION I - INTRODUCTION

Introduction

A stormwater management plan for Adams County was prepared to meet the requirements of the *Pennsylvania Storm Water Management Act (Act of October 4, 1978, P.L. 864 No. 167)*. This law is commonly referred to as Act 167 and requires Pennsylvania Counties to prepare and adopt stormwater management plans. It also requires municipalities to amend or adopt stormwater management ordinances consistent with the plan. The Adams County Stormwater Management Plan is the result of a collaborative effort led by the Adams County Conservation District (ACCD) and Adams County Office of Planning & Development (ACOPD), with assistance from the Stormwater Plan Advisory Committee (SPAC). It was developed based on the requirements of Act 167 and the input of the SPAC, municipal Engineers, stakeholders, and the Pennsylvania Department of Environmental Protection (DEP).

The Adams County Stormwater Management Plan is a county-wide plan, covering all Act 167 designated watersheds and municipalities within Adams County. A county-wide approach to stormwater management will allow the County to improve the correlation of stormwater controls with standards enforced by the Adams County Conservation District and DEP, while reducing the costs associated with the production of separate watershed plans and promoting multi-municipal planning. The County's efforts will promote non-point source pollution removal procedures, encourage groundwater recharge, and/or water quality enhancement, recommend methods for facilitating low impact land development practices, stabilize impaired stream channels, and develop quantitative standards for improving the conditions that contribute to extreme flood events. Adams County took advantage of the stormwater planning process to establish a consistent model ordinance across the County. Adams County will experience the benefits of establishing cohesive standards for stormwater runoff quality, groundwater recharge, and peak rate of stormwater runoff.

Why Plan for Stormwater Runoff

The water flowing across the surface of the land during and immediately following a rainfall event is referred to as stormwater runoff. In a watershed subject to land development, the amount of stormwater runoff resulting from a particular rainfall event increases in response to the reduction in pervious land area (i.e., natural land being covered by pavement, concrete, or buildings). Furthermore, the alteration of natural land cover and land contours to accommodate residential, commercial, industrial, and agricultural uses results in decreased infiltration capabilities, increased rates of stormwater runoff, and the overall volume of stormwater runoff.

Improperly planned development projects may lead to significant future challenges associated with an increase in stormwater runoff. Non-management of stormwater runoff

intensifies flooding events; destabilizes stream channels, making them susceptible to erosion and siltation; and diminishes groundwater aquifers due to a reduction in recharge rates.

Individual land development projects have historically been viewed on a stand-alone basis without maintaining sight of the cumulative impact on the environment. This scenario is common when land development occurs in neighboring municipalities. Repeated complaints from downstream property owners regarding damage to their property and increased frequency and severity of flooding have been key indicators to local municipalities of the cumulative impacts resulting from a lack of stormwater management.

Application of proper stormwater management practices requires cooperation between the State, County, and local Municipalities with assistance from their engineering, planning, construction, and maintenance personnel. Preliminary cooperation efforts are focused on education, modification of policy, adoption of new regulations and consistent enforcement. The Adams County Stormwater Management Plan, under the Pennsylvania Stormwater Management Act, will encourage responsible land development to occur by utilizing both structural and non-structural stormwater runoff control measures in every watershed across the entire County.

Background

In 2002, the Adams County Commissioners adopted the Monocacy River Watershed Stormwater Management Plan. The Monocacy River watershed includes seventeen Adams County municipalities and covers 228 of Adams County's 520 square miles. The Adams County Stormwater Management Plan will be considered the five year update of the Monocacy Plan, while addressing the six watersheds of Adams County as listed in the "Index of Designated Watersheds (Stormwater Management)", published by DEP on May 31, 1980 (and subsequently amended), pursuant to Section 14(a)(10) of Act 167. The designated watersheds of Adams County are: Antietam Creek, Conewago Creek (West), Conococheague Creek, Monocacy River, and Mountain Creek. The Adams County Stormwater Management Plan will supersede the current Monocacy River Watershed Stormwater Management Plan, the Antietam Creek Watershed Stormwater Management Plan, and the Conochocheague Creek Watershed Stormwater Management Plan.

Adams County received funding from DEP to complete a Scope of Study for a countywide stormwater management plan in 2007. The Study was completed in 2009 and approved by DEP in May of 2010. This Study anticipated that funding would be available to complete an engineered, countywide stormwater management plan. Due to the lack of an appropriation by the Commonwealth for stormwater management planning, Adams County was unable to apply for funding, but decided to proceed with a reduced scope of work, utilizing County staff.

Pennsylvania Storm Water Management Act (Act 167)

The Pennsylvania General Assembly enacted the Stormwater Management Act, P.L. 864, No. 167, October 4, 1978 and found that:

1. Inadequate management of accelerated runoff of stormwater resulting from development throughout a watershed increases flood flows and velocity; contributes to erosion and sedimentation; overtaxes the carrying capacity of streams and storm sewers; greatly increases the cost of public facilities to carry and control stormwater; undermines floodplain management and floodplain control efforts in downstream communities; reduces groundwater recharge; and threatens public health and safety.

2. A comprehensive program of stormwater management, including reasonable regulation of development and activities causing accelerated runoff, is fundamental to the public health, safety, and welfare and the protection of the people of the Commonwealth, their resources, and their environment.

The policy and purpose of Act 167 is to:

1. Encourage planning and management of storm water runoff in each watershed which is consistent with sound water and land use practices.

2. Authorize a comprehensive program of storm water management designated to preserve and restore the flood-carrying capacity of Commonwealth streams; to preserve to the maximum extent practicable natural storm water runoff regimes and natural course, current, and cross-section of water of the Commonwealth; and to protect and conserve groundwater and groundwater recharge areas.

3. Encourage local administration and management of storm water consistent with the Commonwealth's duty as trustee of natural resources and the people's constitutional right to the preservation of natural, economic, scenic, aesthetic, recreational, and historic values of the environment.

Act 167 requires Pennsylvania counties to prepare and adopt stormwater management plans that promote management of stormwater runoff in every watershed. The Act gives the Counties discretion regarding the details of how the county manages the preparation and publication of its plans. Within six months following the adoption and approval of a stormwater management plan (SMP), each municipality is required to adopt (or amend) and implement ordinances and regulations as necessary to regulate development and other land alterations that may affect runoff characteristics in a manner consistent with the applicable SMP and the provisions of the Act. The plans must be reviewed and revised at least every five years.

The basic standard for stormwater management as established by Act 167 affects landowners, or any person engaged in the alteration or development of land, which may

affect storm water runoff characteristics. Those developing property shall implement measures consistent with the provisions of the SMP so that changes in land cover and topography will not cause injury or harm health, safety, or property. Such measures shall include actions to assure that the maximum rate of storm water runoff is no greater after development than prior to development activities. In addition, stormwater management plans must also include standards to address water quality, stream channel protection, and groundwater recharge.

The standards for managing stormwater must address runoff volume and groundwater recharge, peak rate of runoff discharge, and the quality of stormwater runoff. New land development activities must incorporate features and facilities that will limit the volume and rate of stormwater discharge. Land development must provide for an acceptable degree of runoff water quality protection and/ or enhancement. The stormwater control standards set forth in this Plan require, to the extent practicable, runoff characteristics from new land development activities to approximate those characteristics that existed prior to the development in terms of groundwater recharge, peak rate of discharge, volume of discharge, and water quality. Stormwater management techniques known as "Best Management Practices" (BMPs) can be used to help satisfy these requirements. The *Pennsylvania Stormwater Best Practices Manual* (DEP) lists BMPs that can be employed to assist in meeting the standards presented in this Plan.

Stormwater Plan Advisory Committee (SPAC)

As required under Act 167, a Stormwater Plan Advisory Committee (SPAC) was formed and provided valuable input throughout the stormwater management planning process. The SPAC met several times during the development of the Plan. Table 1 on page 5 lists the primary representative appointed by the municipality. A list of the attendees at each SPAC meeting is presented in Appendix F. Municipal engineers and consultants were also present at the SPAC meetings and were a very important part of the planning process.

Table 1: Adams County Stormwater Plan Advisory Committee (SPAC)	
Organization	**Primary Representative Appointed by Municipality**
Adams County Conservation District	Russell Ryan, Larry Martick, Deb Musselman
Adams County Planning Office	Sarah Weigle
ABBOTTSTOWN Borough	Dennis Posey
ARENDTSVILLE Borough	Ken Shafer
BENDERSVILLE Borough	Martha Schriver
BERWICK Township	Dean Hempfing
BIGLERVILLE Borough	Dick Mountfort
BONNEAUVILLE Borough	Rob Czyzewski
BUTLER Township	Adam Anderson
CARROLL VALLEY	Ken Lundberg
CONEWAGO Township	Monique Keefe
CUMBERLAND Township	Tom Shealer
EAST BERLIN Borough	Charles Eisenhart
FAIRFIELD Borough	Francis Cool
FRANKLIN Township	Bicky Redman
FREEDOM Township	Allen Beckett
GERMANY Township	Richard Valko
GETTYSBURG Borough	Dan Hillard
HAMILTONBAN Township	Coleen Reamer
HIGHLAND Township	Craig Rockey
HUNTINGTON Township	Gus Fridenvalds
LATIMORE Township	John Shambaugh
LIBERTY Township	Peter Foscato
LITTLESTOWN Borough	Tim Topper
MCSHERRYSTOWN Borough	Robert Sharrah
MENALLEN Township	Alan Black
MOUNT JOY Township	David Updyke
MOUNT PLEASANT Township	Barry Stone
NEW OXFORD Borough	StanWannop
OXFORD Township	Bill McMaster
READING Township	Kelly Duty
STRABAN Township	Glenn Zepp
TYRONE Township	Emma Seibert
UNION Township	Dean Shultz
YORK COUNTY Planning Commission	Terry Ruby
FRANKLIN CO. Planning Commission	Rochelle Barvinchack
CARROLL CO. Planning Commission	Tom Devilbliss
FREDERICK CO. Planning Commission	Betsy Smith
AC Water Resources Advisory Committee	Bill Hanne

SECTION II – GOALS AND OBJECTIVES

Sound Stormwater Management

The objective of stormwater management is to prevent or mitigate the adverse impacts related to the conveyance of excessive rates and volumes of stormwater runoff. Early efforts in managing storm flows consisted of simple routing of stormwater through gutters and sewer systems with the objective of removing the stormwater as quickly as possible. It has been recognized for some time that simply bypassing storm flows can shift the location of the problem and very often aggravate the problem by compounding flows downstream. The end result is an increase in total flow, peak flow rate, stream velocity, and stream stage in major and minor downstream channels.

A more effective approach to stormwater management often appears to be to maintain natural runoff flow characteristics as much as possible. This can be accomplished either by augmenting the infiltration process, evapotranspiration, or by temporarily storing stormwater for release at controlled rates of discharge. Actual stormwater management techniques can be structural (detention ponds, pipes, etc.) or nonstructural (land-use planning to effectively preserve existing vegetation, drainage swales, perviousness, etc.). Both techniques should be utilized as complementary elements of a management plan. The effectiveness of a given stormwater management program is a function of comprehensive planning and sound engineering design.

Effective stormwater management planning must be done on a regional basis and Act 167 confers to counties the responsibility for development of the stormwater management plans (SMP). Municipalities have an obligation to implement the criteria and standards developed in each SMP by amending or adopting laws and regulations for land use and development. The implementation of stormwater management criteria and standards at the local level is necessary since municipalities are responsible for local land-use decisions and planning. A major goal of the SMP and the attendant municipal regulations is to prevent future drainage problems and avoid aggravation of existing problems.

Any person engaged in the alteration or development of land which may affect stormwater runoff characteristics must implement reasonable provisions which may be necessary to prevent injury to health, safety or other property. Such provisions will assure that the maximum rate of stormwater runoff is no greater after development than prior to development activities, or that the quantity, velocity, and direction of resulting stormwater runoff is managed in a manner which protects health and property.

An important provision of the SMP is the requirement to manage stormwater runoff so that activities in one municipality do not cause problems in other municipalities. The same is true for groundwater and groundwater recharge areas. Poor stormwater management in one municipality should not affect the groundwater resources of another community. Although existing inter-municipal problems may continue, the objective is to prevent aggravation of existing problems.

GOALS AND OBJECTIVES OF THE PLAN

The goal of Adams County Stormwater Management Plan is to provide a consistent, comprehensive, and common sense approach to stormwater management, while satisfying the requirements of Act 167.

The principal purpose of this Plan is to protect health, safety, and property by addressing the impacts associated with the development of land. The Plan also recommends measures to maintain or increase water quality and reduce the impacts of flood damage. The Adams County Stormwater Management Plan provides Adams County municipalities the opportunity to achieve the primary goal and purpose of the Plan while meeting the requirements of Act 167 through the following objectives:

- Present standards that are consistent with Title 25 Pennsylvania Code Chapter 102 and NPDES permit requirements.
- Preserve natural drainage patterns and natural stormwater runoff regimes to the maximum extent possible.
- Protect and restore the flood-carrying capacity of streams and prevent erosion of stream banks and sedimentation in streambeds.
- Manage stormwater close to the source of runoff with as many natural processes as possible.
- Utilize Best Management Practices (BMPs) appropriate for the development site.
- Encourage groundwater recharge, where appropriate to prevent degradation of groundwater supplies and groundwater quality.
- Meet water quality requirements of Title 25 Pennsylvania Code Chapter 93 and Section 303(d) and 305 (b) of the Clean Water Act relating to the protection and restoration of existing and designated uses.
- Protect the quality of those streams designated as Exceptional Value (EV) or High Quality (HQ).

Through the stormwater management planning process several goals, more specific to Adams County, were consistently identified. The goals were complied from feedback received during SPAC meetings, municipal surveys, and interaction with municipal engineers. The goals and recommended objectives to achieve those goals are discussed in the following paragraphs.

Consistency – Municipal regulation of stormwater can vary from municipality to municipality. Currently, only seventeen (17) Adams County municipalities are covered

under an approved Act 167 stormwater management plan (Monocacy River Watershed SMP, 2002). A countywide approach to stormwater management through the Adams County Stormwater Management Plan and adoption of the model ordinance should allow for greater consistency between the regulation of stormwater at the municipal level.

Currently, many projects are designed to satisfy municipal stormwater management requirements and National Pollutant Discharge Elimination System (NPDES) requirements through a Post Construction Stormwater Management Plan. A second level of consistency achieved by a current, county-wide stormwater management plan is consistency with NPDES for those projects requiring a permit for the discharge of stormwater from construction activities. This would result in the preparation of a single plan to meet both requirements.

Minor Project Concerns – A major concern which arose from the adoption of the Monocacy model ordinance was the cost to homeowners associated with meeting stormwater management requirements for smaller projects, like a shed or addition. The Adams County SMP attempts to provide relief for certain projects through model ordinance criteria and the Stormwater Design Assistance Manual for Minor Land Development Activities - Simplified Approach. The Simplified Approach will allow certain projects to employ simplified administrative procedures instead of a technical approach, which can become costly.

Water Quality –Adams County has streams of elevated water quality, as well as impaired streams. Maintaining and improving water quality will provide benefits to current and future terrestrial and aquatic inhabitants of Adams County. Water quality can be enhanced through the use of BMPs. Enhanced measures to maintain and improve water quality will also be beneficial as the Phase II Chesapeake Bay TMDL Watershed Implementation Plans (WIPs) are executed at the County level.

One recommended BMP which provides many benefits, including water quality, is the establishment and protection of riparian forest buffers. Riparian buffers can be an efficient and economical way of improving water quality, stabilizing and protecting stream channels, reducing fluctuations in stream temperature, providing temporary storage and gradual conveyance of floodwater to the stream and water table, slowing the velocity of stormwater runoff, reducing the level of downstream flooding, filtering and storing sediment from erosion in the watershed, as well as filtering and trapping nutrients and pollution from overland runoff. Priority areas for establishing and maintaining riparian forest buffers are along those streams which are considered Exceptional Value, High Quality, or impaired.

Water Supply - Maintaining a supply of water is essential to the viability of Adams County. The County has limited water resources and protecting what we have, as well as the quality of water, is a priority. Stormwater should be infiltrated in settings appropriate for infiltration.

Identification of Best Management Practices Suitable for Adams County – Adams County is unique in that many areas of the County do not allow for infiltration of stormwater due to soil limitations or geography. An analysis of the BMPs that are suitable in different soil settings within the County would be of great benefit. This analysis was not completed for this Plan but should be a priority if funding becomes available.

Training – The adoption of a county-wide SMP will require the municipalities to implement ordinances or provisions to manage stormwater. Whether the municipality was administering an ordinance consistent with the Monocacy SMP or some other standard, it was clear that a change in regulation would require training and assistance. Many municipal officials felt training opportunities should be part of the implementation of a county-wide SMP Plan. This included training relating to the administration of the ordinance and use of the Simplified Approach Method. The Conservation District will provide training sessions related to the model ordinance and the Simplified Approach Method after the Plan is approved by DEP.

Training on the use of certain BMPs was also identified by the municipal engineers as something that would be of benefit to them professionally, as well as a benefit to the County. Knowledge of techniques appropriate for different areas of the County could be used during site design. BMP training could be pursued if funding opportunities are available. This should be done after an analysis of the BMPs have recognized techniques that can be utilized within the areas of soil limitations in Adams County.

Plan Contents Required by Act 167

Section 5 of Act 167 specifies that a stormwater management plan shall, at a minimum, include the following elements:

(b.1) **A survey of existing runoff characteristics in small as well as large storms, including the impact of soils, slopes, vegetation and existing development**

Refer to Section III – County Characteristics.

(b.2) A survey of existing significant obstructions and their capacities

A survey of stream obstructions and their estimated capacities for Alloway Creek, Marsh Creek, and Rock Creek was completed for the Monocacy River Stormwater Management Plan (2002) and located in Section VI – Problem Areas & Impairments. Other locations may also be found on the Flood Prone Map in Appendix B.

(b.3) An assessment of projected and alternative land development patterns and the potential impact on runoff quantity, velocity and quality

Preferred and potential land development patterns are depicted in the Future Land Use Plan and Composite Zoning Maps in Appendix B.

(b.4) An analysis of present development in flood hazard areas and its sensitivity to damage from future flooding or increased runoff

The Adams County Hazard Mitigation Plan (2004) identifies the number of parcels in each municipality that are within the floodplain. The Plan also provides a Flood Vulnerability Assessment. Each municipality that participates in the FEMA floodplain program has updated their floodplain ordinance to regulate development in

the floodplain. Future flooding issues due to stormwater runoff from regulated activities will be addressed by implementation and enforcement of the model ordinance by each municipality.

(b.5) A survey of existing drainage problems and proposed solutions

See Section VI – Problem Areas & Impairments and the Flood Prone Locations Map in Appendix B.

(b.6) A review of existing and proposed stormwater collection systems and their impacts

Proposed stormwater management facilities will be designed, reviewed, approved, maintained, and enforced in accordance with the adopted ordinance, which is regulated by each municipality. These systems could be inventoried as part of future updates to the Plan as technology like GPS location and integration of CADD data with County mapping becomes regularly used.

(b.7) An assessment of alternative runoff control techniques and their efficiency in the particular watershed

The Adams County Stormwater Management Plan recommends the use of the PA Stormwater Best Management Practices Manual to assist in meeting runoff volume requirements. Best Management Practice techniques are discussed, as well as assessed, for their contribution toward volume reduction in this Manual. Future updates to this Plan envision an assessment of the BMP techniques to determine which ones are suitable in different geologic settings of Adams County.

(b.8) An identification of existing and proposed State, Federal and local flood control projects located in the watershed and their design capacities

The Adams County Emergency Services Department confirmed that there are no known existing or proposed State, Federal, or local flood control projects located within Adams County.

(b.9) A designation and description of those areas to be served by stormwater collection and control facilities within a ten-year period

The County has no known or proposed major projects to design and construct new stormwater control and collection facilities during the next 10 years. .

(b.10) An identification of flood plains within the watershed

Refer to Section III – Water Features or the Water Features Map in Appendix B.

(b.11) Criteria and standards for the control of stormwater runoff from development activities that is necessary to minimize dangers to property and life and carry out the purposes of Act 167

Refer to Section VII - Model Ordinance Provisions and the model ordinance in Appendix A, which provide criteria and standards for the control of stormwater runoff from development activities consistent with Act 167 and this Plan.

(b.12) Priorities for implementation of action within the plan

Refer to Section IX - Implementation and Update Procedure. The initial step in the implementation of the Adams County Stormwater Management Plan begins with DEP approval. Approval of the Plan sets in motion the mandatory schedule of adoption of municipal ordinance provisions and standards consistent with the Plan. Adams County municipalities will have six (6) months from the date of DEP approval to adopt the necessary ordinance provisions. The Recommendations in the Plan could, upon further consideration by the County or municipality, be implemented as funding or other assistance becomes available.

(b.13) Provisions for periodically reviewing, revising and updating the plan

Refer to Section IX - Implementation and Update Procedure. Act 167 requires that this Plan is reviewed and any necessary revisions made at intervals not exceeding 5 years.

(c.1) Contain such provisions as are reasonably necessary to manage storm water such that development or activities in each municipality within the watershed do not adversely affect health, safety, and property in other municipalities within the watershed and in basins to which the watershed is tributary

Refer to Section VII – Model Ordinance Provisions. The Plan will implement controls for stormwater that are not less protective of public health, safety, property, and the environment than the statewide model ordinance and statewide regulations. These controls also include measures to protect water quality.

(c.2) Consider and be consistent with other existing municipal, county, regional, and State environmental and land use plans

Refer to Section V – Existing Plans and Regulations.

SECTION III – COUNTY CHARACTERISTICS

Adams County Overview

Adams County is located in southern Pennsylvania along the Mason-Dixon Line. It extends 26 miles from east to west and 24 miles from north to south.

In Pennsylvania, much of the governing control is at the municipal level. The municipality is the regulating agency for stormwater management through land use controls. Adams County is comprised of 34 municipalities, 13 boroughs and 21 townships.

Geology

The underlying geologic formations of Adams County can be classified into four physio-graphic areas. The western portion of the County is known as South Mountain, which is an extension of the Blue Ridge Mountains. The underlying geology consists of Precambrian bedrock, primarily from metarhyolite, Weaverton Formation, Louden Formation, and metabasalt.

Through the center of the County runs the Gettysburg-Newark Lowland. This section consists primarily of Triassic sandstone from the Gettysburg and New Oxford Formations. Diabase is also present and accounts for the rolling hills and boulder deposits in and around the Gettysburg National Military Park.

The Piedmont Lowland and Piedmont Upland make up the underlying geology in the southeastern portion of Adams County. This is a relatively small area compared to the previous two sections. The Piedmont Lowland is centered around McSherrystown and consists primarily of dolomite, shale, and limestone from the Conestoga, Kinzers, and Ledger Formations. To the north and south of the Piedmont Lowland is the Piedmont Upland consisting primarily of quartz and slate from the Chickies Formation and metabasalt.

It should be noted that diabase intrusions are know to have poor recharge and infiltration capacity. There are also areas of limestone in Conewago, Oxford, and Union Townships and McSherrystown Borough, which are subject to sinkholes. A Geology map is located in Appendix B.

Soils

Soil characteristics indicate the inherent suitability of an area for development or in the case of stormwater, the ability to infiltrate runoff back into the ground. The primary source of soil data for Adams County is the *Soil Survey of Adams County, Pennsylvania*. The latest complete copy of the Adams County Soil Survey available is dated 2005. The current Soil Survey is only available on the US Department of Agriculture's Natural Resources

Conservation Service website under the Web Soil Survey: http://websoilsurvey.nrcs.usda.gov/.

Hydrologic soil groups represent groupings of soils having similar hydrologic properties that directly influence the volume and rate of stormwater runoff. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The Hydrologic Soil Group map in Appendix B illustrates the location of soils by hydrologic soil group.

The Natural Resources Conservation Service (NRCS) describes the hydrologic soil groups as:

> *Group A* – Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
>
> *Group B* – Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transfer.
>
> *Group C* – Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine or fine texture. Theses soils have a slow rate of water transmission.
>
> *Group D* – Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.
>
> Those soils assigned to a dual hydrologic group (B/D), the first letter is for the drained areas and the second is for undrained areas.

Table 2 identifies the percentage of hydrologic soil groups within the County.

Table 2: Hydrologic Soil Groups

Soil Group	Infiltration Potential	Percentage
A	High Infiltration Rate – Low Runoff Potential	0.5%
B	Moderate Infiltrate Rate	40.2%
C	Slow infiltration rate	45.1%
D	Very Slow Infiltration Rate – High Runoff Potential	10.7%
B/D		3.5%

Slopes

Slopes are often a limitation for development. Disturbance to steep slopes, those which are greater than 15%, often results in accelerated erosion processes from stormwater runoff and sedimentation of water bodies, which can lead to degradation of water quality and loss of aquatic life. In Adams County, slopes greater than 25% are primarily found in the South Mountain area. Several other areas of steep slopes may be found southeast of Gettysburg Borough, in the Pigeon Hills of Berwick Township, and along stream banks. A map of Steep Slopes is located in Appendix B.

Topography for the County is available through the United States Geological Survey (USGS) http://www.usgs.gov/pubprod/ or the Adams County GIS Department.

Water Features

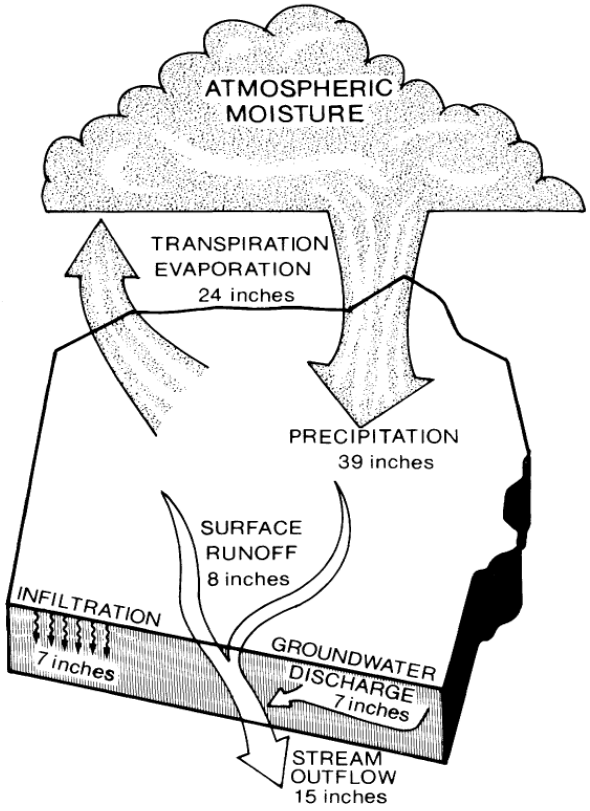
There are nearly 1,300 miles of streams within Adams County. The streams in the northeastern half of the County drain to the Susquehanna River and those streams in the southwestern half of the County drain to the Potomac River. Both watersheds eventually drain to the Chesapeake Bay.

Areas of surface water in Adams County are not very extensive. The two largest areas of surface water are Lake Meade and Lake Heritage. Both of these lakes are man-made and non-potable. Several smaller areas of surface water provide drinking water to adjacent counties.

Floodplains are the areas subject to flooding in heavy storm. Floodplains with vegetative cover are the most suited to absorb stream overflow, resist erosion, and recycle nutrient-rich sediment that may be deposited after a flood. The Pennsylvania Floodplain Management Act (Act 166 of 1978) requires municipalities enact an ordinance which, at a minimum, meets the requirements of the National Flood Insurance Program (NFIP). The Adams County Conservation District performs the responsibilities of floodplain monitoring in Adams County. Floodplain areas in all jurisdictions of Adams County, with the exception of New Oxford Borough, have been mapped by the Federal Emergency Management Agency (FEMA). The most recent floodplain maps were released in February 2009. FEMA depicts flood zones according to varying levels of flood risk.

Wetlands are typically characterized by a high water table, poor drainage, and surface ponding during the year. They are a valuable resource because of the role they play in flood control, water quality, and groundwater recharge. They also support a wide variety of plant and animal species by providing sources of food and refuge. The numerous farm ponds, which dot the landscape, are also considered wetlands according to the National Wetlands Inventory.

Adams County receives an average of 40 inches of rainfall each year, which is fairly evenly distributed throughout the year. Of those 40 inches, only about 7 inches of rainfall infiltrate the soil to recharge the groundwater supply. The illustration to the left depicts the annual hydrologic cycle for Adams County (Taylor & Royer, 1981: *Summary Groundwater Resources of Adams County, Pennsylvania*).



These features described in this section are mapped on the Water Features and Woodlands Map in Appendix B.

Land Use Evaluation

The basic configuration of land use in Adams County has its roots in the original settlement patterns, with agriculture still the predominant land use activity throughout both the Susquehanna and Potomac River basins. A steadily evolving road network gradually made most of Adams County accessible. Thirteen historic roads converge at Gettysburg, the County seat, located in the Monocacy River watershed. Smaller settlements such as Biglerville and New Oxford developed at significant road crossings within the West Conewago Creek watershed. Mountainous or hilly terrain in the western and northwestern parts of the county serve to discourage large scale development within the headwaters of the Conochocheague and Antietam Creek watersheds.

Today, most areas of Adams County are non-urbanized and consist of lands under cultivation, open fields, orchards, woodlands, surface water bodies, and wetlands. Agricultural land, interspersed with small wooded areas, still prevail over much of the county and river basins. Orchards are widespread in the foothills north of Fairfield in the Monocacy River watershed and extend northeast towards Latimore Township in the West Conewago Creek watershed. Extensive woodlands also cover the South Mountain region in the western portion of the County and include Michaux State Forest. The Hanover Shoe

Farms in the southeast portion of the County are another type of specialized agriculture, dedicated to breeding standardbred horses.

Urban land uses are concentrated within and adjoining the boroughs, a few villages, and along major roads. Residential uses predominate, comprising the major land use in the boroughs and villages, as well as along roadways. Within the boroughs, a mix of housing types and densities exist, including single-family detached dwellings, duplexes, rowhomes, and some apartment buildings. Boroughs tend to exhibit a mixed-use character at their hubs, with close intermingling of residential, shopping, and employment facilities.

Since 1990, large-scale (100 units or more) residential developments have emerged on the landscape. These are especially evident in eastern Adams County, adjoining McSherrystown, Littlestown, and New Oxford in the West Conewago Creek and Monocacy River watersheds. A few large-scale mobile home parks have also been developed in rural areas of the County.

Second-home ventures of the 1960s and 1970s (Lake Heritage, Lake Meade, and Charnita) have made a significant impact on the landscape of Adams County. Apart from their flooding of stream valleys to create artificial lakes (in the case of Lake Heritage and Lake Meade), these developments have also evolved into dense agglomerations of housing units, now mostly occupied as year-round permanent residences. The Lake communities still have a few vacant lots remaining, but are almost at capacity. In 1974, more than half of the former Charnita lots were incorporated into Carroll Valley Borough within the Monocacy River watershed. Less than half of the lots located in Carroll Valley have been built upon. An even higher percentage of Charnita lots located outside of Carroll Valley remain vacant.

Commercial activity predominates at the core of major incorporated places, alongside major highways which serve these boroughs, and frequently between built-up areas on US Route 30 and on PA Route 34 north of Gettysburg. During the late 1990s a major "outlet center" was built at the Route 97/15 Interchange and commercial activity along Route 30 within the Monocacy River watershed between Gettysburg and Route 15 greatly intensified. Through the efforts of ACEDC, a business park was developed at Route 30/15 in Straban Township. Approximately 100 acres is devoted to a tourism-related facility known as Gateway Gettysburg. The remainder of the site is under development as a general business park. Currently, the park contains uses such as medical, automobile/motorcycle related businesses, operations centers, and a national manufacturer.

Industrial land uses are found in different parts of the County, such as a small industrial park at Cross Keys and development in Conewago Township's industrially zoned districts. Three mineral extraction operations occupy significant land areas in either end of the County within the Monocacy River and West Conewago Creek watersheds. Major manufacturing establishments tend to be dispersed. Food processing plants are established in and near the orchards area.

Government and institutional uses exhibit a similar scattered pattern, with a concentration of these uses in Gettysburg within the Monocacy River watershed. Large areas of land are held by the Commonwealth or Federal government in the Gettysburg National Military Park, Michaux State Forest, and State Game Lands.

Adams County's population has increased in recent years. The cost of living in the Baltimore/Washington metropolitan area is one of the highest in the nation, and it is continuing to increase at a time when the federal government is decentralizing many functions. Many of the potential new residents are likely to maintain higher paying jobs in Maryland and commute long distances in exchange for the less expensive, more rural lifestyle offered by Adams County.

Several major new employment centers focusing on research and development, government services, and technology-oriented businesses are planned or under construction in northern Maryland within the Potomac River basin. Build-out of these facilities will place an added burden on Adams County to provide housing and services to a relatively young, skilled workforce. In addition, an aging population will require more non-motorized transportation options and increased opportunities for both active and passive recreation.

In relation to potential future growth of the County, the Adams County Comprehensive Plan (1991) includes a Land Use Plan, illustrating the desired pattern of land use for Adams County. The Land Use Plan featured a "designated growth area" (DGA) concept to provide for the orderly expansion of various types and densities of development in close proximity to existing boroughs and villages, while providing the opportunity to walk or bicycle to various community functions. The Plan also envisioned the conservation and protection of Adams County's agricultural resources and environmentally sensitive areas. A permanent open space system was also provided for, which is related to the conservation of floodplains, stream corridors, steep slopes, and animal habitat areas.

The DGAs, located in areas surrounding boroughs, selected villages, and several crossroads and interchanges, were designated to accommodate most of the County's growth. By designating growth areas, the plan envisioned:

- Maximum protection of agricultural landscapes which sustain the county's agricultural related economy.
- Creation of efficient communities which are less reliant on frequent, long automobile trips than those associated with suburban sprawl.
- Maintaining sustainability and viability of the County's historic boroughs and villages.
- Encouraging new growth and development to locate in areas that could be cost effectively and efficiently served by public services.
- Keeping energy utilization to manageable levels.

Future uses of land and densities are also somewhat dictated by the zoning districts adopted by the municipalities in municipal and county zoning ordinances. Currently, Arendtsville Borough is the only municipality in Adams County without zoning. A Composite Zoning Map was produced to depict categories of zoning throughout the County. Please refer to the individual municipal zoning ordinances for the densities allowed in each district. Refer to Appendix B for the Existing Land Use, Composite Zoning, and Future Land Use Maps.

SECTION IV – WATERSHED CHARACTERISTICS

General Overview

Adams County is divided between two major watersheds - the Potomac River Basin and the Lower Susquehanna River Basin. Both basins are tributary to the Chesapeake Bay. Within the Potomac River basin, there are three sub-basins: Antietam Creek, Conococheague Creek, and Monocacy River. The Lower Susquehanna watershed contains two sub-basins: Conewago Creek (West) and Mountain Creek. Table 3 provides a summary of the land area contain within each watershed. A map of the watersheds is included in Appendix B.

Table 3: Land Area Within Watersheds

Location	Acreage	Square Miles	% of County
Adams County	333,945	522	100%
Major Watersheds			
Potomac River	162,254	254	49%
Lower Susquehanna River	171,691	268	51%
Sub-Basins			
Conewago Creek (West) (S)	167,838	262	50%
Monocacy River (P)	144,652	226	43%
Conococheague Creek (P)	14,249	22	4%
Mountain Creek (S)	3,853	6	1%
Antietam Creek (P)	3,353	5	1%

Seven townships are split between the Potomac and Susquehanna River Basins. Table 4 lists the municipalities and area within each basin.

Table 4: Municipalities Split by a Major Watershed Basin

Municipality	Acreage and Percentage within Major Watershed Basin			
	Potomac River		Susquehanna River	
Butler Township	1,582	10%	13,787	90%
Cumberland Township	21,471	>99%	22	<1%
Franklin Township	34,714	79%	9,179	21%
Menallen Township	866	3%	26,599	97%
Mount Pleasant Township	6,436	33%	13,119	67%
Straban Township	11,215	51%	10,895	49%
Union Township	1,845	16%	9,393	84%

The watersheds and the municipalities they encompass, as well as the percentage of each municipality located within the watershed, is listed in Table 5.

Table 5: Sub-Basin Watersheds: Adams County, PA			
Name	Municipality	Acreage of Munic. in each 2nd Order Watershed	% of Munic. within each 2nd Order Watershed
Conewago Creek (West)	Abbottstown Borough	353.5	100%
Conewago Creek (West)	Arendtsville Borough	515.6	100%
Conewago Creek (West)	Bendersville Borough	289.2	100%
Conewago Creek (West)	Berwick Township	4,957.7	100%
Conewago Creek (West)	Biglerville Borough	418.0	100%
Monocacy River	Bonneauville Borough	618.6	100%
Monocacy River	Butler Township	1,777.9	12%
Conewago Creek (West)	Butler Township	13,590.7	88%
Monocacy River	Carroll Valley Borough	3,499.8	100%
Conewago Creek (West)	Conewago Township	6,727.2	100%
Monocacy River	Cumberland Township	21,470.5	>99%
Conewago Creek (West)	Cumberland Township	21.7	<1%
Conewago Creek (West)	East Berlin Borough	461.8	100%
Monocacy River	Fairfield Borough	429.4	100%
Conococheague Creek	Franklin Township	12,402.2	28%
Monocacy River	Franklin Township	22673.3	52%
Conewago Creek (West)	Franklin Township	8,818.0	20%
Monocacy River	Freedom Township	8,996.6	100%
Monocacy River	Germany Township	6,974.4	100%
Monocacy River	Gettysburg Borough	1,064.8	100%
Conewago Creek (West)	Hamilton Township	8,720.1	100%
Antietam Creek	Hamiltonban Township	3,353.0	13%
Conococheague Creek	Hamiltonban Township	1,114.8	5%
Monocacy River	Hamiltonban Township	20,650.6	82%
Monocacy River	Highland Township	7,785.9	100%
Conewago Creek (West)	Huntington Township	16,014.2	100%
Conewago Creek (West)	Latimore Township	13,733.3	100%
Monocacy River	Liberty Township	10,382.8	100%
Monocacy River	Littlestown Borough	963.1	100%
Conewago Creek (West)	McSherrystown Borough	326.0	100%
Conococheague Creek	Menallen Township	732.1	3%
Conewago Creek (West)	Menallen Township	22879.8	83%
Mountain Creek	Menallen Township	3,853.0	14%
Monocacy River	Mount Joy Township	16,800.0	100%

Sub-Basin Watersheds: Adams County, PA			
Name	Municipality	Acreage of Munic. in each 2nd Order Watershed	% of Munic. within each 2nd Order Watershed
Monocacy River	Mount Pleasant Township	6,674.4	34%
Conewago Creek (West)	Mount Pleasant Township	12,880.0	66%
Conewago Creek (West)	New Oxford Borough	396.2	100%
Conewago Creek (West)	Oxford Township	6,219.1	100%
Conewago Creek (West)	Reading Township	17,122.0	100%
Monocacy River	Straban Township	11,610.1	53%
Conewago Creek (West)	Straban Township	10,500.1	47%
Conewago Creek (West)	Tyrone Township	13,798.5	100%
Monocacy River	Union Township	2,279.8	20%
Conewago Creek (West)	Union Township	8,958.0	80%
Conewago Creek (West)	York Springs Borough	137.7	100%

Physical Evaluation of Watersheds

The Conewago Creek (West) Watershed drains 515 mi.^{2} from northern and southeastern Adams towards northeast York County. The watershed encompasses the entire border between Adams and York County. The highest elevation of the watershed is at the northern portion of Adams County at 1,440 ft. This area is part of the Ridge and Valley physiographic province and drains toward the central and eastern Piedmont physiographic province, which is characterized as low, gently rolling hills and shallow streams. The watershed contains deep, well-drained soils formed from materials weathered from igneous and metamorphic rocks suitable for agricultural purposes.

The Monocacy River Watershed drains 744 mi.^{2} and is formed by the confluence of Marsh and Rock Creeks. The highest elevation of the Monocacy River is in the western part of Adams County at the split between the Conococheague Creek and Antietam Creek Watersheds at 400 ft. The southeast corner of the watershed is the next highest elevation. Therefore, the Monocacy drains towards the middle of the county with the lowest elevations at the middle of the Adams County and Maryland border. Soils in the higher elevations range from moderately deep and moderately well-drained, to deep and well-drained with moderate infiltration rates. Additionally, these soils are located in several long strips of land throughout the watershed. The areas in between these soils consist of soils with slower infiltration rates. These slower infiltrating soils makes up approximately 60% of the watershed area.

Portions of the Antietam Creek and Conococheague Creek Watersheds that lie within Adams County have some of the highest elevations within the overall watersheds. Both of these watersheds drain west into Franklin County. Antietam Creek watershed drains 291 mi^2, while the Conochocheague Creek watershed drains 568 mi.^{2}.

Mountain Creek Watershed is part of the mountain chain that contains the higher elevations within the other watersheds. The small portion of this watershed in Adams County drains northeast into Cumberland County. This watershed contains the same deep, well-drained soils that lie within Antietam Creek, Conococheague Creek, and the western portions of the Conewago Creek Watershed. The location of each watershed Is depicted in the Watersheds map in Appendix B.

Exceptional Value and High Quality Watersheds

Some Pennsylvania streams receive increased protection against pollution through special protection designation as "high quality" or "exceptional value". High quality surface waters are those which have a quality exceeding levels necessary to support propagation of fish, shellfish, wildlife, and recreation in and on the water. Exceptional value surface waters are of high quality and satisfy Pennsylvania Code requirements relating to antidegradation. The goals and requirements for water quality in Pennsylvania streams are described in Title 25 Chapter 93 of the Pennsylvania Code.

Special designation watersheds are located in the South Mountain Region of western Adams County. The only Exceptional Value stream in Adams County is Carbaugh Run, located in Franklin Township and a portion of Hamiltonban Township. Subwatersheds of the Monocacy River, Antietam Creek, Conococheague Creek, West Conewago Creek, and Mountain Creek all contain High Quality streams. Their location can be found in the Watersheds map in Appendix B. The water quality of these streams should be maintained and protected, not only from pollution but also thermal impacts of stormwater runoff.

SECTION V – EXISTING PLANS & REGULATIONS

Existing Plans

Adams County Comprehensive Plan (1991)

The County Comprehensive Plan, while adopted in1991, is still relevant in regard to its approach to Land Use, Growth Management, and Environmental Protection. The Land Use Plan was previously discussed in the Land Use Evaluation of Section III.

The Environmental Protection Component of the Comp Plan recommends that the County, with funding from DEP, should initiate watershed studies with participation from municipalities that focus on potential effects of land development on discharge rates. The studies should include model regulations to assure that developments use the best technology available to minimize stormwater runoff, increase infiltration, minimize discharge of pollutants, and encourage natural filtration functions. Best available technology includes things like retention basins, porous paving, swales, trenches, etc.

The Plan also recommends that municipalities identify stormwater management and control structures that may need repair or replacement, stream segments that may need clearing, bank improvements, and other measures to handle anticipated stormwater flows.

Adams County Water Supply and Wellhead Protection Plan (2001)

The Water Supply Plan recognized several types of regulatory and non-regulatory techniques to assist with the protection of groundwater sources for future consumptive use. One of the techniques included best management practices for stormwater management, including the promotion of pervious surfaces for development.

The Wellhead Protection Plan provides a strategy to protect groundwater quality of public supply wells from potential contaminant threats. Four pilot projects were completed for Abbottstown, Fairfield, Gettysburg, and Littlestown.

Adams County Greenways Plan (2010)

The County Greenways Plan classifies riparian greenways as those which are located along a water course and containing natural vegetation and animal life.

The County Greenways Plan states that riparian greenways provide natural areas for overflow in times of flooding, which may help minimize flood damage. Greenways could be used as a tool by developers to reduce the potential of future flooding.

Greenways can also provide a vegetative buffer between streams and developed areas, which plays a role in the protection of water resources. Greenways, coupled with Best Management Practices, can help control and purify stormwater runoff, reduce soil erosion, conserve water supply, and enhance water quality. Greenways in open spaces can provide recharge areas for groundwater aquifers.

The Plan recommends that conservation riparian greenways be protected as a component of a county stormwater management plan (See Significant Riparian Greenways map in Appendix B).

Conewago Creek River Conservation Plan (2007)

The Conewago Creek River Conservation Plan (RCP) was developed with the intent of providing a long term management strategy for the entire Conewago Creek watershed. The Plan identified issues, concerns, and opportunities and provided recommendations that dealt directly with those issues and concerns. It was envisioned that the Plan would be adopted by the municipalities within the watershed. In Adams County, the Conewago Creek watershed encompasses 50% of the County.

The Conewago Creek RCP recognized that stormwater management was critical to the protection of aquifers, streams, and waterways. However, stormwater was primarily handled on a site specific basis, rather than managed on a regional level. Some of the problems that are created include an increase in energy and quantity of flows after a storm's peak discharge, release of stormwater into conveyances instead of back into the aquifers, and an increased sediment load.

The Plan recommends a potential way of alleviating one of the problems with stormwater is through infiltration. It has been recognized that many Adams County soils do not allow for infiltration of stormwater. However, in those areas of soils that are suitable and appropriate for infiltration, stormwater should be infiltrated to the greatest extent possible using BMPs that maximize infiltration. The Plan further describes several infiltration BMP techniques and recognizes that infiltration should be done in conjunction with a filtration system and not in areas of karst.

Marsh/ Rock Creek Critical Areas Resource Plan (CARP) (In Progress)

A Critical Areas Resource Plan is underway for the Rock Creek and Marsh Creek Watersheds. Pennsylvania deemed this area as having the potential for water demand to exceed supply. This plan is taking a closer look into this issue, as well as water quality, which is also a concern within the watersheds. Recommendations related stormwater management could be implemented, if applicable to the involved municipalities.

Municipal Stormwater Management

The enforcement of stormwater at the municipal level varies between the 34 municipalities in Adams County. Those 17 municipalities within the Monocacy watershed have an adopted ordinance or regulations consistent with the Monocacy River Watershed Stormwater Management Plan. The municipalities were surveyed during the Phase I Scope of Study. Of the 27 municipalities that responded, all but two have an adopted stormwater ordinance. The results of the survey can be found in Appendix E.

Existing State Regulations

Statewide standards for stormwater regulation may be found in *The Pennsylvania Code, Title 25*. Stormwater standards in Pennsylvania meet federal standards and provide a statewide system for the regulation of stormwater. Existing regulations may be found in the following Chapters of *Title 25*.

- Chapter 92a – National Pollution Discharge Elimination System (NPDES) Permitting, Monitoring, and Compliance
- Chapter 93 – Water Quality Standards
- Chapter 96 - Water Quality Standards Implementation
- Chapter 102 – Erosion and Sediment Control
- Chapter 105 – Dam Safety and Waterway Management
- Chapter 106 – Floodplain Management

SECTION VI – PROBLEM AREAS & IMPAIRMENTS

Flood Prone Locations

As part of the municipal survey, municipalities were asked to identify locations that were prone to flooding and the cause of flooding. The results were categorized by the primary cause. Municipalities identified 92 flood-prone locations with roadway or bridge inundation being the most common problem.

Table 6: Primary Cause of Flooding	
Category	# of Occurrences
Roadway/ Bridge Inundation	68
Stormwater Runoff	11
Property Flooding	7
Clogs from Debris	4
Storm Sewer Surcharge	2

Each of the flood-prone locations are listed in Table 7. The Id number in the table corresponds to a mapped location on the Flood Prone Locations map in Appendix B.

Table 7: Flood Prone Locations				
Id	Municipality	Location	Problem	Stream Name
1	Bonneauville Boro	Route 116	Storm sewer overflow	Chicken Run
2	Butler Twp	Zeigler Mill/ Russell Tavern Rds	Inundation	W. Branch Conewago Crk
3	Carroll Valley	Blue Spruce Tr	Inundation	Toms Creek
4	Carroll Valley	Fairfield Rd	Property Floods	Toms Creek
5	Conewago Twp	Kindig Ln	Inundation	Trib to S. Branch Conewago
6	Conewago Twp	Race Horse Rd	Inundation	
7	Conewago Twp	Oxford Ave/ Black Ln	Inundation	Trib to S. Branch Conewago
8	Cumberland Twp	Boyd's School - Patriot's Ch.	SW Runoff	
9	Cumberland Twp	Lincoln Estates	SW Runoff	
10	Cumberland Twp	Tiffany Lane	SW Runoff	
11	Cumberland Twp	Water Works Rd	Inundation	Marsh Creek
12	Cumberland Twp	Red Rock Rd	Inundation	Marsh Creek
13	Cumberland Twp	Natural Dam Rd	Inundation	Marsh Creek
14	Cumberland Twp	Mason-Dixon Rd	Inundation	Marsh Creek
15	Cumberland Twp	Horner Rd	Inundation	Marsh Creek
16	Cumberland Twp	Plank Rd	Inundation	Marsh Creek
17	Cumberland Twp	Black Horse Tavern Rd	Inundation	Marsh Creek
18	Cumberland Twp	Black Horse Tavern Rd	Inundation	Marsh Creek
19	Cumberland Twp	Black Horse Tavern Rd	Inundation	Marsh Creek
20	Cumberland Twp	Black Horse Tavern Rd	Inundation	Marsh Creek
21	Cumberland Twp	Black Horse Tavern Rd	Inundation	Willoughby Run
22	Cumberland Twp	Willoughby Run Rd	Inundation	Willoughby Run
23	Cumberland/ Straban	HACC Shopping Center	Property Floods	Rock Creek

Id	Municipality	Location	Problem	Stream Name
24	Franklin Twp	Old Rt 30 to Orrtanna Rd	Inundation	Muskrat Run
25	Hamiltonban Twp	Cold Springs Rd	Inundation	Trib to E. Branch Antietam
26	Hamiltonban Twp	Hickory Bridge Rd	Inundation	Little Marsh Creek
27	Hamiltonban Twp	Cold Springs Rd	Inundation	Trib to Muddy Run
28	Hamiltonban Twp	Cold Springs Rd	Inundation	Trib to Muddy Run
29	Hamiltonban Twp	Carrolls Tract Rd	Inundation	Rattling Run
30	Hamiltonban Twp	Route 116	Inundation	Middle Creek
31	Hamiltonban Twp	Jacks Mountain Rd	Inundation	Miney Branch
32	Hamiltonban Twp	Iron Springs Rd	SW Runoff	
33	Hamiltonban Twp	Iron Springs Rd	Clogs from Debris	Toms Creek
34	Hamiltonban Twp	Wilderness Ln	Inundation	Trib to Middle Creek
35	Hamiltonban Twp	Route 116	Inundation	Toms Creek
36	Hamiltonban Twp	Beechwood Dr/ Route 116	Inundation	
37	Hamiltonban Twp	Polly Farm	Property Floods	Middle Creek
38	Hamiltonban Twp	Across from Mr. Bream	Property Floods	Middle Creek
39	Hamiltonban Twp	Mount Hope Rd	Inundation	
40	Hamiltonban Twp	Bullfrog Rd	Inundation	
41	Hamiltonban Twp	Cold Springs Rd	Inundation	Muddy Run
42	Hamiltonban Twp	Cold Springs Rd	SW Runoff	Trib to Muddy Run
43	Hamiltonban Twp	Cold Springs Rd	SW Runoff	Trib to Muddy Run
44	Hamiltonban Twp	Carrolls Tract Rd	Inundation	Trib to Muddy Run
45	Hamiltonban Twp	Hickory Bridge Rd	Inundation	Little Marsh Creek
46	hamiltonban Twp	Mount Carmel Rd	SW Runoff	
47	Hamiltonban Twp		Clogs from Debris	Trib to E. Branch Antietam
48	Hamiltonban Twp		Clogs from Debris	Trib to E. Branch Antietam
49	Hamiltonban Twp	Sloe Gin Trl	Stormwater Runoff	
50	Highland Twp	Gettysburg Campground	Property Floods	Marsh Creek
51	Highland Twp	Route 116	Inundation	Trib to Marsh Creek
52	Huntington Twp	Willow Ln	Inundation	Trib to Bermudian Creek
53	Littlestown Borough	Baltimore Pike	Inundation	Piney Creek
54	McSherrystown Boro	North St Park/ Walking Tr	Property Floods	Plum Creek
55	Menallen Twp	Celebration Hill Rd	Inundation	Trib to W.B. Conewago Crk
56	Menallen Twp	Boyds Hollow Rd	Inundation	Trib to W.B. Conewago Crk
57	Menallen Twp	Brysonia/ Fairground Rds	Inundation	Pleasant Dale Creek
58	Menallen Twp	Narrows Rd	Inundation	W. Branch Conewago Crk
59	Menallen Twp	Narrows Rd	Inundation	W. Branch Conewago Crk
60	Menallen Twp	Narrows Rd	Inundation	W. Branch Conewago Crk
61	Menallen Twp	Orchard/ Quaker Run Rds	Inundation	Trib to Quaker Run
62	Menallen Twp	Orchard Rd	Inundation	Opossum Creek
63	Menallen Twp	Aspers-Bendersville/Center Mills	Inundation	Opossum Creek
64	Menallen Twp	Creek Rd	Inundation	Opossum Creek
65	Menallen Twp	Back/ Middle/ W. Point Rds	Inundation	Trib to Opossum Creek
66	Mount Joy Twp	Updyke Rd	Inundation	Alloway Creek
67	Mount Joy Twp	Roberts Rd	Inundation	Alloway Creek
68	Mount Joy Twp	Low Dutch Rd	Clogs from Debris	White Run
69	Mt Pleasant Twp	Fleshman Mill Rd	Inundation	S. Branch Conewago Crk
70	Mt. Pleasant Twp	Bridge #56-Stonebridge/ Storm Store Rd	Inundation	Trib to Conewago Creek

Id	Municipality	Location	Problem	Stream Name
71	Mt. Pleasant Twp	Bender Rd	Inundation	S. Branch Conewago Crk
72	Mt. Pleasant Twp	Willow Rd	Inundation	White Run
73	New Oxford Boro	Borough's Center Square	SW Runoff	
74	New Oxford Boro	Bud Ave Subdiv.	Inundation	S. Branch Conewago Crk
75	New Oxford Boro	Borough's Center Square	Inundation	
76	Oxford Twp	Storm Store Rd	Inundation	S. Branch Conewago Crk
77	Oxford Twp	Kohler Mill Rd	Inundation	S. Branch Conewago Crk
78	Oxford Twp	Fish and Game Rd	Inundation	S. Branch Conewago Crk
79	Reading Twp	Staub Rd	Inundation	Conewago Creek
80	Reading Twp	Turkey Pit School Rd	Inundation	Conewago Creek
81	Reading Twp	Fish & Game Rd/ Roland Rd	SW Runoff	Red Run
82	Reading Twp	"Laughman's Bottom"	SW Runoff	
83	Straban Twp	Keller Rd	Inundation	Rock Creek
84	Straban Twp	Riley/ Flickinger Rds	Inundation	Trib to Rock Creek
85	Straban Twp	Goldenville Rd	Inundation	Trib to Rock Creek
86	Straban Twp	New Chester/ Swift Run Rds	Inundation	Swift Run
87	Straban Twp	Zepp/ Clark Rds	Inundation	Beaverdam Creek
88	Straban Twp	Old Harrisburg Rd	Inundation	Trib to Rock Creek
89	Straban Twp	Twin Oaks subdiv.	Storm sewer overflow	
90	Straban Twp	Beaver Run Rd	Inundation	Beaverdam Creek
91	Straban Twp	Pine Tree Rd/ fields	Inundation	Trib to Beaverdam Creek
92	Tyrone Twp	Rupp Rd	SW Runoff	
93	Fairfield Borough	Route 116	Inundation	Spring Run

Correcting the problems at these locations should be further considered in future updates to the stormwater management plan. This Plan provides a framework for the correction of existing problems through the identification of problem locations. The implementation of the Plan should prevent the existing problems from becoming worse. Solutions and corrections could also be looked at on a municipal or state level, especially if an identified problem is located on a roadway scheduled for improvement.

Stream Obstructions

Structures or materials that may impede, retard, or change flood flows are considered stream obstructions. Obstructions typically include bridge crossings, culverts, suspended pipelines, etc. The Monocacy River Stormwater Management Plan (2002) included a list of 86 obstructions on Alloway Creek, Marsh Creek, or Rock Creek (Table 8: Stream Obstructions). The information was collected by field investigations and site visits. The capacity of each obstruction was estimated based upon field measurements and the application of procedures outlined in the Federal Highway Administration publication *Hydraulic Design of Highway Culverts.* The obstructions were compared against peak stream flow rates to produce capacity assessments. At the time, the majority of the obstructions were predominantly sufficient to pass 100-year flood events. It should be noted that accumulation of debris and sediment can reduce capacity and lead to localized flooding. The *Measured Stream Obstructions* map indicating the location of the obstruction may be

found in Appendix B or the Monocacy River SWM Plan. The obstructions table and map are taken directly from the Monocacy River SWM Plan and have not been re-evaluated. Funding constraints prohibited the evaluation of obstructions for the remainder of Adams County.

Table 8: Stream Obstructions

Watershed	Obstruction ID Number	Model Reach Number	Capacity Return Period	Field Notes
Alloway Creek	39	144	Capacity > 100 yr.	Downstream cattle rack needs cleared
Alloway Creek	40	134	Capacity > 100 yr.	Some brush obstructions
Alloway Creek	41	130	Capacity > 100 yr.	
Alloway Creek	42	144	Capacity > 100 yr.	
Alloway Creek	43	58	Capacity > 100 yr.	
Alloway Creek	44	108	Capacity > 100 yr.	
Alloway Creek	45	108	Capacity > 100 yr.	
Alloway Creek	46	34	Capacity > 100 yr.	Slight siltation right opening
Alloway Creek	47	98	Capacity > 100 yr.	Some erosion at wing wall
Alloway Creek	48	98	Capacity > 100 yr.	Riprap replacing wing wall
Alloway Creek	49	78	Capacity > 100 yr.	
Marsh Creek	1	286	Capacity > 100 yr.	Approximately 25% silted
Marsh Creek	2	284	50 yr. <Capacity <100 yr.	Good condition
Marsh Creek	3	288	Capacity > 100 yr.	Good condition
Marsh Creek	4	288	Capacity > 100 yr.	
Marsh Creek	5	289	Capacity > 100 yr.	Good condition
Marsh Creek	6	289	10 yr. < Capacity < 10 yr.	Brush impinging on opening
Marsh Creek	7	289	Capacity > 100 yr.	Some brush and rock obstructions
Marsh Creek	8	94	Capacity > 100 yr.	Slight siltation
Marsh Creek	9	90	Capacity > 100 yr.	Bridge gone
Marsh Creek	10	90	Capacity > 100 yr.	
Marsh Creek	11	174	Capacity > 100 yr.	
Marsh Creek	12	110	Capacity > 100 yr.	Left opening 1/2 silted
Marsh Creek	13	110	Capacity > 100 yr.	Railroad
Marsh Creek	14	103	Capacity > 100 yr.	Metal superstructure
Marsh Creek	15	148	Capacity > 100 yr.	
Marsh Creek	16	144	Capacity > 100 yr.	Slight brush impingement right opening
Marsh Creek	17	420	Capacity > 100 yr.	
Marsh Creek	18	418	Capacity > 100 yr.	3 openings
Marsh Creek	19	307	Capacity > 100 yr.	Road bed is open metal grate
Marsh Creek	20	178	Capacity > 100 yr.	
Marsh Creek	21	334	Capacity > 100 yr.	Some siltation right opening
Marsh Creek	22	437	Capacity > 100 yr.	
Marsh Creek	23	445	Capacity > 100 yr.	Slight siltation left opening
Marsh Creek	24	446	Capacity > 100 yr.	
Marsh Creek	25	448	Capacity > 100 yr.	
Marsh Creek	26	450	Capacity > 100 yr.	Some siltation left opening
Marsh Creek	27	452	Capacity > 100 yr.	
Marsh Creek	28	454	Capacity > 100 yr.	2 concrete pylons, 3 openings
Marsh Creek	29	370	Capacity > 100 yr.	2 round pylons, 3 openings
Marsh Creek	30	370	Capacity > 100 yr.	Covered bridge
Marsh Creek	31	484	Capacity > 100 yr.	Some siltation left opening
Marsh Creek	32	485	Capacity > 100 yr.	
Marsh Creek	33	512	Capacity > 100 yr.	
Marsh Creek	34	552	Capacity > 100 yr.	Slight siltation left and right openings

Watershed	Obstruction ID Number	Model Reach Number	Capacity Return Period	Field Notes
Marsh Creek	35	526	Capacity > 100 yr.	Some siltation left opening
Marsh Creek	36	489	Capacity > 100 yr.	1 concrete pylon
Marsh Creek	37	428	Capacity > 100 yr.	Some siltation right opening
Marsh Creek	38	428	Capacity > 100 yr.	
Rock Creek	50	630	Capacity > 100 yr.	
Rock Creek	51	211	Capacity > 100 yr.	Channelized
Rock Creek	52	211	Capacity > 100 yr.	Channelized starts downstream
Rock Creek	53	211	Capacity > 100 yr.	Channelized
Rock Creek	54	211	Capacity > 100 yr.	8" pipe crossing in opening
Rock Creek	55	211	Capacity > 100 yr.	
Rock Creek	56	211	Capacity > 100 yr.	
Rock Creek	57	211	Capacity > 100 yr.	
Rock Creek	58	211	Capacity > 100 yr.	Channelized
Rock Creek	59	211	Capacity > 100 yr.	Channelized
Rock Creek	60	211	Capacity > 100 yr.	Channelized
Rock Creek	61	211	Capacity > 100 yr.	Shale stream bed
Rock Creek	62	225	Capacity > 100 yr.	Heavily silted with brush
Rock Creek	63	225	Capacity > 100 yr.	Heavily silted with brush
Rock Creek	64	225	Capacity > 100 yr.	
Rock Creek	65	231	Capacity > 100 yr.	
Rock Creek	66	227	Capacity > 100 yr.	Bank erosion and pole obstructions
Rock Creek	67	227	Capacity > 100 yr.	Heavily riprapped upstream side
Rock Creek	68	207	Capacity > 100 yr.	
Rock Creek	69	205	Capacity > 100 yr.	
Rock Creek	70	177	Capacity > 100 yr.	
Rock Creek	71	18	Capacity > 100 yr.	Some sedimentation right bank
Rock Creek	72	63	Capacity > 100 yr.	Some sedimentation left bank
Rock Creek	73	262	Capacity > 100 yr.	Some sedimentation right bank
Rock Creek	74	414	Capacity > 100 yr.	
Rock Creek	75	458	Capacity > 100 yr.	Cattle guard obstruction some sed.
Rock Creek	76	410	Capacity > 100 yr.	
Rock Creek	77	494	Capacity > 100 yr.	
Rock Creek	78	416	Capacity > 100 yr.	
Rock Creek	79	504	Capacity > 100 yr.	Some sedimentation right bank
Rock Creek	80	274	Capacity > 100 yr.	
Rock Creek	81	616	Capacity > 100 yr.	Some sedimentation middle of creek
Rock Creek	82	572	Capacity > 100 yr.	Some sedimentation left side
Rock Creek	83	554	Capacity > 100 yr.	
Rock Creek	84	619	Capacity > 100 yr.	Some siltation left opening
Rock Creek	85	619	Capacity > 100 yr.	
Rock Creek	86	619	Capacity > 100 yr.	Bank erosion evident

Impaired Streams

Pennsylvania DEP is involved in an ongoing program to assess the quality of Pennsylvania's waters as required by the Federal Clean Water Act (1972). DEP identifies those stream segments that are not attaining any of the four designated uses as "impaired". The four uses

include: aquatic life, water supply, fish consumption, and recreation. DEP uses an integrated format for the Clean Water Act Section 305(b) Reporting and 303(d) Listing.

In Adams County, the impaired streams do not support aquatic life, which pertains to maintaining flora and fauna indigenous to aquatic habitats. According to the 2010 Pennsylvania Integrated Water Quality Monitoring and Assessment Report (DEP), approximately 22% of the 1,281 stream miles within the County are classified as impaired. The primary cause of impairment is siltation. The Impaired Streams of Adams County are mapped in Appendix B and the Source/ Cause of impairment is listed in Appendix D.

TMDL

Impaired waters require the development of a Total Maximum Daily Load (TMDL). The amount of pollutant loading that a water body can assimilate and still meet water quality standards is the TMDL. A TMDL is developed for the source and cause of impairment (see Source/ Cause of Impaired Streams in Appendix D.

The first TMDLs in Adams County were approved for the Beaverdam Creek Watershed in Straban Township and the Plum Run Watershed in Tyrone and Reading Townships.

The installation of riparian forest buffers could improve the health of the impaired streams in Adams County by filtering and trapping excess nutrients, sediment, and pollution. Soil conditions, buffer width, and the route and rate of surface and groundwater movement through the buffer all play a role in the effectiveness of buffers as nutrient and sediment filters.

A TMDL was also developed for the Chesapeake Bay by the US Environmental Protection Agency. As part of the implementation of this TMDL, states within the Chesapeake Bay watershed were required to prepare Watershed Implementation Plans (WIP). Pennsylvania DEP prepared the final Phase I WIP for Pennsylvania in January of 2011. The WIP incorporated current DEP stormwater standards as part of the implementation of the Plan. The volume control and water quality requirements will sustain stream base flows and prevent increases in peak runoff rates for larger events (2-year through 100 year storms), which will protect water quality and reduce sediment reaching the Bay. At the time of Plan adoption, Pennsylvania was in the process of developing a Phase II WIP. Adams County is still unsure of the impact of the Chesapeake Bay TMDL, however integrating additional water quality improvements now may make the transition easier in the future if requirements become more stringent.

SECTION VII – MODEL ORDINANCE PROVISIONS

Technical Standards

The current criteria and standards used will be applied to all areas of Adams County. Previous stormwater management standards adopted to be consistent with the Monocacy Plan will be superseded by this Plan. The current standards have been developed to comply with the requirements of the Pennsylvania Storm Water Management Act and are consistent with DEP's *Pennsylvania Stormwater Best Management Practices Manual*. The use of structural and non-structural Best Management Practices (BMPS) in Regulated Activities throughout Adams County will help prevent and reduce flooding, maintain and improve water quality, maintain groundwater recharge, reduce erosion. Additional guidance on the selection and design of BMPs and stormwater methodologies are located in the Pennsylvania Stormwater Best Management Practice Manual. For the purposes of this Plan, Regulated Activities will include any earth disturbance activity or activity that involves the alteration or development of land in a manner that may affect stormwater runoff.

Regulated Activities must incorporate measures to meet these requirements:

- Protect public health, safety, and property.
- Minimize the creation of impervious surfaces and where practical, direct
- Maintain, to the highest extent possible, the hydrologic regime.
- Minimize water quality impacts.
- Protect stream and stream banks from erosion and sedimentation.

A model Stormwater Management Ordinance has been included in Appendix A as a guide for municipalities to implement the following technical standards. The model Ordinance is a recommended format. Municipalities may make changes and, in certain sections, consultation with the municipal solicitor is encouraged so that the municipality incorporates procedures they are most comfortable with.

Volume Control

An increase in the volume of stormwater runoff is a product of development. Volume control guidelines are focused on providing protection to stream channels, water quality, and groundwater recharge from the frequent rainfalls that comprise the majority of runoff events. Low impact development practices provided in the BMP Manual shall be used for all Regulated Activities.

Volume controls will be met using the following guidelines:

Design Storm Method (Control Guideline 1, CG-1 in BMP Manual: This method is applicable to a Regulated Activity of any size and requires detailed modeling.

- Regulated Activities do not increase the total runoff volume from the 2-year/ 24 hour event.

- For modeling purposes, CG-1 assumes that existing non-forested pervious areas must be considered meadow (good condition). CG-1 also assumes that twenty percent (20%) of existing impervious area, when present, shall be considered meadow (good condition).

Simplified Method (Control Guideline 2, CG-2 in BMP Manual): This method is independent of site conditions and is used if CG-1 is not followed. CG-2 is **not** applicable to Regulated Activities greater than one (1) acre or for projects that require the design of stormwater storage facilities.

- CG-2 sizes stormwater facilities to capture at least the first two (2) inches of runoff from new impervious surfaces.

- Of the two inches captured, at least the first one (1) inch of stormwater runoff shall be permanently removed from the runoff flow and not discharged into surface waters of the Commonwealth. Removal options include reuse, evaporation, transpiration, and infiltration. If infiltration facilities are used, they should be designed to accommodate as much infiltration as the site will allow. If the soils within the project area do not allow infiltration, other forms of runoff volume control will be necessary to achieve the required capture and removal volumes, such as a vegetated roof or bioretention combined with a capture-and-reuse system or the Infiltration Alternative may be used.

Infiltration Alternative: In cases where it is not possible, or desirable, to accomplish volume control requirements using infiltration BMPs, the following water quality control shall be met.

- Post-development water quality pollutant load reductions will be required for all disturbed areas within the proposed project:

Table 9: Infiltration Alternative Pollutant Removal Efficiencies

Pollutant Load	Units	Required Removal Efficiency (%)
Total Suspended Solids (TSS)	Pounds	85 %
Total Phosphorus (TP)	Pounds	85 %
Total Nitrate (NO_3)	Pounds	50 %

- Design guidance from the most current version of the PA Stormwater Best Management Practices Manual is recommended when determining criteria for water quality BMPs.

Peak Rate Control

Peak rate control, for storms up to the 100-year event, is essential to protect against immediate downstream erosion and flooding. Most designs achieve peak rate control through the use of detention structures. Peak rate control may also be integrated into volume control BMPs in ways that eliminate the need for additional peak rate control detention systems. Non-structural BMPs can also contribute to rate control.

- Post-development discharge rates shall not exceed the pre-development discharge rates for the 1-year through 100-year, 24 hour storms. If it is shown that the peak rates of discharge indicated by the post development analysis are less than or equal to the peak rates of discharge indicated by the pre-development analysis for the 1-year through 100-year, 24 hour storms, then requirements of this section have been met. Otherwise, the applicant shall provide additional controls as necessary to satisfy the peak rate of discharge requirement.

- For computation of pre-development peak discharge rates, twenty percent (20%) of existing impervious areas, when present, shall be considered meadow.

Water Quality

Water quality control is achieved through the use of various Best Management Practices. BMPs which provide water quality benefits should be placed as close as practical to the discharge point of the impervious surface. It is recommended that as many water quality BMPs as possible are used in Special Protection watersheds and properties which drain to impaired streams.

Adams County recognizes the importance and benefits of riparian buffers and stresses the use of buffers as a BMP whenever possible. All regulated activities should be planned to minimize any impacts to existing riparian corridors. The County supports the retention, expansion, and establishment of riparian forest buffers, especially along Exceptional Value, High Quality, and impaired streams.

Special Management Areas

Certain land use types, considered “Special Management Areas” in the BMP Manual, are places where land disturbance can alter the original natural environment. These areas include brownfields, highways and roads, karst areas, mined lands, water supply well areas, surface water supplies, and Special protection Waters. Chapter 7 of the BMP Manual describes the Special Management Areas in more detail and provides recommendations and suggestions of appropriate BMPs to be used within those areas. Responsibly dealing with stormwater management in three Special Management Areas in particular is a priority for Adams County.

Karst Areas

Karst areas are a concern to several municipalities in Adams County. When addressing stormwater management issues, the complexities of a karst system demand a more rigorous scrutiny than other geologic settings. Successful stormwater management in karst areas can be achieved by developing a strategy for the site that will be best suited to function within the tolerance limits of the natural system. The pre-development hydrologic regime should be maintained and every effort made to use the existing karst drainage features in a safe way. The Basic Principals in Chapter 7 of the BMP Manual must be considered in karst areas. BMP considerations are also listed in Chapter 7.

Water Supply Wells

Considering almost all of Adams County's public water supplies are from ground water sources, it would seem that infiltration in those areas contributing to the recharge of those wells would be logical. However, the BMP Manual recommends against infiltration BMPs within Zone 1 and caution in Zone II wellhead protection areas. This does not seem consistent with other policy and sources. It is recommended that, if located within an appropriate geologic setting, infiltration BMPs, coupled with water quality BMPs, are used in wellhead protection areas and those areas contributing to the recharge of groundwater.

To date, not many wellhead delineations have been preformed. Four pilot projects, delineating the wellhead protection zones of the wells for Abbottstown, Littlestown, Fairfield, and Gettysburg were completed for the Water Supply and Wellhead Protection Plan. Other municipal water suppliers could delineate wellhead protection areas and utilize infiltration BMPs to enhance the contribution to groundwater recharge.

Special Protection Waters

Adams County has several streams that have been designated Exceptional Value or High Quality. These designations should be sustained. Stormwater resulting from projects should be infiltrated to the maximum extent possible and water quality treatment BMPs should be employed for all discharged stormwater. BMPs should be spread out to a number of locations around the site.

Antidegradation requirements for special protection waters will be met if post-construction stormwater infiltration volume equals the pre-construction stormwater infiltration volume, and that any post-construction stormwater discharge is pre-treated and managed so that it will not degrade the physical, chemical, or biological characteristics of the receiving stream.

The Simplified Approach (SA)

One of the objectives of the Adams County Stormwater Management Plan, was to address concerns from residents regarding the costs associated with the preparation of stormwater management plans for smaller projects, like an addition to a home or the placement of a shed on a property. In many cases, the engineering and related approvals associated with stormwater management plans exceeded the actual cost of the minor projects. The Simplified Approach was developed to save applicants time and money.

The Simplified Approach (Appendix C) includes the Stormwater Management Design Assistance Manual, Municipal Stormwater Management Worksheets, and Guide to Choosing Stormwater BMPs. Together, these documents guide applicants and municipalities through a more stream-lined and straightforward process for smaller projects. The Simplified Approach is applicable to many, but not all, residential and accessory structure projects proposing up to 10,000 square feet of impervious area. It is recommended that the Municipal Stormwater Management Worksheets are used to determine if a project is exempt or clarify what is required from the applicant. The Simplified Approach also allows for the preparation of a scaled-down, minor stormwater site plan for certain projects. This allows the applicant the option of choosing BMPs to fit their site and budget. It is recommended that all municipalities utilize the Simplified Approach and the Municipal Stormwater Management Worksheets for consistency throughout the County.

Type of Stormwater Management Plan Required:

Based upon the model ordinance in Appendix A and utilization of the Simplified Approach in Appendix C, Adams County recommends the following in regard to the type of stormwater management plan prepared. Completion of the Municipal Stormwater Management Worksheets (part of the Simplified Approach in Appendix C) will assist the municipality and applicant in determining the project requirements.

Table 10: Type of Stormwater Management Plan Required

SMP Plan Requirement	Impervious Area	Disturbed Area	Next Steps
Exempt	Up to 1,000 ft²	Less than 1 acre	File Municipal Stormwater Management Worksheet with municipality*
May be Exempt	1,000 to ≤ 10,000 ft², if entirely disconnected from impervious areas	Less than 1 acre	File Municipal Stormwater Management Worksheets with municipality*
Minor Stormwater Site Plan	1,000 ft² to ≤ 5,000 ft² IF connected to impervious areas	Less than 1 acre	Prepare a minor stormwater site plan, see SA
Formal Stormwater Management Plan	Greater than 5,000 ft²	Greater than 1 acre	Consult an Qualified Person

* It is highly recommended that municipalities use the Stormwater Management Worksheets, but it is not required.

Recommended Municipal SWM Plan Review and Approval Process

Each municipality may include language in the stormwater management ordinance based on their preferred method of reviewing formal stormwater management plans. The

recommended municipal review process for formal stormwater management plans includes the following components.

- **Intake:** Upon receipt, the municipal official accepting the SWM Site Plan forwards a copy of the Plan to the municipal engineer and Adams County Conservation District. The official accepting the SWM Site Plan will also include the application on the agenda for the next available Planning Commission meeting.

  For projects requiring a General NPDES Permit for the discharge of stormwater from a construction activity, the applicant shall provide municipal engineer and Conservation District with complete NPDES permit package submission as per DEP requirements. Upon the Conservation District's completion and approval of the administrative permit review, the Conservation District shall provide in writing to applicant and municipal engineer, a cover letter of said approval. The approval letter will also inform the applicant as to the remaining process in obtaining the right to use the General NPDES permit.

- **Municipal Engineer Review:** The municipal engineer reviews the SWM Site Plan for compliance with the requirements of the Stormwater Management Ordinance and communicates the review to the municipal Planning Commission and Governing Body.

  For projects requiring an NPDES permit, the municipal engineer will conduct a technical review of the SWM. They may choose to utilize the optional Technical Review Checklist included in the Appendix C of the Model Stormwater Management Ordinance and forward the checklist to the Adams County Conservation District. Once the municipality has completed its technical review, the municipality will notify the Conservation District and recommend that the Conservation District proceed with the General NPDES permit process. When both the erosion and sediment control review is completed by the Conservation District and the technical review is completed by the municipality, the District will acknowledge the use of the General NPDES permit.

- **Planning Commission Review:** The municipal Planning Commission reviews the application with the municipal engineer's review and provides a recommendation regarding the SWM Site Plan in writing to the Governing Body.

- **Governing Body Decision:** The Governing Body considers the SWM Site Plan, the municipal engineer's review, and the Planning Commission's recommendation at its next available meeting. Following review of this

information, the Governing Body approves, approves with conditions, or disapproves the SWM Site Plan.

For projects requiring a General NPDES permit, the municipality may conditionally approve a project if the Conservation District has not yet acknowledged the use of the General Permit.

- **Decision Notification Procedure:** In all cases, the decision of the Governing Body to approve, approve with conditions, or disapprove the SWM Site Plan will be in writing. The decision will be delivered to the applicant no later than fifteen (15) days following the decision. If the SWM Site Plan is disapproved, the written decision by the Governing Body shall specify the defects in the application, describe the requirements which were not met, and shall cite the provisions of the Ordinance relied upon. If the SWM Site Plan is approved with conditions, the notification to the applicant shall state the acceptable conditions for approval and the time limit for satisfying conditions.

SECTION VIII – BEST MANAGEMENT PRACTICES

The *Pennsylvania Stormwater Best Practices Manual* provides guidance for stormwater management planning through the use of design standards and planning concepts known as best management practices (BMPs) to control the volume, rate, and water quality of stormwater runoff. The Manual describes an approach to stormwater management that strives to prevent or minimize stormwater problems through comprehensive planning and site development techniques and mitigate any remaining potential problems by employing structural and non-structural BMPs.

Non-Structural Best Management Practices

The emphasis on the integration of site design and planning techniques that preserve natural systems and hydrologic functions is known as Non-Structural Best Management Practices. Non-Structural BMPs maintain the natural functioning landscape, encouraging the treatment, infiltration, and transpiration of precipitation close to where it falls. Through a variety of practices that preserve open space and incorporate existing natural features, non-structural BMPs not only have the ability mitigate impacts related to stormwater but also prevent generation of stormwater.

Extensive site clearing and grading, which result in the destruction of existing vegetation and soil compaction, are typical to conventional land development. The incorporation of Non-Structural BMPs may reduce costs associated with land clearing, grading, and infrastructure while creating desirable, marketable communities.

The PA BMP Manual identifies and provides details in several areas of preventive Non-Structural BMPs. These areas include: Protect sensitive and special value features, cluster and concentrate, minimize disturbance and minimize maintenance, reduce impervious cover, disconnect/ distribute/ decentralize, and source control. Non-Structural BMPs should be the primary consideration when developing a site.

Structural Best Management Practices

Structural BMPs usually bring to mind the often used stormwater management tool, the detention basin. Structural BMPs can also be based on natural features and functions, like vegetation and infiltration, but are more specific to a certain location and explicit in their form. They are referred to as “structural” because they may need to be constructed or engineered.

The BMP Manual describes twenty-one (21) structural BMPs, which are grouped according to their primary stormwater function: Volume/ peak rate reduction by infiltration, volume/ peak rate reduction, Runoff quality, restoration, and other BMPs. There are also two Protocols that have been specifically developed to use with all infiltration BMPs.

Simplified Approach Guide to Choosing BMPS

For those projects that are able to use the Simplified Approach and are required to incorporate best management practices into their site, a guide to choosing BMPs is part of the Simplified Approach in Appendix C. This guide provides details on installing several types of BMPs that are easier for homeowners to install on their own, however any type of BMP may be used if it achieves the required control of stormwater runoff.

SECTION VIII - RECOMMENDATIONS

- Municipalities are encouraged to update Subdivision and Land Development Ordinances and Zoning Ordinances to be consistent with the adopted stormwater management ordinance. Municipalities, especially those that have opted-in to the Uniform Construction Code, should also be aware of the Pennsylvania Environmental Council document *Impact of Conflicting Codes on Stormwater Management* (Appendix G).

- Municipalities should consider revising Ordinances to incorporate non-structural best management practice planning techniques as requirements for new subdivisions or land developments. These techniques include, but are not limited to: reducing residential street widths, minimizing the number and imperviousness of cul-de-sacs, curb excess parking space requirements, reducing overall imperviousness of parking lots, etc. as recommended in the Monocacy River Stormwater Management Plan or further described in Chapter 5 of the BMP Manual.

- Municipal public water suppliers should delineate recharge areas and wellhead protection zones and are encouraged to complete a wellhead protection plan.

- Utilize infiltration BMPs in areas where soils are suitable for infiltration. Especially in groundwater recharge areas which contribute to public drinking water supplies. If infiltration BMPs are used in areas of groundwater recharge to public water supplies, water quality BMPs should also be used.

- Promote the establishment and maintenance of riparian forest buffers to satisfy stormwater management requirements, especially along Exceptional Value, High Quality, and impaired streams.

- Where appropriate, protect natural habitats along proposed riparian greenways, as depicted in the Adams County Greenways Plan (2010) and Significant Riparian Greenways map (Appendix B).

- Identify areas and opportunities for county and municipal governments to address existing stormwater management problems through retrofitting.

- If existing flood-prone locations are within areas of roadway that are scheduled for improvement, the existing problems should be evaluated to determine if they can be corrected during the time of road work.

- Current state law requires the identification of existing stormwater problems but does not include guidance or funding to solve the existing problems or alleviate recurrences. The existing flood-prone locations should be prioritized and a strategy developed to correct existing problems if funding becomes available.

SECTION IX - IMPLEMENTATION & UPDATE PROCEDURE

County Adoption

The Adams County Stormwater Management Plan preparation process is complete with the adoption of the Plan by the Adams County Commissioners. The Adams County Commissioners held a public hearing, pursuant to public notice of not less than 2 weeks, on November 2, 2011. The Plan was adopted by resolution carried by an affirmative vote of the majority of the County Commissioners on November 23, 2011.

DEP Approval of the Plan

Once adopted, the Plan is submitted to the PA Department of Environmental Protection (DEP) for approval. DEP will have ninety (90) days to approve or disapprove the Plan.

Plan Implementation - Municipal Ordinance Adoption

Subsequent to DEP approval of the Adams County Stormwater Management Plan, initial implementation is the responsibility of the municipalities. Adams County municipalities will have six (6) months from the date of DEP approval to adopt the necessary ordinance provisions consistent with the Plan.

The Adams County Conservation District will host two workshops geared toward the use of the model ordinance and the Simplified Approach to assist the municipalities administer the ordinance.

Plan Implementation – Plan Recommendations

Further implementation of the Plan, through the execution of the Recommendations described in Section VIII, may come about through the actions and assistance of Adams County, County organizations, or municipalities, at the discretion of the County or municipality.

Update of the Plan

Section 5(a) of Act 167 states that a stormwater management plan shall be periodically reviewed and revised “at least every five years”. If no significant problems associated with the adopted model ordinance are identified and considerable changes to state legislature have not been made within 5 years, Adams County will re-evaluate the Adams County Stormwater Management Plan and re-activate the SPAC.

SECTION X - REFERENCES

The following references were cited throughout the Adams County Stormwater Management Plan. These documents and publications provide additional sources of valuable information.

- Pennsylvania Department of Environmental Protection, December 2006: Pennsylvania Stormwater Best Management Practices Manual, Document #363-0300-002. www.elibrary.dep.state.pa.us/dsweb/View/Collection-8305

- Adams County Office of Planning & Development, September 2002: Monocacy River Watershed Stormwater Management Plan. http://adamscounty.us/MunicipalitiesPlansOrdinances/AdamsCounty.aspx

- Adams County Office of Planning & Development, 1991: Adams County Comprehensive Plan. http://adamscounty.us/MunicipalitiesPlansOrdinances/AdamsCounty.aspx

- Adams County Office of Planning & Development, 2001: Water Supply and Wellhead Protection Plan. http://adamscounty.us/MunicipalitiesPlansOrdinances/AdamsCounty.aspx

- Adams County Office of Planning & Development, 2010: Adams County Greenways Plan. http://adamscounty.us/MunicipalitiesPlansOrdinances/AdamsCounty.aspx

- Commonwealth of Pennsylvania, November 2010: Title 25, Chapter 102. Erosion and Sediment Control. http://www.pacode.com/secure/data/025/chapter102/chap102toc.html

- Commonwealth of Pennsylvania, August 2006: Title 25, Chapter 93. Water Quality Standards. http://www.pacode.com/secure/data/025/chapter93/chap93toc.html

- Pennsylvania Department of Environmental Protection, November 2010: Riparian Forest Buffer Guidance, Document #394-5600-001. www.elibrary.dep.state.pa.us/dsweb/Get/Document-82308/394-5600-001.pdf

- Pennsylvania Department of Environmental Protection, 2010: 2010 Pennsylvania Integrated Water Quality Monitoring and Assessment Report, Clean Water Act Section 305(b) and 303(d) List. http://www.depweb.state.pa.us, keyword "Water Quality List"

- Pennsylvania Department of Environmental Protection, January 11, 2011: Pennsylvania Chesapeake Watershed Implementation Plan.

- U.S. Department of Transportation, Federal Highway Administration, September 2001, rev. May 2005: Hydraulic Design of Highway Culverts, Publication No. FHWA-NHI-01-020. http://isddc.dot.gov/OLPFiles/FHWA/012545.pdf

- Pennsylvania Environmental Council, 2007: Conewago Creek River Conservation Plan. http://www.pecpa.org/conewago

ADAMS COUNTY
STORMWATER MANAGEMENT PLAN

ADOPTED at a regular meeting of the

ADAMS COUNTY BOARD OF COMMISSIONERS

On this 23rd day of November, 2011.

George A. Weikert

George Weikert (Name) Chairman (Title)

R. Glenn Snyder

R. Glenn Snyder (Name) Vice-chairman (Title)

Lisa Moreno-Woodward

Lisa Moreno-Woodward (Name) Commissioner (Title)

ATTEST:

Paula V. Neiman

Paula Neiman, Chief Clerk

Appendix A
Model Stormwater Management Ordinance

MUNICIPAL STORMWATER MANAGEMENT ORDINANCE

ORDINANCE NO._____

MUNICIPALITY OF

ADAMS COUNTY, PENNSYLVANIA

Adopted at a Public Meeting Held on

_____, 20___

2011

MODEL STORMWATER MANAGEMENT ORDINANCE FOR THE COUNTY OF ADAMS

This Model Stormwater Management Ordinance is based upon a February 2010, draft of the "Pennsylvania Model Stormwater Management Ordinance" (Document Number 363-0300-003) created by the Bureau of Watershed Management of the Pennsylvania Department of Environmental Protection. The "Model" has been revised by the staffs of the Adams County Office of Planning and Development and the Adams County Conservation District, with suggestions and assistance from the Stormwater Planning Advisory Committee, PA DEP, as well as agencies, firms and individuals, both public and private.

The Model Ordinance contains a number of spaces which require insertions by the adopting Municipality. The information needed includes the municipality's name, number values, or a term or phrase. These missing parts of the Model Ordinance are identified by (***parentheses, underlining, and bold italics***). In some instances, the completion of such information may require consultation with the municipal staff or municipal advisors. Municipalities are also encouraged to make sure definitions are consistent with other Ordinances.

Table of Contents

Appendices

ARTICLE I - GENERAL PROVISIONS

Section 101. Short Title

This Ordinance shall be known and may be cited as the "(***Name of Municipality***) Stormwater Management Ordinance."

Section 102. Statement of Findings

The governing body of (***Name of Municipality***) finds that:

A. Stormwater is an important water resource, which provides groundwater recharge for water supplies and base flow of streams, which also protects and maintains surface water quality.

B. Inadequate management of accelerated runoff of stormwater resulting from development throughout a watershed increases flows and velocities, contributes to erosion and sedimentation, overtaxes the carrying capacity of streams and storm sewers, greatly increases the cost of public facilities to carry and control stormwater, undermines floodplain management and flood control efforts in downstream communities, reduces groundwater recharge, threatens public health and safety, and increases nonpoint source pollution of water resources.

C. A comprehensive program of stormwater management, including reasonable regulation of development and activities causing accelerated runoff, is fundamental to the public health, safety, and welfare and the protection of people of (***Name of Municipality***), their resources, and the environment.

Section 103. Purpose

The purpose of this Ordinance is to promote health, safety, and welfare within (***Name of Municipality***) and its watersheds by minimizing the harm and maximizing the benefits described in Section 102 of this Ordinance, through provisions designed to:

A. Meet water quality requirements under state law, including regulations at 25 Pa. Code 93, to protect, maintain, reclaim, and restore the existing and designated uses of the waters of the Commonwealth.

B. Preserve the natural drainage systems as much as possible.

C. Manage stormwater runoff close to the source.

D. Provide procedures and performance standards for stormwater planning and management.

E. Maintain groundwater recharge to prevent degradation of surface and groundwater quality and to otherwise protect water resources.

F. Prevent scour and erosion of stream banks and stream beds.

G. Provide proper operation and maintenance of all stormwater management Best Management Practices that are implemented within the municipality.

H. Provide standards to meet NPDES permit requirements.

Section 104. Statutory Authority

The Municipality is empowered to regulate land use activities that affect stormwater impacts by the authority of the ***(Cite relevant sections of the applicable municipal code,— confer with municipal solicitor.***), and the Act of October 4, 1978, P.L. 864 (Act 167), 32 P.S. Section 680.1, *et seq*., as amended, the "Stormwater Management Act."

Section 105. Applicability

A. All Regulated Activities, as defined in Article II, and all activities that may affect stormwater runoff, including land development and earth disturbance activity, are subject to regulation by this Ordinance.

B. Any submission that does not require a stormwater management plan at the time of subdivision or land development will still be required to address stormwater management at the time the individual lots are developed or construction commences, unless said subdivision proposes infrastructure features, such as a cul-de-sac street, for which stormwater management controls are ordinarily required.

C. Development of the individual lots is subject to stormwater management as defined within the ordinance.

Section 106. Repealer

Any other ordinance provision or regulation of the Municipality inconsistent with any of the provisions of this Ordinance is hereby repealed to give this Ordinance full force and effect to the extent of the inconsistency only.

Section 107. Severability

In the event that a court of competent jurisdiction declares any section, clause or provision of this Ordinance invalid, such decision shall not affect the validity of any of the remaining sections, clauses or provisions of this Ordinance.

Section 108. Compatibility with Other Requirements

Approvals issued and actions taken under this Ordinance do not relieve the applicant of the responsibility to secure required permits or approvals for activities regulated by any other code, law, regulation, or ordinance. In the event of a conflict, between this Ordinance and any other ordinance, the more restrictive ordinance shall apply.

Section 109. Interpretation

Unless otherwise expressly stated, the succeeding shall, for the purposes of this Ordinance, be interpreted in the following manner:

A. Words used in the present tense also imply the future tense.

B. Words used in the singular include the plural, and vice versa.

C. Words of masculine gender include feminine gender, and vice versa.

D. The words and abbreviation "includes," "including," "shall include," "such as," and "e.g." are not limited to the specific example(s) given but are intended to extend the words or words' meaning(s) to all other instances of like kind and character.

E. The words "shall," "required," or "must" are mandatory; the words "may" and "should" are permissive.

Section 110. Erroneous Permit

Any permit or authorization issued or approved based on false, misleading or erroneous information provided by an applicant is void without the necessity of any proceedings for revocation. Any work undertaken or use established pursuant to such permit or other authorization is unlawful. No action may be taken by a board, agency or employee of (***Name of Municipality***) purporting to validate such a violation.

Section 111. Duty of Persons Engaged in the Development of Land

Notwithstanding any provision(s) of this Ordinance, including exemptions, any landowner or any person engaged in the alteration or development of land which may affect stormwater runoff characteristics shall implement such measures as are reasonably necessary to prevent injury to health, safety, or other property. Such measures shall include actions as are required to manage the rate, volume, direction, and quality of resulting stormwater runoff in a manner which adequately protects health, property and water quality.

(The following was included as guidance. Municipalities should consult with their Solicitor.)

Section 112. Municipal Liability Disclaimer

A. Neither the granting of any approval under this Ordinance, nor the compliance with the provisions of this Ordinance, or with any condition imposed by a municipal official hereunder, shall relieve any person from any responsibility or damage to persons or property resulting there from, or as otherwise imposed by law nor impose any liability upon the Municipality for damages to persons or property.

B. The granting of a permit which includes any stormwater management facilities shall not constitute a representation, guarantee, or warranty of any kind by the Municipality, or by an official or employee thereof, of the practicability or safety of any structure, use or other plan proposed, and shall create no liability upon or cause of action against such public body, official or employee for any damage that may result pursuant thereto.

ARTICLE II – DEFINITIONS

Adams County Conservation District – As defined in Section 3(c) of the Conservation District Law (3 P.S. § 851 (c)) that has the authority under a delegation agreement executed with DEP to administer and enforce all or a portion of the regulations promulgated under 25 Pa. Code 102.

Agricultural Activity - Activities associated with agriculture such as agricultural cultivation, agricultural operation, and animal heavy use areas. This includes the work of producing crops including tillage, land clearing, plowing, disking, harrowing, planting, harvesting crops or pasturing and raising of livestock and installation of conservation measures. Construction of new buildings or impervious area is not considered an agricultural activity.

Applicant - A landowner, developer, or other person who has filed an application to the municipality for approval to engage in any Regulated Activity at a project site in the Municipality.

Best Management Practice (BMP) - Activities, facilities, designs, measures, or procedures used to manage stormwater impacts from Regulated Activities, to meet state water quality requirements, to promote groundwater recharge, and to otherwise meet the purposes of this Ordinance.

Best Management Practice, Nonstructural – Operational and/or behavior-related practices that attempt to minimize the contact of pollutants with stormwater runoff.

Best Management Practice, Structural – Measures consisting of a physical device or practice that is installed to capture and treat stormwater runoff. Structural BMPs include, but are not limited to, a wide variety of practices and devices, from large-scale retention ponds and constructed wetlands, to small-scale underground treatment systems, infiltration facilities, filter strips, low impact design, bioretention, wet ponds, permeable paving, grassed swales, riparian or forested buffers, sand filters, detention basins, and manufactured devices. Structural stormwater BMPs are permanent appurtenances to the project site.

BMP Manual – Pennsylvania Stormwater Best Management Practices Manual, Pennsylvania Department of Environmental Protection, December 2006 (Document #363-0300-002), as amended and updated.

Culvert - A structure which carries surface water through an obstruction.

Dam - An impoundment structure regulated by the Pennsylvania DEP Chapter 105 regulations.

DEP - The Pennsylvania Department of Environmental Protection.

Design Storm - The magnitude and temporal distribution of precipitation from a storm event measured in probability of occurrence, e.g., a 5-year storm, and duration, e.g., 24 hours, used in the design and evaluation of stormwater management systems.

Detention Basin - A structure designed to retard stormwater runoff by temporarily storing and releasing the runoff at a predetermined rate.

Detention Volume - The volume of runoff that is captured and released into the waters of the Commonwealth at a controlled rate.

Disconnected Impervious Area (DIA) - An impervious or impermeable surface that is disconnected from any stormwater drainage or conveyance system and is redirected or directed to a pervious area, which allows for infiltration, filtration, and/ or increased time of concentration.

Disturbed Area - An unstabilized land area where an earth disturbance activity is occurring or has occurred.

Drainage Plan (also stormwater management plan) – The documentation of the stormwater management system, if any, to be used for a given project site.

Earth Disturbance Activity - A construction or other human activity which disturbs the surface of the land, including land clearing and grubbing, grading, excavations, embankments, land development, agricultural plowing or tilling, operation of animal heavy use areas, timber harvesting activities, road maintenance activities, oil and gas activities, well drilling, mineral extraction, and the moving, depositing, stockpiling, or storing of soil, rock or earth materials.

Erosion - The natural process by which the surface of the land is worn away by water, wind, or chemical action.

E&S Manual – The Pennsylvania DEP Erosion and Sedimentation Control Manual, as amended and updated.

Erosion and Sedimentation Control Plan (E&S Plan) – A site-specific plan consisting of both drawings and a narrative that identifies BMPs to minimize accelerated erosion and sedimentation before, during and after earth disturbance activities.

Evapotranspiration - The combined process of water surface evaporation, soil moisture evaporation, and plant transpiration.

Existing Condition - The dominant land cover during the 5-year period immediately preceding a proposed Regulated Activity.

FEMA - Federal Emergency Management Agency.

Floodplain - Any land area susceptible to inundation by water from any natural source or delineated by applicable FEMA maps and studies as being a special flood hazard area.

Forest Management/ Timber Operations - Planning and activities necessary for the management of forest land. These include conducting a timber inventory, preparation of a forest management plan, silvicultural treatment, developing or establishing a cutting budget, logging road design and construction, timber harvesting, site preparation, and reforestation.

Hydrologic Soil Group (HSG) - A group of soils having similar runoff potential under similar storm and cover conditions. HSGs range from A to D, with A soils being the most pervious and D soils being the least pervious.

Impervious Surface (Impervious Area) - A surface that prevents the infiltration of water into the ground. Impervious surfaces and areas include but are not limited to roofs, additional indoor living spaces, patios and decks, garages, storage sheds and similar structures, streets, driveways, access drives, parking areas, and sidewalks. Any areas designed to be covered by loose surfacing materials such as gravel, stone and/or crushed stone, and intended for storage of and/or travel by vehicles, or pedestrians shall be considered impervious. Surfaces or areas designed, constructed and maintained to permit infiltration may be considered pervious.

Infiltration - Water flowing downward through the ground surface.

In-Kind Repair/ Replacement – Repair or replacement which uses the same or similar materials in the same location.

Invasive/ Exotic Plants – Plant species on the "Invasive Exotic Plants in Pennsylvania List" published by the PA Department of Conservation and Natural Resources, as amended.

Karst - A type of topography or landscape characterized by surface depressions, sinkholes, rock pinnacles/uneven bedrock surface, underground drainage, and caves. Karst is formed on carbonate rocks, such as limestone or dolomite.

Land Development - Shall include any of the following activities:

A. the improvement of one lot or two or more contiguous lots, tracts, or parcels of land for any purpose involving:

    1. a group of two (2) or more residential or nonresidential buildings, whether proposed initially or cumulatively, or a single nonresidential building on a lot or lots regardless of the number of occupants or tenure; or

2. the division or allocation of land or space, whether initially or cumulatively, between or among two (2) or more existing or prospective occupants by means of, or for the purpose of streets, common areas, leaseholds, condominiums, building groups, or other features.

B. A subdivision of land.

C. Development in accordance with Section 503(1.1) of the Pennsylvania Municipalities Planning Code.

Limit of Disturbance – A line provided on the E&S Plan or SWM Plan that indicates the total area to be disturbed over the life of the project.

Loading Ratio – The ratio of impervious area draining to a stormwater management facility to the area of the stormwater management facility itself.

Municipality - (***name of municipality***), Adams County, Pennsylvania.

Noxious Plant – Those species as listed in the PA Noxious Weed Control Law (3 P.S. § § 255.1—255.11), as amended and/or recodified.

NPDES - National Pollution Discharge Elimination System, as authorized by the Clean Water Act (33 U.S.C. §1251 *et seq.* [1972], as amended).

NPDES Permit – A permit required for stormwater discharges associated with construction activities, as required by the Clean Water Act (33 U.S.C. §1251 *et seq.* [1972], as amended).

NRCS - USDA Natural Resources Conservation Service (previously SCS).

O&M - Operation and Maintenance.

O&M Plan - Operation and Maintenance Plan.

PCSM - Post-Construction Stormwater Management**.**

PCSM Plan – Post Construction Stormwater Management Plan.

Peak Discharge - The maximum rate of stormwater runoff from a specific storm event.

Pervious Area - Any area not defined as impervious.

Pennsylvania Municipalities Planning Code - Act of 1968, P.L.805, No. 247, as reenacted and amended.

Point Source - Any discernible, confined, or discrete conveyance, including, but not limited

to: any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, CAAP, CAFO, landfill leachate collection system, or vessel or other floating craft from which pollutants are or may be discharged.

Project Site (Site) - The specific area of land where any Regulated Activity in the municipality is planned for, conducted on, constructed, or maintained.

Qualified Person - Any person licensed by the Pennsylvania Department of State or otherwise qualified by law to perform the work required by this Ordinance.

Reduction Factor – A form of safety factor that, when multiplied by the site tested infiltration rate, is used to help determine the design infiltration rate for a stormwater management facility.

Regulated Activities - Any earth disturbance activities or any activities that involve the alteration or development of land in a manner that may affect stormwater runoff.

Removed Runoff - The volume of runoff that is captured and not released directly into the surface waters of the Commonwealth during or after a storm event.

Retention Basin - An impoundment in which stormwater is stored and not released to surface waters of the Commonwealth.

Return Period - The average interval, in years, within which a storm event of a given magnitude can be expected to occur one time. For example, the 25-year return period rainfall would be expected to occur on average once every 25 years; or, stated in another way, the probability of a 25-year storm occurring in any one year is 0.04, i.e., a 4% chance.

Riparian Forest Buffer - A type of riparian buffer that consists of permanent vegetation that is predominantly native trees and shrubs along surface waters that is maintained in a natural state or sustainably managed to protect and enhance water quality, stabilize stream channels and banks, and separate land use activities from surface waters.

Road Maintenance Activities – See definition as found in Title 25, Chapter 102.1.

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

Safety Factor – An adjustment applied to a site-tested infiltration rate to ensure that the designed infiltration rate for a stormwater management facility is less than that shown under tested conditions.

Sediment - Soils or other materials transported by surface water as a product of erosion.

Simplified Approach (SA) – A process that property owners proposing certain types of projects may utilize to prepare a stormwater management plan without having to conduct the detailed technical analysis and design required for larger projects.

Special Management Areas – Those areas outlined in Chapter 7 of the BMP Manual. Special Management Areas include: brownfields, highways and roads, karst areas, mined lands, water supply well areas, surface water supplies and special protection waters.

State Water Quality Requirements - The regulatory requirements to protect, maintain, reclaim, and restore water quality under Title 25 of the Pennsylvania Code and the Clean Streams Law.

Storm Sewer - A pipe or conduit, or a system of pipes or conduits, which intercepts and carries surface stormwater runoff, but excludes sewage, industrial wastes and similar discharges.

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

Stormwater Management Facility - Any structure, natural or man-made, that, due to its condition, design, or construction, conveys, stores, or otherwise affects stormwater runoff. Typical stormwater management facilities include, but are not limited to: detention and retention basins; open channels; storm sewers; pipes; and infiltration facilities.

Stormwater Management Plan (The Plan) - The Adams County Stormwater Management Plan of <<Insert Approval Date>>, which incorporates the requirements of the Act of October 4, 1978, P.L. 864 (Act 167), as amended, and known as the "Storm Water Management Act."

Stormwater Management Site Plan (SWM Site Plan) – A plan prepared by the developer or his representative indicating how stormwater runoff will be managed at the development site in accordance with this Ordinance.

Subdivision - The division or re-division of a lot, tract or parcel of land by any means into two or more lots, tracts or parcels or other divisions of land including changes in existing lot lines for the purpose, whether immediate or future, of lease, partition by the court for distribution to heirs or devisees, transfer of ownership or building or lot development; provided, however, that the subdivision by lease of land for agricultural purposes of an area of more than ten acres, not involving any new street or easement of access or any residential dwelling, shall not be considered a subdivision.

Swale - A low-lying stretch of land which gathers and/or carries surface water runoff.

SWM - Stormwater Management.

Technical Review Checklist (Optional) – A checklist of technical items to be used by the reviewing entity when reviewing a PCSM Plan.

USDA - United States Department of Agriculture.

Waters of the Commonwealth – Any and all rivers, streams, creeks, rivulets, impoundments, ditches, watercourses, storm sewers, lakes, dammed water, wetlands, ponds, springs, and all other bodies or channels of conveyance of surface and underground water, or parts thereof, whether natural or artificial, within or on the boundaries of the Commonwealth.

Watershed - Region or area drained by a river, watercourse, or other surface water of this Commonwealth.

Wetland - Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions, including swamps, marshes, bogs, and similar areas.

ARTICLE III - STORMWATER MANAGEMENT STANDARDS

Section 301. General SWM Site Plan Requirements

A. For all regulated activities, unless preparation of an SWM Site Plan is specifically exempted in Section 302:

   1. Preparation and implementation of an approved SWM Site Plan is required.

   2. No regulated activities shall commence until the Municipality issues written approval of an SWM Site Plan which demonstrates compliance with the requirements of this Ordinance.

B. All SWM Site Plans for Regulated Activities shall include such measures as necessary to:

   1. Protect health, safety, and property.

   2. Meet the water quality goals of this Ordinance, as stated in Section 103, by including measures that:

      a. Minimize disturbance to floodplains, wetlands, wooded areas, and existing vegetation.

      b. Maintain or extend riparian buffers. ***(If municipality already has specific riparian buffer standards, cross reference these standards here.)***

      c. Avoid erosive flow conditions in natural flow pathways.

      d. Minimize thermal impacts to waters of the Commonwealth.

      e. Disconnect impervious surfaces by directing runoff to pervious areas.

      f. Minimize soil disturbance and compaction.

   3. Incorporate the techniques for Low Impact Development Practices described in the Pennsylvania Stormwater Best Management Practices Manual (BMP Manual).

C. Stormwater flows onto adjacent property shall not be created, increased, decreased, relocated, or otherwise altered without the written notification of the adjacent property owner(s) by the developer. Copies of all such notifications shall be included in the SWM Site Plan submission.

D. For all Regulated Activities where erosion and sediment control is required in accordance with Title 25 of the Pennsylvania Code and the Clean Streams Law, the SWM Site Plan shall include the required erosion and sedimentation control

measures. Necessary E&S BMPs shall be designed in accordance with the Erosion and Sediment Pollution Control Program Manual (E&S Manual) 2, No. 363-2134-008 (April 15, 2000), as amended and updated. Approval of the SWM Site Plan by (***Name of Municipality***) shall be conditioned on the applicant obtaining erosion and sedimentation control approval from the appropriate agency(ies), when applicable .

E. For all Regulated Activities where NPDES permitting is required in accordance with the Clean Water Act (33 U.S.C. §1251 *et seq.* [1972], as amended), the SWM Site Plan shall include the information required in the applicant's NPDES Permit application. Approval of the SWM Site Plan by (***Name of Municipality***) shall be conditioned on the applicant obtaining NPDES Permit approval from the appropriate agency(ies), when applicable.

F. For all regulated activities, implementation of the volume controls in Section 304 is required.

G. Special Management Areas – SWM Site Plans involving Regulated Activities within Special Management Areas shall be prepared in a manner consistent with the guidance provided in Chapter 7 of the BMP Manual. The SWM Site Plan submission shall include design details for SWM BMPs within said Special Management Area.

H. A SWM Site Plan may propose that stormwater related to the proposed Regulated Activities be accommodated by existing stormwater management facilities on adjoining or nearby properties provided that the SWM Site Plan documents the following.

1. The use of the stormwater management facilities located on said adjoining or nearby property is approved in writing by the owner of the property.

2. The stormwater management facilities located on said adjoining or nearby property are designed in a manner that can accommodate the stormwater management needs of the Regulated Activity in a manner consistent with all requirements of this Ordinance. The SWM Site Plan shall include all documentation necessary for (***Name of Municipality***) to confirm such compliance.

I. The design storm volumes to be used in the analysis of peak rates of discharge shall be obtained from the Precipitation-Frequency Atlas of the United States, Atlas 14, Volume 2, Version 3.0, as amended and updated, U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Weather Service, Hydro meteorological Design Studies Center, Silver Spring, Maryland. NOAA's Atlas 14 can be accessed at: http://hdsc.nws.noaa.gov/hdsc/pfds/.

J. SWM Site Plans, once approved by (***Name of Municipality***), shall remain on site throughout the duration of the Regulated Activity and be available for review as may be necessary by representatives of (***Name of Municipality***).

K. The design of all facilities over karst shall include an evaluation of measures to minimize adverse effects.

L. (***Name of Municipality***) may, after consultation with DEP, approve measures for meeting the state water quality requirements other than those in this Ordinance, provided that they meet the minimum requirements of, and do not conflict with, state law including, but not limited to, the Clean Streams Law. The municipality shall maintain a record of consultations with DEP pursuant to this paragraph.

Section 302. Exemptions

A. A property owner or developer of any Regulated Activity that meets the following exemption criteria is, upon approval from (***Name of Municipality***), exempt from the formal SWM plan submission requirements of this Ordinance as specified herein. However, the property owner or developer shall be subject to all other requirements of this Ordinance other than the formal SWM plan submission requirements for which an exemption or exemptions have been authorized. The criteria for exemption in this Section apply to the total development proposed, including instances in which the development is proposed to take place in phases. The date of enactment of this Ordinance shall be the starting point from which future development and the respective exemption criteria shall be cumulatively considered and regulated.

1. Regulated Activities that involve equal to or less than one thousand (1,000) square feet of impervious surface may be exempted from the peak rate control, volume control and the SWM Site Plan preparation and submission requirements of this Ordinance. The applicant shall complete page 1 of the Municipal Stormwater Management Worksheet from the Stormwater Management Design Assistance Manual (see Plan Appendix C) and file said Worksheet with (***Name of Municipality***).

2. Regulated Activities that involve greater than one thousand (1,000) square feet and equal to or less than ten thousand (10,000) square feet of impervious area, and where the all the proposed impervious area can be entirely disconnected, may be exempted from the peak rate control, volume control, and the SWM Site Plan preparation and submission requirements of this Ordinance. The applicant shall complete the Stormwater Management Worksheets from the Stormwater Management Design Assistance Manual (see Plan Appendix C) and file said Worksheets with (***Name of Municipality***).

3. Regulated Activities that involve greater than one thousand (1,000) square feet and equal to or less than five thousand (5,000) square feet of impervious area may be exempted from the peak rate control and volume control preparation and submission requirements of this Ordinance. A Minor Stormwater Site Plan, as detailed in the Stormwater Management Design Assistance Manual (see Plan Appendix C), shall be submitted to (***Name of Municipality***) instead of the

submission of a full SWM Site Plan in accordance with Article IV of this Ordinance.

4. Agricultural Activities shall be exempt from the rate control, volume control and SWM Site Plan preparation and submission requirements of this Ordinance provided the agricultural activities are performed in accordance with the requirements of 25 Pa. Code 102. Further, such activities shall not be subject to the exemption approval process of Section 302.B of this ordinance.

5. Forest management and timber operations are exempted from the rate control, volume control and SWM Site Plan preparation and submission requirements of this Ordinance provided the forest management and timber operations are performed in accordance with the requirements of 25 PA Code 102.

6. Regulated Activities involving domestic gardening for single-family consumption shall be exempted from volume control, rate control, and SWM Site Plan preparation and submission requirements of this Ordinance, and shall not be subject to the exemption approval process of Section 302.B of this Ordinance.

7. In Kind Repair, In Kind Replacement, and maintenance of existing surfaces, and structures shall be exempted from volume control, rate control, and SWM Site Plan preparation and submission requirements of this Ordinance, and shall not be subject to the exemption approval process of Section 302.B of this Ordinance.

(Each Municipality should develop a procedure to formally request Exemptions. The following language is recommended.)

B. Authorization of Exemptions: (***Name of Municipality***) shall determine, in accordance with the following requirements and process, whether a proposed Regulated Activity may be exempted from any of the requirements of this Ordinance.

1. The property owner or developer proposing the Regulated Activity shall submit, in writing on a form supplied by (***Name of Municipality***), a request for said proposed Regulated Activity to be exempted from allowable requirements of this Ordinance pursuant to Section A. The written request shall identify the project and shall indicate the specific exemption criteria, as listed in Section 302.A, that apply to the project.

2. Upon receipt of the exemption request form, the ***(Name of Governing Body)*** or its designee shall either approve or deny the exemption request. If the exemption request is denied, the ***(Name of Governing Body)*** or its designee shall direct the property owner or developer to submit the information required to demonstrate that the proposed Regulated Activity complies with the requirements of this Ordinance or meets the exemption criteria.

3. Exemption request approval shall be at the discretion of (***Name of Municipality***), and shall be subject to the following:

    a. (***Name of Municipality***) may deny any exemption request or suspend or revoke any approved exemption request at any time for any project where (***Name of Municipality***) believes that the proposed Regulated Activity poses a threat to public health, safety, property, or the environment.

    b. Approval of an exemption request does not relieve the property owner or developer from other applicable requirements of this Ordinance or of other (***Name of Municipality***) ordinance or regulations.

    c. (***Name of Municipality***) reserves the right to deny an exemption request if a drainage problem is known or identified by ***(Name of Municipality)*** to exist or is expected to exist downstream from the proposed Regulated Activity.

Section 303. General Design Standards

A. Impervious Area.

1. The measurement of impervious areas shall include all of the impervious areas in the total proposed development, even if development is to take place in phases.

2. For development taking place in phases, the total proposed impervious area within the SWM Site Plan must be used in determining conformance with this Ordinance.

3. For projects that add impervious area to a parcel, the total impervious area on the parcel is subject to the requirements of this Ordinance; except that the volume controls in Section 304 and the peak rate controls of Section 305 do not need to be retrofitted to existing impervious areas that are not being altered by the proposed Regulated Activity.

B. Normally dry, open-top storage facilities, designed as such, shall completely drain both the volume control and rate control capacities over a period of time not less than 24 hours and not more than 72 hours from the end of the design storm. However, any designed infiltration volume at such facilities is exempt from the minimum 24-hour standard, i.e., may infiltrate in a shorter period of time, so long as none of the stormwater intended for infiltration is discharged into the surface waters of the Commonwealth.

C. Infiltration BMPs shall be spread out, made as shallow as practicable, and located to maximize use of natural on-site infiltration features while still meeting the other requirements of this Ordinance.

Section 304. Volume Controls

The low impact development practices provided in the BMP Manual shall be utilized for all Regulated Activities. Water volume controls shall be implemented using the Design Storm Method in Section 304.A or the Simplified Method in Section 304.B. For Regulated Activity involving less than one (1) acre of impervious coverage that does not require hydrologic routing to design the stormwater facilities, the applicant may select either methodology on the basis of economic considerations, the intrinsic limitations on applicability of the analytical procedures associated with each methodology, and/ or other factors. The Design Storm Method in Section 304.A shall be used for all Regulated Activity involving greater than one (1) acre of impervious coverage.

A. The Design Storm Method (CG-1 in the BMP Manual) may be used for any size of Regulated Activity. This method requires detailed modeling to achieve the following standards.

    1. The post-development total runoff volume shall not increase for all storms equal to or less than the two (2)-year 24-hour duration precipitation.

    2. For modeling purposes:

        a. Existing (pre-development), non-forested, pervious areas must be considered meadow.

        b. Twenty percent (20%) of existing impervious area, when present, shall be considered meadow in the model for existing conditions.

B. The Simplified Method (CG-2 in the BMP Manual) is independent of site conditions and may be used for projects involving Regulated Activities proposing equal to or less than one (1) acre of impervious coverage and that do not require design of stormwater storage facilities. When the Simplified Method is used to address stormwater management needs of new impervious surfaces, the following design standards shall be achieved:

    1. Stormwater facilities shall capture at least the first two (2) inches of runoff from all new impervious surfaces.

    2. At least the first one (1) inch of runoff from new impervious surfaces shall be permanently removed from the runoff flow and shall not be released into the surface waters of the Commonwealth. Removal options for the first one (1) inch of runoff include, but are not necessarily limited to, reuse and infiltration.

    3. Infiltration facilities shall be designed to accommodate infiltration of as much of the permanently removed runoff as site conditions will allow. If the soils within the project area do not allow for infiltration of the entire first one (1) inch of runoff from new impervious surfaces, other forms of runoff volume control shall

be used to achieve the required removal volume. Such measures may include, but are not limited to vegetated roofs, biorention, and capture-and-reuse systems. In addition, the Infiltration Alternative authorized in Section 304.C may be employed.

4. This method is exempt from the requirements of Section 305, Rate Controls.

C. Infiltration Alternative: Where infiltration is not possible due to soil characteristics or is not desirable given other characteristics, water quality control may be proposed as an alternative to strict adherence to the volume control standards of Section 304 of this Ordinance. Where water quality control is proposed, the following standards shall be achieved.

1. At a minimum, the following documentation shall be provided to justify the proposal to reduce the infiltration requirements:

   a. Description of and justification for field infiltration/ permeability testing with respect to the type of test and test locations.

   b. An interpretive narrative describing existing soils of the site and their structure as these relate to the interaction between soils and water characteristics of the site. In addition to providing soil and soil profile descriptions, this narrative shall identify depth to seasonal water tables and depth to bedrock and provide a description of all subsurface elements (restrictive layers, geology, etc.) that influence the direction and rate of subsurface water movement.

   c. A qualitative assessment of the site's contribution to annual aquifer recharge shall be made, along with the identification of any restrictions or limitations associated with the use of designed infiltration facilities.

   d. The provided documentation must be signed and sealed by a professional engineer or geologist.

2. Water Quality BMPs shall be implemented on all permanent stormwater discharges from the proposed project site to achieve pollutant removal efficiencies in accordance with the Table 304.1.

Table 304.1 Required Pollutant Removal Efficiencies for Infiltration Alternatives

Pollutant Load	Units	Required Removal Efficiency (%)
Total Suspended Solids (TSS)	Pounds	85%
Total Phosphorus (TP)	Pounds	85%
Total Nitrate (NO_3)	Pounds	50%

3. Design guidance from the most current version of the Pennsylvania Stormwater Best Management Practices Manual, or equivalent resource as pre-coordinated with ***(Name of Municipality)***, shall be consulted when choosing design criteria for water quality BMPs.

Section 305. Rate Controls

A. Post-development discharge rates shall not exceed the pre-development discharge rates for the 1-, 2-, 5-, 10-, 25-, 50-, and 100-year 24-hour storms. If it is shown that the peak rates of discharge indicated by the post-development analysis are less than or equal to the peak rates of discharge indicated by the pre-development analysis for 1-, 2-, 5-, 10-, 25-, 50-, and 100-year, 24-hour storms, then the requirements of this section have been met. Otherwise, the applicant shall provide additional controls as necessary to satisfy the peak rate of discharge requirement.

B. For computation of pre-development peak discharge rates, twenty percent (20%) of existing impervious areas, when present, shall be considered meadow.

Section 306. – Riparian Buffers/ Riparian Forest Buffers

Where an applicant proposes to utilize riparian buffers as the means to meet the requirements of this Ordinance, said riparian buffers shall be established and/or maintained in accordance with the BMP Manual or the publication *Riparian Forest Buffer Guidance*, published November, 2010 by the Pennsylvania Department of Environmental Protection, and as may be amended or updated.

Section 307. Prohibited Discharges and Connections

A. Any drain or conveyance, whether on the surface or subsurface, that allows any non-stormwater discharge including sewage, process wastewater, and wash water to enter the waters of the Commonwealth is prohibited.

B. No person shall allow, or cause to allow, discharges into surface waters of the Commonwealth which are not composed entirely of stormwater, except (1) as provided in Subsection C below and (2) discharges allowed under a state or federal permit.

C. The following discharges are authorized unless they are determined to be significant contributors to pollution to the waters of the Commonwealth:

- Discharges from firefighting activities	- Flows from riparian habitats and wetlands
- Potable water sources including water line flushing	- Uncontaminated water from foundations or from footing drains
- Irrigation drainage	- Lawn watering
- Air conditioning condensate	- De-chlorinated swimming pool discharges
- Springs	- Uncontaminated groundwater
- Water from crawl space pumps	- Water from individual residential car washing
- Pavement wash waters where spills or leaks of toxic or hazardous materials have not occurred (unless all spill material has been removed) and where detergents are not used	- Routine external building wash-down (which does not use detergents or other compounds)
- Diverted stream flows	- Water discharged in well testing for potable water supplies

D. In the event that the municipality or DEP determines that any of the discharges identified in Subsection C significantly contribute to pollution of the waters of the Commonwealth, the municipality or DEP will notify the responsible person(s) to cease the discharge.

Section 308. Roof Drains, Sump Pumps and Footer Drains

Roof drains, sump pumps, and footer drains should discharge to infiltration or vegetative BMPs and, to the maximum extent practicable, satisfy the criteria for DIAs. Discharges of each should be conveyed in such a manner as to not cause water problems for adjoining property owners.

Section 309. Alteration of SWM BMPs

No person shall modify, remove, fill, landscape, or alter any SWM BMPs, facilities, areas, or structures in a manner, without the written approval of (***Name of Municipality***), with the exception of necessary maintenance activities such as mowing.

ARTICLE IV - STORMWATER MANAGEMENT (SWM) SITE PLAN REQUIREMENTS

Section 401. SWM Site Plan Submission

A. When a property owner or developer proposes a Regulated Activity, said property owner or developer shall submit a SWM Site Plan to demonstrate compliance with the stormwater management provisions of this Ordinance. Said submission shall be required by (***Name of Municipality***) unless said Regulated Activity is exempted from SWM Site Plan submission in accordance with the exemption criteria and exemption approval process established in Section 302 of this Ordinance. Where (***Name of Municipality***) determines that the property owner or developer proposing the Regulated Activity is eligible to employ the process established in the Stormwater Management Design Assistance Manual (SWM Plan Appendix C) to address the stormwater management needs of a site, the submission of the required documentation from said Manual shall substitute for the SWM Site Plan requirements of this Article.

B. Copies of the SWM Site Plan shall be distributed as follows:

   1. ____ Two (2) copies to the Municipality.

   2. ____ One (1) copy to the ***(Name of Municipality)*** Engineer, when applicable.

   3. ____ One (1) copy to the Adams County Conservation District (if an NPDES permit is required).

   4. ____ One (1) copy to the Adams County Planning Commission (only if submitted as a component of a subdivision and land development plan in accordance with the ***(Name of Municipal Subdivision and Land Development Ordinance).***

C. Additional copies shall be submitted as requested by (***Name of Municipality***).

D. The property owner or developer shall submit a review fee in accordance with Article VI. Payment of the required fee shall be considered a component of the SWM Site Plan submission. The SWM Site Plan submission shall not be considered to be complete until such time that any required fee is paid.

Section 402. Plan Requirements

A. The SWM Site Plan shall include the following information. Where the Regulated Activity for which a SWM Site Plan is being submitted is also subject to subdivision and/or land development plan review in accordance with the (***Name of Municipality***)

Subdivision and Land Development Ordinance, the SWM Site Plan shall be submitted as a component of the subdivision or land development plan submission for the project and shall include the following information. Where the submission requirements of this section conflict with the submission requirements of the ***(Name of Municipal Subdivision and Land Development Ordinance)***, the submission requirements of this Ordinance shall control.

1. The name of the development, the name and address of the owner of the property, and the name and address of the individual or firm preparing the SWM Site Plan. Also to be included are the name, address, signature and seal of any registered surveyor (attesting the accuracy of the boundary survey), professional engineer, landscape architect, or professional geologist (for geomorphological assessments) contributing to and/or responsible for any aspect of the SWM Site Plan.

2. A graphic and written plan scale of one (1) inch equals no more than fifty (50) feet. For parcels of twenty (20) acres or more, the scale shall be one (1) inch equals no more than one hundred (100) feet.

3. North point (arrow).

4. Existing and proposed land uses within the project boundary plus twenty-five (25) feet outside the project boundary.

5. The location of existing and proposed utilities, stormwater facilities, sanitary sewers, and water lines within the project boundary and for the entire area within the first twenty-five (25) feet beyond the project boundary.

6. Significant physical features and associated boundary limits, including flood hazard areas, sinkholes, existing drainage courses, and areas of natural vegetation.

7. Existing and proposed structures, buildings, streets, driveways, access drives, and parking areas.

8. The SWM Site Plan shall show the locations of existing and proposed on-lot wastewater facilities and water supply wells.

9. The location of the proposed Regulated Activity relative to streets, municipal boundaries, and other significant manmade features for the entire area within the first 25 feet beyond the project boundary.

10. A determination of site conditions in accordance with the BMP Manual. A detailed site evaluation shall be completed for projects proposed in areas of carbonate geology or karst topography, as well as for other environmentally sensitive areas, whether natural or manmade, including floodplains, streams, lakes, ponds, hydric soils, wetlands, brownfields, and wellhead protection zones.

11. Stormwater runoff design computations and documentation as specified in this Ordinance, or as otherwise necessary, to demonstrate compliance with the requirements of this Ordinance.

12. The overall stormwater management concept for the project, including any additional information required for a PCSM Plan as applicable.

13. A hydrogeologic assessment of the effects of stormwater runoff on sinkholes, where present.

14. A description of permanent stormwater management techniques, including the construction specifications of the materials to be used for stormwater management facilities.

15. Plan and profile drawings of all SWM BMPs, including drainage structures, pipes, open channels, and swales.

16. Horizontal and vertical profiles of all open channels, including hydraulic capacity.

17. Proposed changes to the land surface and vegetative cover and the type and amount of existing and proposed impervious area.

18. Existing and final contours at intervals of two (2) feet. In areas of slopes in excess of fifteen percent (15%), five (5) foot contour intervals may be used.

19. Drainage flow pathways.

20. The effect of the project in terms of runoff volumes, water quality, and peak flows on surrounding properties and aquatic features and on any existing stormwater conveyance system that may be affected by the project.

21. The effect of the proposed Regulated Activity in terms of runoff volumes and peak flows on adjacent properties and/or any existing municipal stormwater collection system that may receive runoff from the project site.

22. A map showing all existing manmade features beyond the subject parcel's boundary lines that may be affected by the proposed Regulated Activities.

23. Expected project time schedule.

24. An E&S plan, where applicable, as approved by the Adams County Conservation District.

25. An NPDES Permit application, including PCSM Plan, where applicable, as administratively reviewed and approved by the Adams County Conservation District.

26. The SWM Site Plan shall include an O&M Plan for all existing and proposed physical stormwater management facilities. The plan shall address long-term ownership and maintenance responsibilities as well as schedules and estimated costs for maintenance activities. The O&M Plan shall be prepared in accordance with the requirements of Article V of this Ordinance.

27. Provisions for permanent access or maintenance easements for all physical SWM BMPs, as necessary to implement the O&M Plan

28. A note on the SWM Site Plan indicating the location, and responsibility for maintenance of, SWM facilities and/or easements that would be located on adjoining properties as a result of proposed Regulated Activities, and the location of such facilities and/or easements.

29. The following signature block shall be provided:

    (***Municipal official or designee***), on this date (***date of signature***), has reviewed and hereby certifies that the SWM Site Plan meets all design standards and criteria of ***(Name of Municipality)*** Ordinance No. (***number assigned to the Ordinance***).

Section 403. Plan Review and Approval Procedure

A. Pre-Application Meeting: Prior to proceeding with SWM Site Plan preparation and submission, the applicant is encouraged to request a pre-application meeting with ***(Name of Municipality)*** to discuss the plan concept and responsibility for submission of required documents and information. If the project requires an E&S plan or an NPDES permit, the applicant is encouraged to meet with a staff member of the Adams County Conservation District as well.

B. SWM Site Plan Review and Approval Procedure:

1. If a SWM Site Plan is not submitted as a component of a subdivision and/or land development plan, the review of the SWM Site Plan, recommendations, approval, approval with conditions, or disapproval shall occur within 45 calendar days of submission to (***Name of Municipality***). Where the applicant submits revisions to a previously submitted SWM Site Plan, either because the applicant has elected to revise the SWM Site Plan or as a result of a determination by ***(Name of Municipality)*** that a revision is necessary to meet the requirements of this Ordinance, this 45-day period shall be restarted. Should ***(Name of Municipality)*** fail to render a decision on the SWM Site Plan within this 45 day time period, the application shall be deemed approved. The review process shall include the following components.

   (Each Municipality should develop a review process and insert ordinance language describing the process here. For guidance, please see the review

process discussion in Section VII of the Adams County Stormwater Management Plan.)

2. If a SWM Site Plan is submitted as a component of a subdivision and/or land development plan, the SWM Site Plan shall be reviewed in accordance with the review process and time frame established in the ***(Name of Municipal Subdivision and Land Development Ordinance)*** and in accordance with Section 508 of the Pennsylvania Municipalities Planning Code.

3. NPDES Permit Technical Coordination: Where the project for which a SWM Site Plan is submitted is subject to NPDES permitting, ***(Name of Municipality)*** shall notify the Adams County Conservation District when the applicant has achieved technical compliance with the requirements of this Ordinance. ***(Name of Municipality)*** may address this requirement though the completion of the Technical Review Checklist for NPDES Sites in Appendix D or comparable process as determined by ***(Name of Municipality).*** Upon receipt of this notification, the Adams County Conservation District will acknowledge a General NPDES permit. In the case of an Individual NPDES permit, the Adams County Conservation District will coordinate municipal reviews with the DEP Regional Office.

4. NPDES Permits and E&S Plans: Where the project for which a SWM Site Plan is submitted is subject to NPDES permitting or the submission of an E&S Plan, or both, any final approval of the SWM Site Plan by ***(Name of Municipality)*** shall be conditioned on the applicant's receipt of the required NPDES Permit or E&S Plan approval, as appropriate.

5. Decision Notification Procedure: In all cases, the decision of the ***(Name of Municipal Governing Body)*** to approve, approve with conditions, or disapprove the SWM Site Plan shall be in writing and shall be delivered to the applicant no later than fifteen (15) calendar days following the decision. If the SWM Site Plan is disapproved, the written decision by the ***(Name of Municipal Governing Body)*** shall specify the defects in the application, describe the requirements which were not met, and shall cite the provisions of the Ordinance relied upon. If the SWM Site Plan is approved with conditions, the notification to the applicant shall state the acceptable conditions for approval and the time limit for satisfying such conditions. Should ***(Name of Municipality)*** fail to notify the applicant of the decision within this fifteen (15) calendar day period, the application shall be deemed approved.

C. Waiver Requests:

1. If a SWM Site Plan is not submitted as a component of a subdivision and/or land development plan, the ***(Name of Municipal Governing Body)*** may accept a request for waiver of one or more of the requirements of this Ordinance. Any such waiver requests shall comply with the following requirements.

a. The ***(Name of Municipal Governing Body)*** may accept a request for waiver of the requirements of one or more provisions of this Ordinance if the literal enforcement will enact undue hardship because of peculiar conditions pertaining to the land in question, provided that ***(Name of Municipality)*** determines that such waiver will not be contrary to the public interest and that the purpose and intent of the Ordinance is observed.

b. All requests for waivers from an applicant shall be in writing and shall accompany and be a part of the application for approval of a SWM Site Plan. The request shall state in full the grounds and facts of unreasonableness or hardship on which the request is based, the provision or provisions of the Ordinance involved, and the minimum waiver necessary to afford relief.

2. The ***(Name of Municipal Governing Body)*** shall act to accept or reject requests for waivers within the context of its SWM Site Plan decision-making process established in Section 403.B.1 of this Ordinance. The decision of the ***(Name of Municipal Governing Body)*** regarding acceptance of each request for waiver shall be incorporated into the written decision of the ***(Name of Municipal Governing Body)*** for the overall SWM Site Plan as required in Section 403.B.3 of this Ordinance. The ***(Name of Municipal Governing Body)*** shall keep a written record of all action on requests for waivers.

3. If a SWM Site Plan is submitted as a component of a subdivision and land development plan, requests for waiver to obtain relief from one or more of the requirements of this Ordinance shall be handled in accordance with the modification process established in the ***(Name of Municipal Subdivision and Land Development Ordinance)*** and Section 512.1 of the Pennsylvania Municipalities Planning Code.

4. The final decision to approve or disapprove all accepted requests for waiver shall be made in accordance with Section 301.L.

Section 404. Revision of Plans

A. SWM Site Plan not Submitted as a Component of a Subdivision and/or Land Development Plan: Revisions to a previously approved SWM Site Plan to incorporate a change in SWM BMPs or techniques, or the relocation or redesign of SWM BMPs, or different information about soil or other conditions from what was stated in the SWM Site Plan, shall be submitted by the applicant to (***Name of Municipality***). ***(Name of Municipality),*** at its sole discretion may require a re-submission of the revised SWM Site Plan in accordance with this Ordinance, including applicable review fee. For NPDES permitted sites, any revised SWM Site Plan shall be re-submitted to the Adams County Conservation District for its review.

In the case of a SWM Site Plan which contains minor deficiencies (such as a missing label, omission of a required note or minor construction detail). At its sole discretion, ***(Name of Municipality)*** may accept a re-submission of such SWM Site Plan without the requirement of a full review fee, or a lesser fee, as determined by ***(Name of Municipality).***

B. SWM Site Plan Submitted as a Component of a Subdivision and/or Land Development Plan: A revision of an SWM Site Plan approved as a component of a subdivision and/or land development plan shall be treated as a revision of the subdivision and/or land development plan and shall be subject to the review process established in the ***(Name of Municipal Subdivision and Land Development Ordinance).***

Section 405. Re-submission of Disapproved SWM Site Plans

A. SWM Site Plan not Submitted as a Component of a Subdivision and/or Land Development Plan. A previously disapproved SWM Site Plan may be resubmitted with the revisions addressing the defects of the original submission as listed in (***Name of Municipality***) Decision Notification provided in accordance with Section 403.B.1.e. The re-submitted SWM Site Plan shall be reviewed and acted upon in accordance with Section 403.B.1 of this Ordinance. The applicable review fee must accompany the submission of a revised SWM Site Plan, unless such fee is waived by (***Name of Municipality***).

B. SWM Site Plan Submitted as a Component of a Subdivision and/or Land Development Plan: The resubmission of the SWM Site Plan originally submitted as a component of a subdivision and/or land development plan shall be treated as resubmission of said subdivision and/or land development plan and shall be subject to the review process established in the ***(Name of Municipal Subdivision and Land Development Ordinance)***.

Section 406. Authorization to Construct and Term of Validity

A. SWM Site Plans not Submitted as a Component of a Subdivision and/or Land Development Plan - (***Name of Municipality***) approval of a SWM Site Plan, when such Plan is not submitted as a component of a subdivision and/or land development plan, authorizes the Regulated Activities contained in the SWM Site Plan for a maximum term of validity of five (5) years following the date of approval. (***Name of Municipality***) may specify a term of validity shorter than five (5) years in the Decision Notification for any specific SWM Site Plan, particularly if the nature of the proposed SWM facilities requires more frequent maintenance and/or short-term replacement of certain components. Terms of validity shall commence on the date (***Name of Municipality***) signs the Decision Notification for an SWM Site Plan. If an approved SWM Site Plan is not completed according to Section 407 within the term of validity, (***Name of Municipality***), and if a request to extend the permit has not been submitted to ***(Name of Municipality)*** by the applicant, the permit terminates and

(Name of Municipality) may revoke any and all permits applicable to the project. SWM Site Plans for projects with expired permits may be resubmitted in accordance with Section 405 of this Ordinance.

B. SWM Site Plans Submitted as a Component of a Subdivision and/or Land Development Plan - (***Name of Municipality***) approval of a SWM Site Plan as a component of a subdivision and/or land development plan is subject to the term of validity as specified in the (***Name of Municipality***) Subdivision and Land Development Ordinance.

Section 407. Final Inspection, Completion Certificate, and As-Built Plans

(*The Municipality may wish to consider including language regarding inspection during the construction of BMPs on those sites that do not require an NPDES permit)*

A. The stormwater management facilities constructed in accordance with a SWM Site Plan not submitted as a component of a subdivision and/or land development plan shall be subject to the following process upon the completion of construction of said facilities.

1. The property owner or developer shall contact (***Name of Municipality***) within seven (7) days of the completion of the construction process to schedule a Final Inspection. The Final Inspection shall be conducted by the (***Name of Municipality***)

2. The (***Name of Municipality***) may inspect the completed improvements to confirm consistency with the approved SWM Site Plan. Following the inspection, if any, the (***Name of Municipality***) may take one of the following two actions.

    a. Issue a Completion Certificate: A Completion Certificate may be issued when the (***Name of Municipality***) determines that the stormwater management facilities have been constructed in conformance with the approved SWM Site Plan.

    b. Issue Correspondence Regarding Discrepancies: If (***Name of Municipality***) determines that the stormwater management facilities have not been constructed in accordance with the approved SWM Site Plan, (***Name of Municipality***) shall issue correspondence addressed to the property owner or developer summarizing the discrepancies from the approved SWM Site Plan. Such correspondence does not by itself constitute an extension of any applicable SWM Permit.

3. Upon receipt of correspondence summarizing discrepancies in the constructed stormwater facilities, the property owner or developer shall, apply for permit extensions when necessary, and take one of the following two actions.

a. Reconstruct the required stormwater management facilities in a manner that complies with the approved SWM Site Plan. Upon completion of the reconstruction work, the property owner or developer shall contact the municipality for a subsequent Final Inspection in accordance with the process established in Section 407.A.1.

b. Submit a revised SWM Site Plan in accordance with the process established in Section 404.A. The revised SWM Site Plan shall be consistent with the improvements as constructed. Upon receipt, (***Name of Municipality***) may review the revised SWM Site Plan in accordance with the review and approval process of Section 403. If the revised SWM Site Plan is approved, (***Name of Municipality***) shall issue the Completion Certificate. If the revised SWM Site Plan fails to demonstrate that the constructed stormwater management facilities can comply with the requirements of this Ordinance, (***Name of Municipality***) may then require the property owner or developer to reconstruct the required stormwater facilities in accordance with the originally approved SWM Site Plan. If the revised SWM Site Plan is approved, (***Name of Municipality***) shall then issue the Completion Certificate.

4. Within fifteen (15) days of the Completion Certificate, the property owner or developer shall submit to (***Name of Municipality***) an As-Built Plan depicting the stormwater management facilities as constructed. If requested by the applicant, ***(Name of Municipality)*** may grant an extension of the deadline to submit As-Built Plans.

B. The stormwater management facilities constructed in accordance with a SWM Site Plan submitted as a component of a subdivision and/or land development plan shall be subject to the completion of improvements requirements of the ***(Name of Municipal Subdivision and Land Development Ordinance)*** and Sections 509 through 511 of the Pennsylvania Municipalities Planning Code.

ARTICLE V - OPERATION AND MAINTENANCE

Section 501. Determination of Ownership and Maintenance Responsibility

A. The ***(Name of Municipal Elected Body)*** shall make the final determination on the continuing operation and maintenance responsibilities prior to final approval of the SWM Site Plan. The ***(Name of Municipal Elected Body)*** may require a dedication of such facilities as part of the requirements for approval of the SWM Site Plan. (***Name of Municipality***) shall not be obligated to accept the facilities if offered for dedication. The ***(Name of Municipal Elected Body)*** reserves the right to accept or reject the ownership, maintenance, and operating responsibility for any portion of the stormwater management facilities and controls.

B. If the ***(Name of Municipal Elected Body)*** accepts dedication of any or all stormwater management facilities associated with a project, (***Name of Municipality***) shall operate and maintain said facilities in accordance with the approved O&M Plan.

C. If the ***(Name of Municipal Elected Body)*** does not accept dedication of some or all of the stormwater management facilities associated with a project, the property owner shall sign an O&M Agreement in accordance with Section 502 of this Ordinance. The Municipality shall not approve the SWM Site Plan before the owner signs the O&M Agreement.

Section 502. Operation and Maintenance Agreements

A. Prior to final approval of the SWM Site Plan, the property owner shall sign and record an O&M Agreement binding the property owner to conduct all maintenance activities identified in the approved O&M Plan for all stormwater control facilities which are to be privately owned.

1. The property owner, heirs, successors and assigns shall maintain all facilities in accordance with the approved maintenance schedule in the O&M Plan.

2. The property owner shall provide to (***Name of Municipality***) easements to ensure access for periodic inspections and maintenance by ***(Name of Municipality),*** as necessary.

3. The property owner shall keep on file with (***Name of Municipality***) the name, address, and telephone number of the person or company responsible for maintenance activities. In the event of a change, new information shall be submitted by the property owner to (***Name of Municipality***) within ten (10) working days of the change.

4. The O&M Plan shall be recorded with the Adams County Recorder of Deeds.

B. The owner is responsible for operation and maintenance of the SWM BMPs. If the owner fails to adhere to the O&M Agreement or the O&M Plan, (***Name of Municipality***) may perform the services required and charge the owner appropriate fees. Nonpayment of fees, costs and other expenses incurred in the performance of services required may result in a municipal lien against the property.

Section 503. Performance Guarantee

For SWM Site Plans submitted as a component of a subdivision and/or land development plan, the property owner or developer shall provide a financial guarantee to (***Name of Municipality***) for the timely installation and proper construction of all stormwater management controls as required by the approved SWM Site Plan and this Ordinance in accordance with the completion of improvements requirements of the ***(Name of Municipal Subdivision and Land Development Ordinance)*** and the provisions of Sections 509 through 511 of the Pennsylvania Municipalities Planning Code.

ARTICLE VI - FEES AND EXPENSES

Section 601. General

A. The ***(Name of Municipal Elected Body)*** shall, by resolution, establish a fee schedule to defray costs incurred by (***Name of Municipality***) associated with the administration and enforcement of this Ordinance.

B. The applicant shall be responsible for the payment of all fees, costs, and other expenses incurred in the submission, review, and decision on SWM Site Plans and/ or other submissions pursuant to this ordinance.

Section 602. Expenses Covered by Fees

The fee(s) may include, but are not limited to, costs for the following:

A. Administrative, clerical, and legal costs.

B. Review of the SWM Site Plan and reports by (***Name of Municipality***) and representatives or counselors of the Municipality.

C. Attendance at meetings by (***Name of Municipality***) and representatives and counselors of the Municipality, as may be necessary.

D. Various Inspections (such as during construction and after construction) by (***Name of Municipality***) or its representatives.

E. Any additional work required to enforce any provision (s) regulated by this Ordinance, correct violations, and ensure proper completion of stipulated remedial actions.

ARTICLE VII - ENFORCEMENT AND PENALTIES

Section 701. Municipal Inspection

A. Upon presentation of proper credentials, (***Name of Municipality***) officials or their designee may enter at reasonable times upon any property within (***Name of Municipality***) to inspect the condition of the stormwater structures and facilities in regard to any aspect regulated by this Ordinance.

B. Inspections regarding compliance with the SWM Site Plan may be conducted by the Municipality at any time when there may be a question of compliance with the approved SWM Site Plan, the approved O&M Plan, or when any condition exists that may threaten public health, safety, or welfare.

Section 702. Owner Inspection

A. SWM BMPs shall be inspected by the landowner, or landowner's designee (which shall include ***(Name of Municipality)*** where such facilities have been dedicated to ***(Name of Municipality)***), or the owner's designee, according to the following list of minimum frequencies:

1. Annually for the first five (5) years.

2. Once every three (3) years thereafter.

3. During or immediately after the cessation of a ten (10)-year or greater storm, i.e., a storm of an estimated frequency of recurrence of ten (10) years or greater interval of time.

4. At any other interval as may be specified in the approved O&M Agreement.

(***Municipalities may decide how, when, and in what form they would like inspection records and include in Section 702)***

Section 703. Suspension or Revocation of SWM Site Plan Approval

A. Any SWM Site Plan approval issued by (***Name of Municipality***) pursuant to this Ordinance may be suspended or revoked for any of the following reasons.

1. Non-compliance with or failure to implement any provision of the approved SWM Site Plan or O&M Plan.

2. A violation of any provision of this Ordinance or any other applicable law, ordinance, rule, or regulation relating to the Regulated Activity.

3. The creation of any condition or the conduct of any Regulated Activity which constitutes or creates a hazard, nuisance, pollution, or endangers life or property.

B. A suspended SWM Site Plan approval may be reinstated by the ***(Name of Municipal Elected Body)*** when the following conditions are met.

1. (***Name of Municipality***) officials or their designee(s) have inspected and approved the corrections to the violations that caused the suspension.

2. The ***(Name of Municipal Elected Body)*** is satisfied that the violation has been corrected.

C. An SWM Site Plan approval that has been revoked by the ***(Name of Municipal Elected Body)*** shall not be reinstated. The applicant may apply for a new SWM Site Plan approval under the provisions of this Ordinance.

D. If a violation causes no immediate danger to life, public health, or property, the ***(Name of Municipal Elected Body)*** may, at its sole discretion, provide a limited time period for the owner to correct the violation. In these cases, the ***(Name of Municipal Elected Body)*** will provide the owner, or the owner's designee, with a written notice of the violation and the time period allowed for the owner to correct the violation. If the owner does not correct the violation within the allowed time period, the municipality may revoke or suspend any, or all, applicable approvals and permits pertaining to any provision of this Ordinance.

Section 704. Enforcement

(***Name of Municipality***) may institute injunctive, mandamus, or any other appropriate action or proceeding at law or in equity for the enforcement of this Ordinance when (***Name of Municipality***) determines that a property owner or developer has initiated a Regulated Activity without receiving SWM Site Plan approval, that a property owner or developer has failed to comply with an approved SWM Site Plan or approved O&M Plan, or that a property owner or developer has violated any other provision of this Ordinance. Any court of competent jurisdiction shall have the right to issue restraining orders, temporary or permanent injunctions, mandamus or other appropriate forms of remedy or relief.

Section 705. Penalties

(***Municipalities should confer with their solicitors to provide appropriate wording and a judgment amount for this section.***)

A. Anyone violating the provisions of this Ordinance shall be guilty of a summary offense, and upon conviction, shall be subject to a fine of not more than ***(List Dollar Amount)*** for each violation, recoverable with costs. Each day that the violation continues shall be a separate offense and penalties shall be cumulative.

B. In addition, the municipality may institute injunctive, mandamus, or any other appropriate action or proceeding at law or in equity for the enforcement of this Ordinance. Any court of competent jurisdiction shall have the right to issue restraining orders, temporary or permanent injunctions, mandamus, or other appropriate forms of remedy or relief.

Section 706. Appeals

A. Any person aggrieved by any action of (***Name of Municipality***) or its designee, relevant to the enforcement of the provisions of this Ordinance, may appeal said action to the ***(Name of Municipal Elected Body)*** within thirty (30) days of that action.

B. Any person aggrieved by any decision of the ***(Name of Municipal Elected Body)*** regarding the appeal of any action of (***Name of Municipality***) or its designee, may appeal the decision to the Adams County Court of Common Pleas within thirty (30) days of the decision of the ***(Name of Municipal Elected Body).***

ARTICLE VIII: ENACTMENT

(Municipality will add appropriate language and signatory lines)

APPENDIX A

OPERATION AND MAINTENANCE (O&M) AGREEMENT

STORMWATER MANAGEMENT BEST MANAGEMENT

PRACTICES (SWM BMPs)

THIS AGREEMENT, made and entered into this _____ day of _____, 20_____, by and between _____, (hereinafter the "Landowner"), and _____, Adams County, Pennsylvania, (hereinafter "Municipality");

WITNESSETH

WHEREAS, the Landowner is the legal or equitable owner of certain real property as recorded by deed in the land records of Adams County, Pennsylvania, Deed Book _____ at page__, (hereinafter "Property").

WHEREAS, the Landowner is proceeding to build and develop the Property; and

WHEREAS, the SWM BMP Operation and Maintenance (O&M) Plan approved by the Municipality (hereinafter referred to as the "O&M Plan") for the property identified herein, which is attached hereto as Appendix A and made part hereof, as approved by the Municipality, provides for management of stormwater within the confines of the Property through the use of BMPs; and

WHEREAS, the Municipality, and the Landowner, his successors 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 SWM BMPs be constructed and maintained on the Property; and

WHEREAS, the Municipality requires, through the implementation of the SWM Site Plan, that SWM BMPs as required by said SWM Site Plan and the Municipal Stormwater Management Ordinance be constructed and adequately operated and maintained by the Landowner, successors, and assigns.

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 Landowner shall construct, or cause the construction of, the BMPs in accordance with the plans and specifications identified in the SWM Site Plan.

2. The Landowner shall operate and maintain the BMPs as shown on the SWM Plan in good working order in accordance with the specific operation and maintenance requirements noted on the approved O&M Plan.

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 credentials, to inspect the BMPs whenever the Municipality deems it appropriate. Whenever possible, the Municipality shall notify the Landowner prior to entering the property.

4. In the event the Landowner fails to operate and maintain the BMPs as provided in the O&M Plan, the Municipality or its representatives may 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.

5. 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 ten (10) days of receipt of invoice from the Municipality.

6. The intent and purpose of this Agreement is to ensure the proper maintenance of the onsite BMPs 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, and other successors in interests, shall release the Municipality 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.

8. The Municipality intends to inspect the BMPs at a minimum of once every three (3) years to ensure their continued functioning.

This Agreement shall be recorded at the Office of the Recorder of Deeds of Adams 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:

For the Landowner:

ATTEST:

_____(City, Borough, Township)
County of Adams, 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)**

APPENDIX B

NOXIOUS AND INVASIVE PLANT CONTROL

A list of noxious and invasive plants in Pennsylvania may be found in several locations:

The Pennsylvania Code
7 Pa. Code § 110. Noxious Weeds

§ 110.1. Noxious weed control list.

Under section 3(b) of the Noxious Weed Control Law (3 P. S. § 255.3(b)), the Noxious Weed Control Committee establishes the following noxious weed control list:

(1) *Cannabis sativa*, commonly known as marijuana.
(2) The *Lythrum salicaria* Complex: Any nonnative *Lythrum* including, *Lythrum salicaria* and *Lythrum virgatum*, their cultivars and any combination thereof.
(3) *Cirsium arvense*, commonly known as Canadian thistle.
(4) *Rosa multiflora*, commonly known as multiflora rose.
(5) *Sorghum halepense*, commonly known as Johnson grass.
(6) *Carduus nutans*, commonly known as musk thistle.
(7) *Cirsium vulgare*, commonly known as bull thistle.
(8) *Datura stramonium*, commonly known as jimson weed.
(9) *Polygonum perfoliatum*, commonly known as mile-a-minute.
(10) *Puerria lobata*, commonly known as kudzuvine.
(11) *Sorghum bicolor* cv. *drummondii*, commonly known as shattercane.
(12) *Heracleum mantegazzianum*, commonly known as Giant Hogweed.
(13) *Galega officinalis*, commonly known as Goatsrue.

Pennsylvania Department of Conservation and Natural Resources (DCNR)

The PA Department of Conservation and Natural Resources (DCNR) lists Invasive Exotic Plants in Pennsylvania on their website:
http://www.dcnr.state.pa.us/forestry/invasivetutorial/List.htm

A copy of the (DCNR) publication "Invasive Plants in Pennsylvania" (rev. 2006) may be found on their web site: www.dncr.state.pa.us

A listing of plants is included on the following page.

Invasive Plants in Pennsylvania

The species below are serious threats to our native ecosystems. Many have been designed as "Noxious Weeds" by the PA Department of Agriculture and are also a major concern to our agricultural community.

SCIENTIFIC NAME	COMMON NAME	PLANT FORM	NOTES
Aegopodium podagraria	Goutweed	Flower	Commonly planted in the past and escaped; spreads aggressively by roots
Alliaria petiolata	Garlic mustard	Flower	Invasive in many states; spreading aggressively in woodlands by seed
Carduus nutans	Musk thistle	Flower	PA Noxious Weed
Cirsium arvense	Canada thistle	Flower	PA Noxious Weed
Cirsium vulgare	Bull thistle	Flower	PA Noxious Weed
Datura stramonium	Jimsonweed	Flower	Sometimes cultivated; spreads by seed, PA Noxious Weed
Galega officinalis	Goatsrue	Flower	PA and Federal Noxious Weed
Heracleum mantegazzianum	Giant hogweed	Flower	PA and Federal Noxious Weed; sap can cause burning blisters
Hesperis matronalis	Dame's rocket	Flower	Planted in gardens; escaped and naturalized along roads; spreads by seed
Lythrum salicaria, L. virgatum	Purple loosestrife	Flower	Garden escape which has become invasive in many states; PA Noxious weed
Myriophyllum spicatum	Eurasian water-milfoil	Flower	Invasive in many states; aquatic
Ornithogalum nutans, umbellatum	Star-of-Bethlehem	Flower	Common garden plant which has widely escaped
Pastinaca sativa	Wild parsnip	Flower	Found commonly along roadsides; widespread and abundant; spread by seed
Perilla frutescens	Beefsteak plant	Flower	Garden escape; widespread mostly along roadsides; spreads by seed
Polygonum (Falopia) cuspidatum	Japanese knotweed	Flower	Invasive in many states; difficult to control; spreads by roots and seeds
Ranunculus ficaria	Lesser celandine	Flower	Spreads by roots and shoots; can be very aggressive in wetlands
Trapa natans	Water chestnut	Flower	Wetland plant; should not be introduced as it will escape, spread, and naturalize
Bromus tectorum	Cheatgrass	Grass	Annual grass; very invasive throughout the west; spreads by seed
Microstegium vimineum	Japanese stilt grass	Grass	Annual grass; invasive in many states; spreading through woodlands by seed
**Miscanthus sinensis*	Maiden grass	Grass	Commonly planted ornamental grass which can escape and spread by seed
Phalaris arundinacea	Reed canary grass	Grass	Aggressive wetland grass; native and introduced strains; widespread and abundant
Phragmites australis	Common reed	Grass	Native and introduced strains; wetland grass which can form huge colonies
Sorghum bicolor ssp. drummondii	Shattercane	Grass	Grass; PA noxious weed
Sorghum halepense	Johnson grass	Grass	Grass; PA noxious weed; spreads by roots and seeds
**Berberis thunbergii*	Japanese barberry	Shrub	Escaped from cultivation and invasive in many states; spread by birds
Berberis vulgaris	European barberry	Shrub	Escaped from cultivation; spread by birds
Elaegnus angustifolia	Russian olive	Shrub	Escaped from plantings and invasive in many states; spread by birds
Elaeagnus umbellata	Autumn olive	Shrub	Escaped from plantings and invasive in many states; rapidly spread by birds
**Euonymus alatus*	Winged Euonymus	Shrub	Escaped from plantings; invasive in moist forests
Ligustrum obtusifolium	Border privet	Shrub	Escaped from cultivation; seeds spread by birds
Ligustrum vulgare	Common privet	Shrub	Planted very commonly in the past and escaped; invasive in many states
Lonicera maackii	Amur honeysuckle	Shrub	Escaped from plantings; seeds spread by birds
Lonicera morrowii	Morrow's honeysuckle	Shrub	Escaped from plantings and invasive in many states; seeds spread by birds
Lonicera morrowii x tatarica	Bell's honeysuckle	Shrub	Escaped from cultivation
Lonicera standishii	Standish honeysuckle	Shrub	Escaped from plantings; seeds spread by birds
Lonicera tatarica	Tartarian honeysuckle	Shrub	Escaped from plantings; seeds spread by birds
Rhamnus catharticus	Common buckthorn	Shrub	Becoming a problem in PA
Rhamnus frangula	Glossy buckthorn	Shrub	Becoming a problem in PA
Rosa multiflora	Multiflora rose	Shrub	Invasive in many states; seeds spread by birds; PA noxious weed
Rubus phoenicolasius	Wineberry	Shrub	Common bramble; not cultivated; spreads by seed
**Spiraea japonica*	Japanese spiraea	Shrub	Frequently planted; escaped in some areas
**Viburnum opulus var. opulus*	Guelder rose	Shrub	Resembles native *Viburnum trilobum* which it replaces; both are cultivated and planted
**Acer platanoides*	Norway maple	Tree	Commonly planted and escaped; invasive in many states; wind spreads prolific seeds
Acer pseudoplatanus	Sycamore maple	Tree	Escaped from cultivation ; wind spreads prolific seeds
Ailanthus altissima	Tree-of -heaven	Tree	Invasive in many states; wind spreads prolific seeds
Paulownia tomentosa	Empress tree	Tree	Prolific seeds fall to start new seedlings
**Pyrus calleryana*	Callery pear	Tree	Commonly planted street tree; becoming a problem as an escape
Ulmus pumila	Siberian elm	Tree	Escaped from cultivation
Akebia quinata	Fiveleaf akebia	Vine	Escaped from cultivation and becoming a major problem in the Philadelphia area
Ampelopsis brevipedunculata	Porcelain-berry	Vine	Escaped from cultivation; spread by birds
Celastrus orbiculatus	Oriental bittersweet	Vine	Escaped from cultivation and invasive in many states; spreading rapidly (by birds)
Lonicera japonica	Japanese honeysuckle	Vine	Invasive in many states
Polygonum perfoliatum	Mile-a-minute vine	Vine	Range expanding, PA Noxious weed
Pueraria lobata	Kudzu	Vine	Invasive in many states; PA Noxious weed

This list of invasive species is not meant to be definitive, but rather a guideline to some of the most troublesome species that degrade native plant communities in Pennsylvania. These species were chosen from a more extensive list compiled from adjacent state or regional lists of invasive plant species. Input was sought from experienced individuals familiar with Pennsylvania's flora from a field perspective. For a more extensive list of invasive species, please contact DCNR, Bureau of Forestry, P.O. Box 8552, Harrisburg, PA 17105-8552.

SITUATIONAL INVASIVES: Some plants become problematic invasive species to a given area. For example, some species are commonly planted for quick groundcover but can be a serious problem when planted, seeded or discarded near native herbaceous communities. These situational invasives require greater care and monitoring when planted near native plant communities. These species include: ***Crown-Vetch, Coronilla varia; English Ivy, Hedera heli; *Tall fescue, Festuca elatior;*** ***Orange day-lily,** ***Hemerocallis fulva,periwinkle, Vinca minor; and Chinese and Japanese wisteria, wisteria sinemsis and w. floridbunda.***

(ASTERIX): An **asterix (*)** denotes that the species has cultivars that are not known to be invasive. Cultivars are cultivated varieties of plant species bred for predictable attributes like shorter height, showier flowers, or colored foliage. An example is Norway Maple 'Crimson King' grown for its reddish leaves; this cultivar is not known to be invasive. Another example are the day lilies which have a host of cultivars that are not known as invasives. If you choose to plant a cultivar of an invasive species, ask a PA certified horticulturalist (PCH), your Penn State extension agent, or a professional horticulturalist about the cultivar's potential to be invasive.

APPENDIX C

TECHNICAL REVIEW CHECKLIST (OPTIONAL)

THESE CHECKLISTS WERE DEFVELOPED TO BE UTILIZED BY CONSERVATION DISTRICTS FOR NPDES SITES

Technical Review

Project Name: _____

Applicant: _____

Document#: _____

Written Narrative

☐ Calculations for permanent stormwater BMPs are consistent with the E&S Report

☐ Curve numbers are consistent with Stormwater BMP Manual or stormwater methodology used

Infiltration:

☐ Infiltration/Geotechnical Report has addressed the following
- ☐ Water Re-use
- ☐ Infiltration
- ☐ If unable to infiltrate, explanation of site-specific constraints

☐ Elevation of each infiltration test provided

☐ Elevation of bottom of each infiltration BMP is provided (in report or on drawings)

☐ Summary of pervious and impervious areas for each infiltration BMP provided

☐ Summary of pre-development and post-development runoff volume for each infiltration BMP provided

☐ Infiltration period provided (not to exceed 72 hours from the end of the design storm)

☐ Infiltration rates **including the safety factor and reduction factor** are not less than 0.05 and inches per hour

Worksheets:

Stormwater calculation volume control credits and criteria – worksheets from Chapter 8.8 of the BMP manual must be provided as applicable.

☐ Worksheet 1 – General Site information, provided and appears to be completed properly

☐ Worksheet 2, appears to be completed properly

☐ Worksheet 3, appears to be completed properly

Volume Control Guideline 1 – Flow Chart B

☐ Worksheet 4, appears to be completed properly

☐ Worksheet 5, appears to be completed properly

☐ Worksheet 6, appears accurate

Water Quality Calculations – Flow Chart D (if needed)

☐ Worksheet 10 appears to be completed properly

Plans/Drawings

☐ PCSM Plan legend meets the E&S Standards for Maps and Drawing requirements

☐ Proposed limits of disturbance on PCSM and E&S Plans are consistent

☐ All details for permanent stormwater BMPs are consistent with E&S Plan

☐ PCSM Plan is consistent with the information as provided in the PCSM report and NOI

☐ Locations of infiltration testing represents locations of proposed BMPs

The following features are identified on plans:

Existing	Proposed	
☐	☐	Labeled Contours
☐	☐	Roads
☐	☐	Buildings
☐	☐	Utilities
☐	☐	BMPs
☐	☐	Channels
☐	☐	Floodplains
☐	☐	Floodways
☐	☐	Stormwater Systems
☐	☐	Streams
☐	☐	Watercourses
☐	☐	Water Bodies
☐	☐	Wetlands

☐ Proposed features on PCSM Plan and E&S Plan are consistent

☐ Wetland Boundaries on PCSM Plan and E&S Plan are consistent

☐ Will the runoff impact the hydrology of any EV wetlands? ☐ Yes ☐ No

Ownership, Operations and Maintenance Procedures

☐ Inspection Schedule of each BMP is provided

☐ Directions for maintenance and/or replacement of each BMP are provided

☐ Directions for sediment disposal are provided

Technical Review

Project Name: _____

Applicant: _____

Document#: _____

Written Narrative

☐ Routing analysis to demonstrate peak control for the 2-year through 100-year storm events appears to be adequate to control peak flows. *(Routing should consider the benefits of BMPs)*

☐ Special Conditions stated in report as required may be conditions of the permit. *(Items used by the consultant may need to be added as a special condition to the permit. It should be at the discretion of the DEP regional office.)*

Infiltration:

☐ Infiltration calculations include a safety factor

Thermal Impact Analysis:

☐ Applicant has adequately addressed thermal impacts of stormwater runoff from the project's impervious surfaces in order to manage, avoid, and minimize or mitigate thermal impacts to surface waters.

Worksheets:

Volume Control Guideline 1 – Flow Chart B

☐ 5.4.1 – Protect Sensitive/ Special Value Features has been addressed

☐ 5.4.2 – Protect/Conserve/enhance Riparian Areas has been addressed

☐ 5.4.3 – Protect/Utilize Natural Flow pathways in Overall Stormwater Planning Design has been addressed

☐ 5.6.1 – Minimize Total Disturbed Area-Grading has been addressed

☐ 5.6.2 – Minimize Soil Compaction in Disturbed Areas has been addressed

☐ 5.6.3 – Re-vegetate and Re-Forest Disturbed Areas, Using native Species has been addressed

☐ 5.8.1 – Rooftop Disconnection has been addressed

☐ 5.8.2 – Disconnect from Storm Sewers has been addressed

Water Quality Calculations – Flow Chart D (if needed)

☐ Worksheet 11, appears to be completed properly

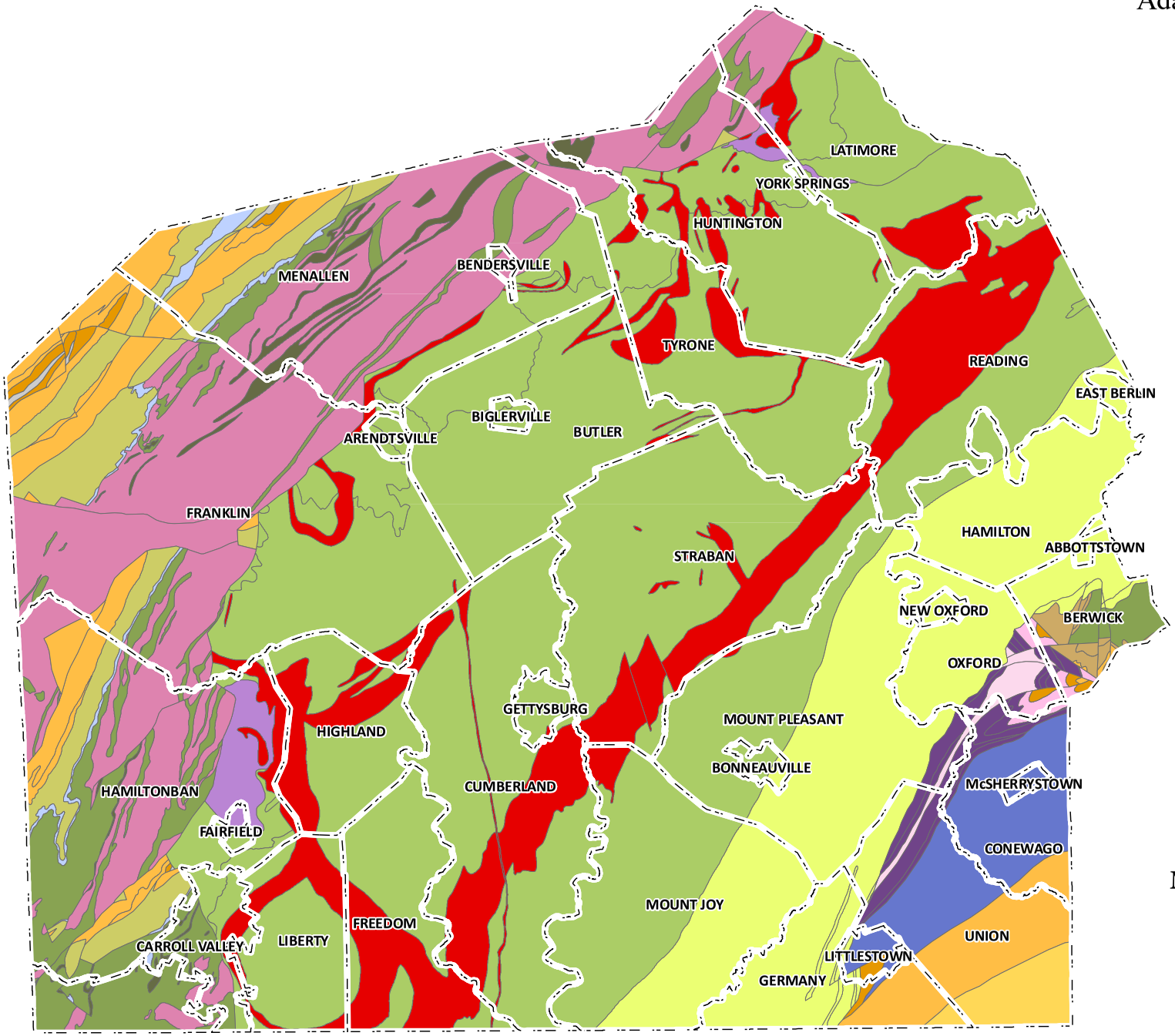
☐ Worksheet 12, appears to be completed properly

☐ Worksheet 13, appears to be completed properly

Appendix B
Maps

Geology

Adams County, Pennsylvania



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- Diabase
- Gettysburg Formation
- New Oxford Formation
- Beekmantown Group
- Conestoga Formation
- Ledger Formation
- Kinzers Formation
- Tomstown Formation
- Vintage Formation
- Antietam Formation
- Harpers Formation
- Weverton Formation
- Chickies Formation
- Loudoun Formation
- Marburg Schist
- Metabasalt
- Metarhyolite
- Greenstone Schist

Miles

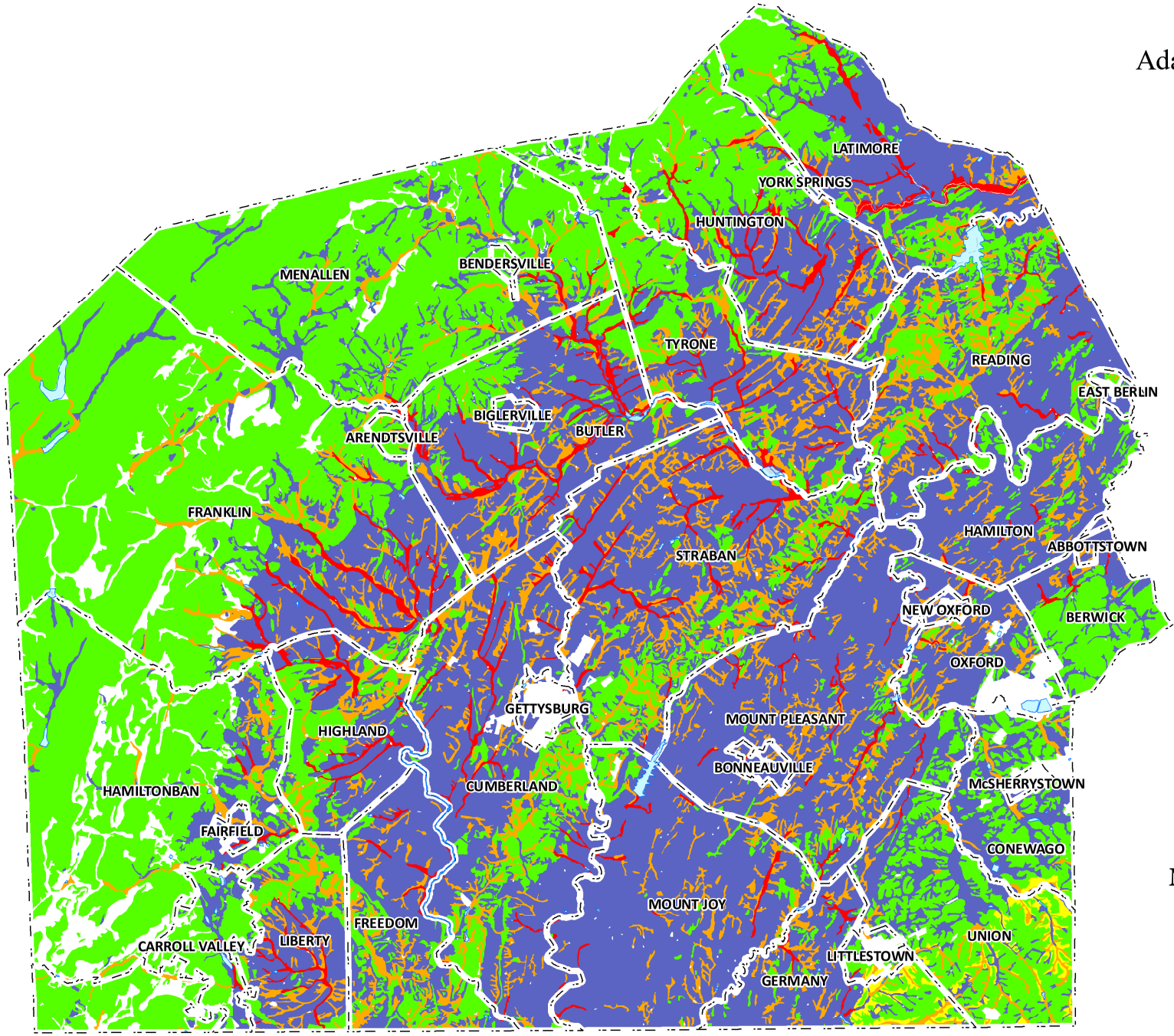
0 1 2 4

ADAMS COUNTY STORMWATER MANAGEMENT PLAN

Prepared By: Adams County Office of Planning & Devpt, June 2011
GIS Data Provided by Adams County GIS/ Mapping Office

Hydrologic Soil Group

Adams County, Pennsylvania



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Hydrologic Soil Group

- A
- B
- B/D
- C
- D
- Undefined
- Waterbody

Miles

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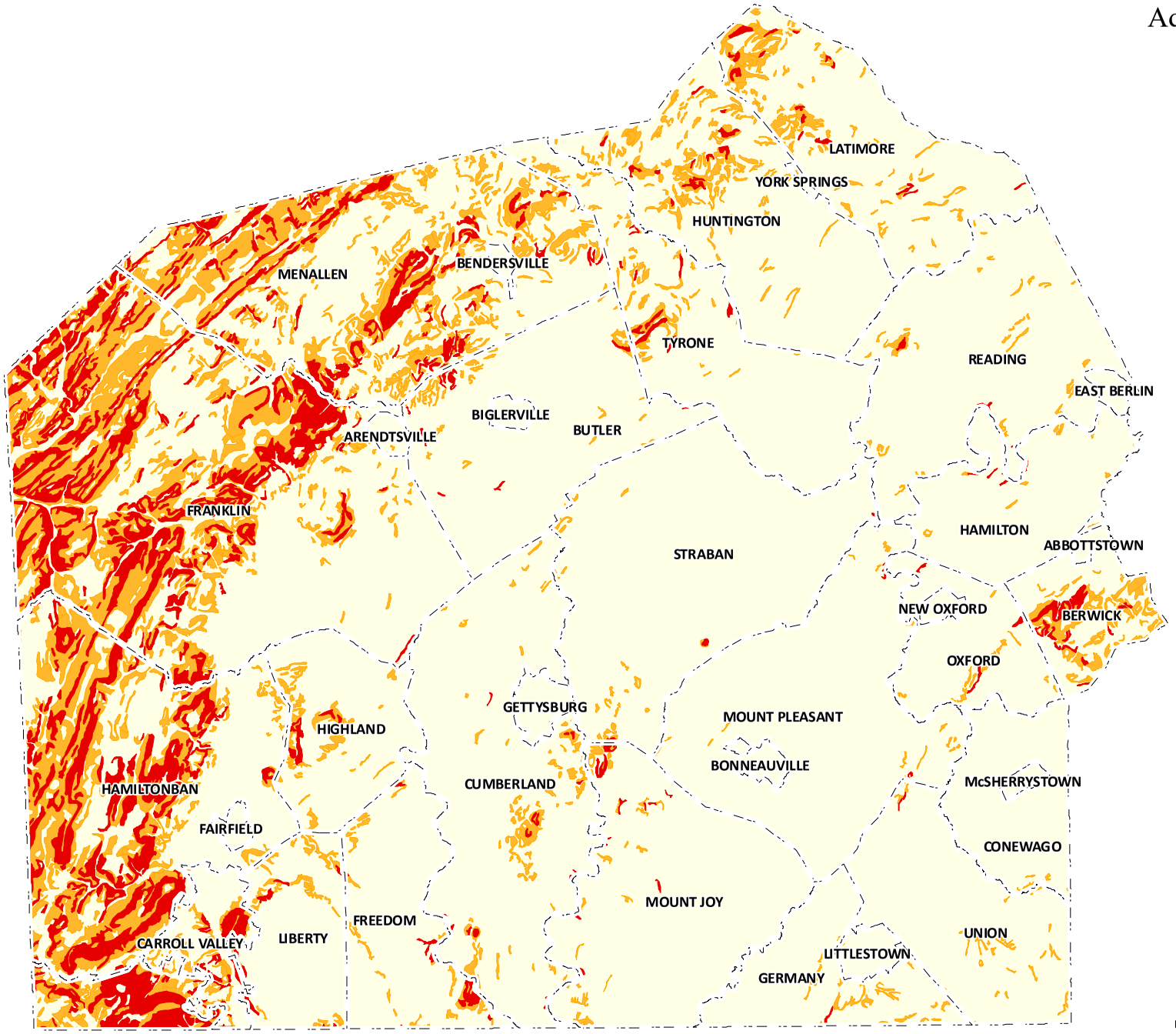
ADAMS COUNTY STORMWATER MANAGEMENT PLAN

Prepared By: Adams County Office of Planning & Devpt, March 2009
GIS Data Provided by Adams County GIS/ Mapping Office, NRCS

Steep Slopes

Adams County, Pennsylvania



Slopes Greater than 25%

Slopes 15% - 25%

Municipal Boundary

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ADAMS COUNTY STORMWATER MANAGEMENT PLAN

Prepared By: Adams County Office of Planning & Devpt, June 2011
GIS Data Provided by Adams County GIS/ Mapping Office, NRCS

Water Features & Woodlands

Adams County, Pennsylvania

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- Major Stream
- Tributary to Major Stream
- Intermittent Stream
- Waterbody
- Floodplain
- Wetlands
- Hydric Soil
- Woodland

Miles

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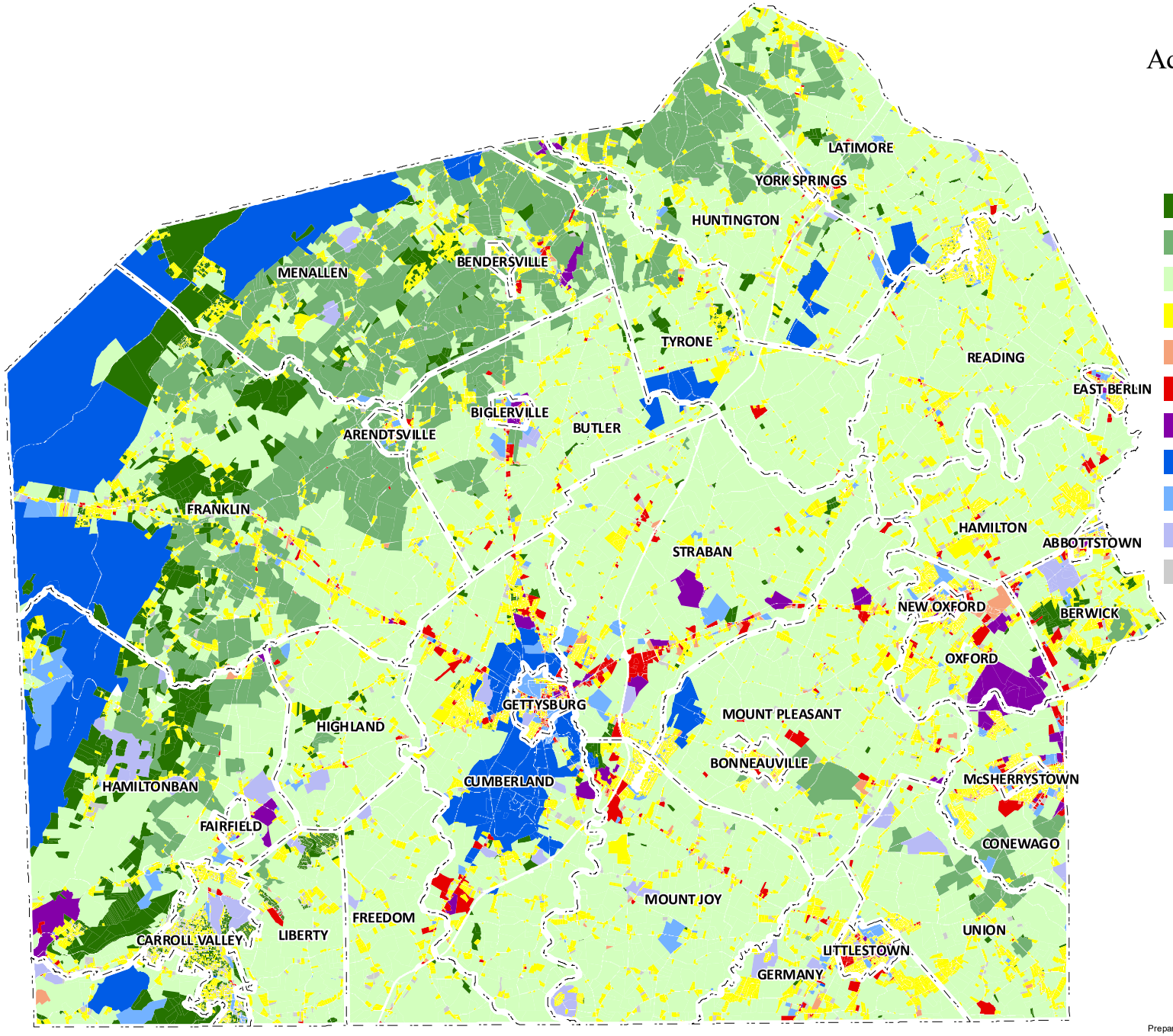
ADAMS COUNTY STORMWATER MANAGEMENT PLAN

Prepared By: Adams County Office of Planning & Devpt, July 2011
GIS Data Provided by Adams County GIS/ Mapping Office

Existing Land Use

Adams County, Pennsylvania



- Vacant/Wooded
- Specialized Agriculture
- Agricultural/Vacant/Residential (10+ ac)
- Residential - Less than 10 acres
- Mixed Use
- Commercial
- Industrial/Quarry
- State/Federal
- Public/Institutional/Utility
- Outdoor Recreation
- Vacant - Less than 10 acres

Miles

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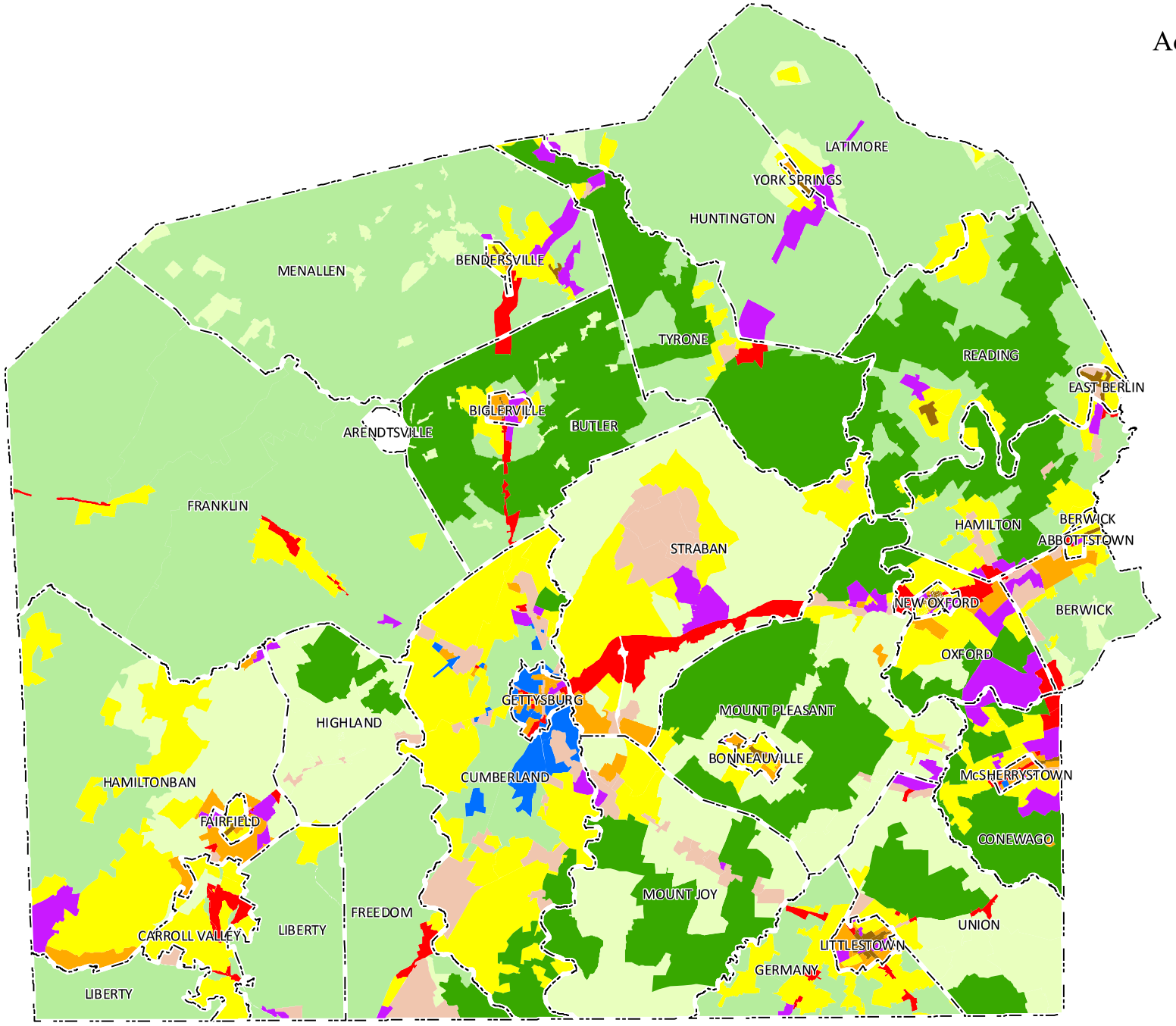
ADAMS COUNTY STORMWATER MANAGEMENT PLAN

Prepared By: Adams County Office of Planning & Devpt, July 2011, Land Use Data 2007
GIS Data Provided by Adams County GIS/ Mapping Office, ACOPD

Composite Zoning Categories

Adams County, Pennsylvania



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- Agricultural Preservation (Sliding scale and maximum lot size)
- Rural Conservation (Density based & other forms of Ag preservation)
- Lower Density Residential*
- Moderate Density Residential (1 - 5 dwelling units/ acre)
- High Density Residential (Over 5 dwelling units/ acre)
- Village Core
- Mixed Use
- Commercial
- Employment-Industrial
- Institutional

* (Less than 1 dwelling unit per acre, without conservation, or up to 2 dwelling units per acre, with substantial conservation techniques)

Disclaimer:
The "Zoning Categories" represented by this map are not to be interpreted as the actual municipal zoning districts, nor should they be interpreted as a critique of individual districts or the techniques they employ. Please see individual municipal/county zoning ordinances and maps for the adopted zoning districts.

Miles

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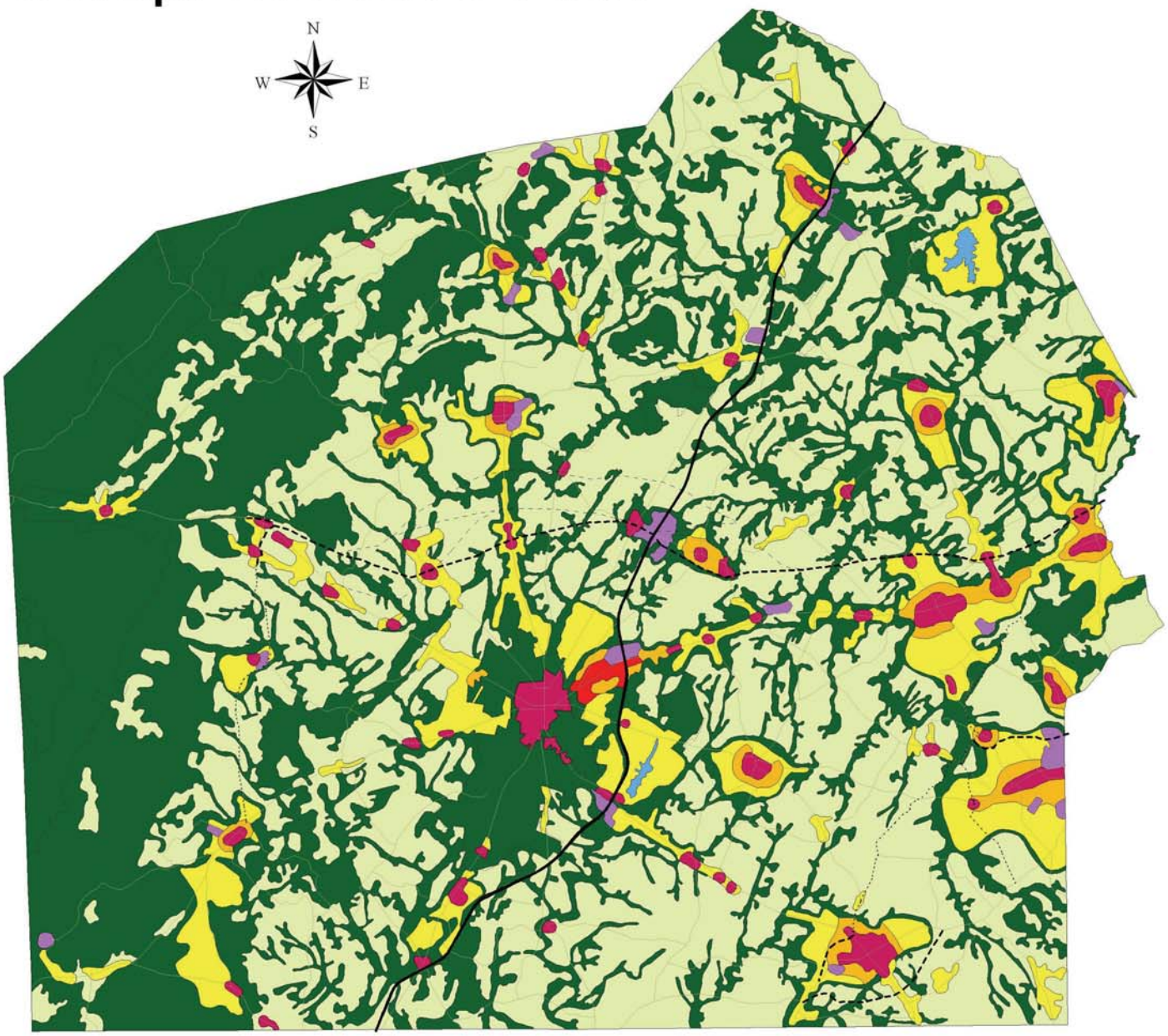
ADAMS COUNTY STORMWATER MANAGEMENT PLAN

Prepared By: Adams County Office of Planning & Devpt, June 2011
GIS Data Provided by Adams County GIS/ Mapping Office

ADAMS COUNTY
Comprehensive Plan



LAND USE PLAN

Key

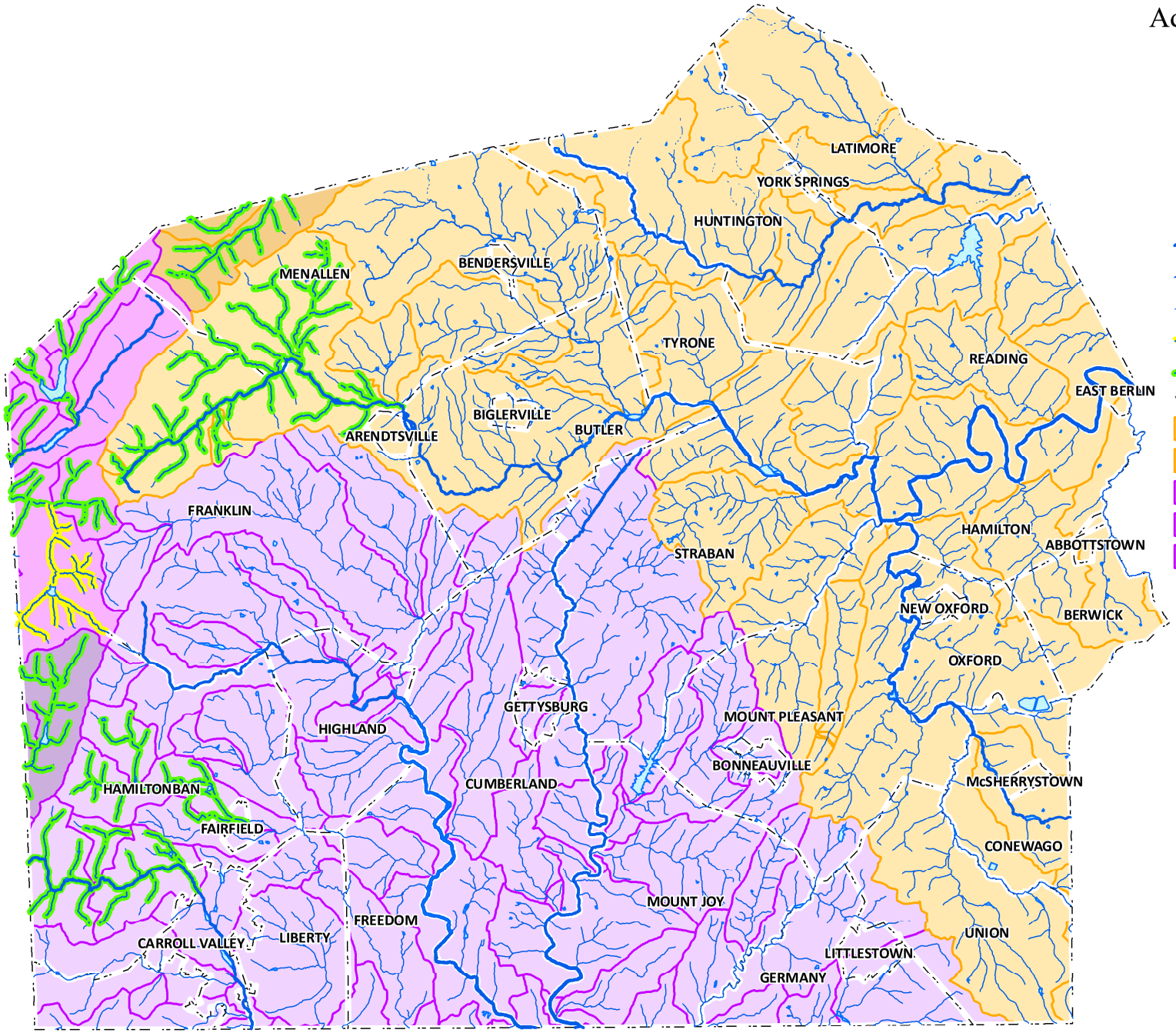
- Parks, Permanent Open Space, & Preservation Areas
- Agricultural, Resource Conservation, & Residential - Very Low Density
- Residential - Medium-Low Density
- Residential - Medium Density
- Borough/Village/Crossroad Center (Mixed Use)
- Commercial
- Employment Center

- New Roads- Possible Alignments
- New Roads- Alternative Alignments
- Improved County Collectors
- Route 15
- Federal and State Pak Boundaries

2002 ACOPD Reproduction of 1990 County Comprehensive Plan Land Use Map

Watersheds

Adams County, Pennsylvania



- Waterbody
- Major Stream
- Tributary to Major Stream
- Intermittent Stream
- Exceptional Value
- High Quality

Watersheds

- W. Conewago Creek - Susquehanna River
- Mountain Creek - Susquehanna River
- Monocacy River - Potomac River
- Conococheague Creek - Potomac River
- Antietam Creek - Potomac River

Miles

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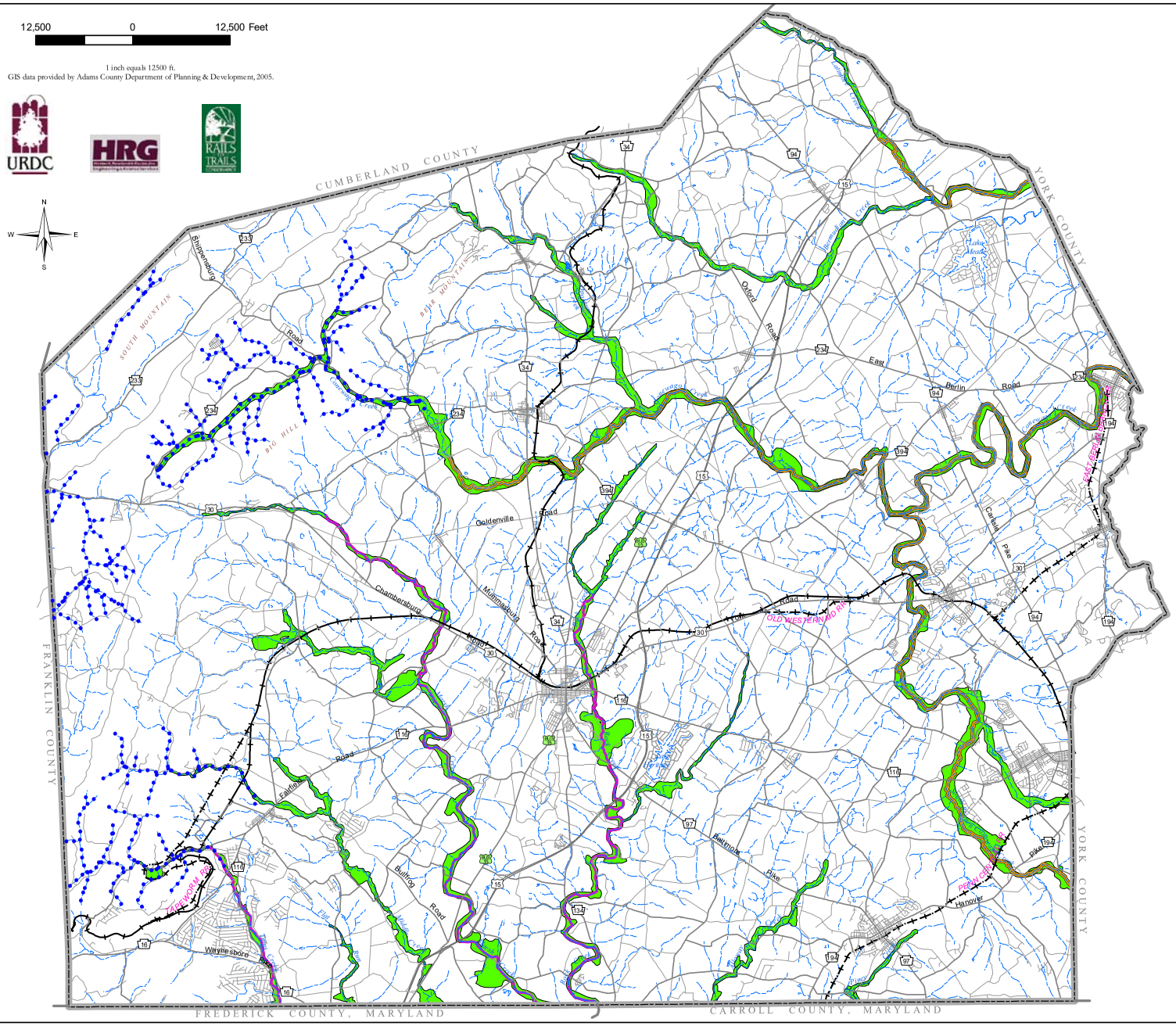
ADAMS COUNTY STORMWATER MANAGEMENT PLAN

Prepared By: Adams County Office of Planning & Devpt, March 2009
GIS Data Provided by Adams County GIS/ Mapping Office



ADAMS COUNTY GREENWAYS PLAN

Adams County, Pennsylvania

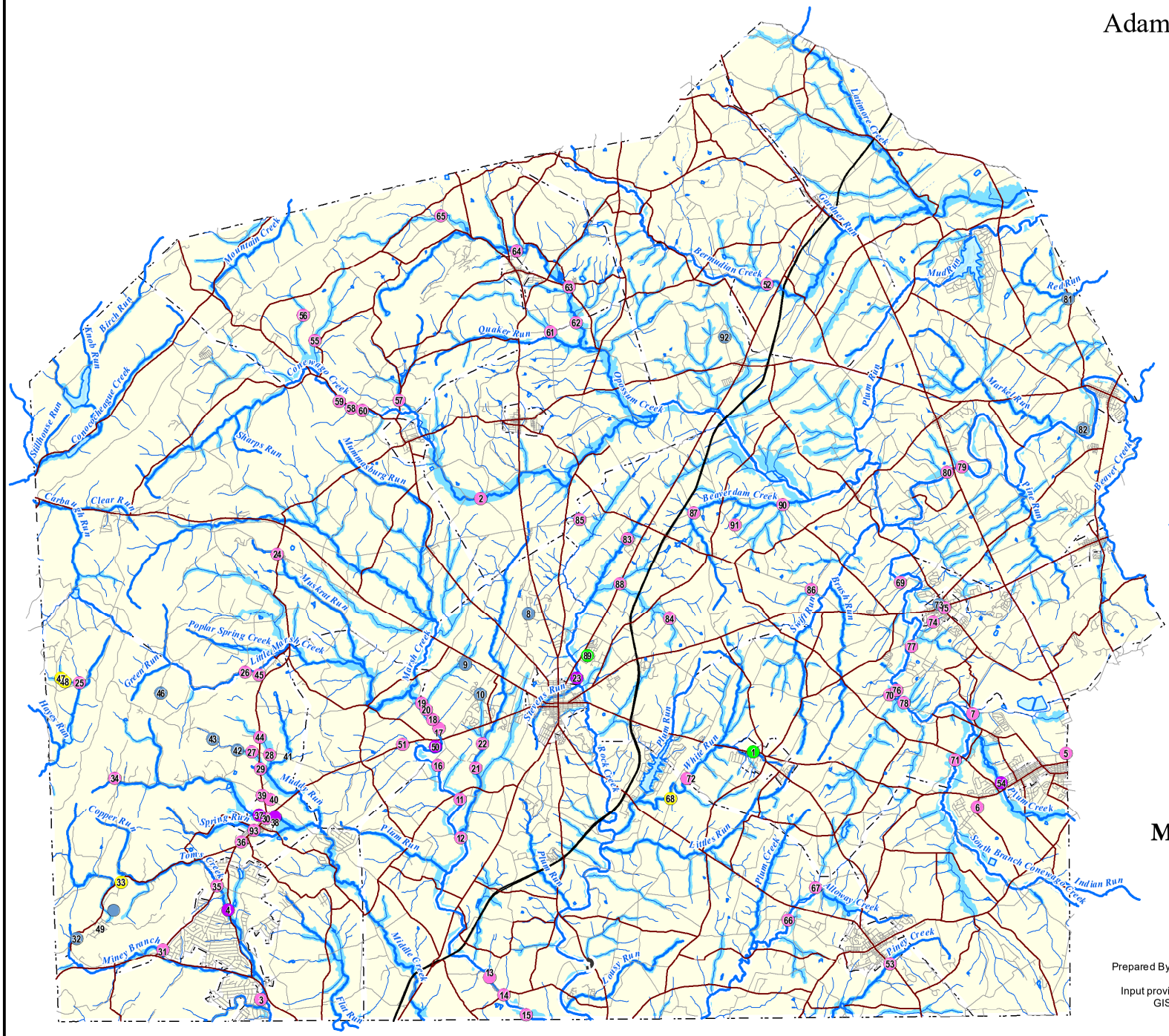
Significant Riparian Greenways

MAP 3.1

- Significant Riparian Greenways
- Active - pursue trails where opportunity arises
- Accessible - selected points of public access
- Passive - limited or no public access
- High Quality Waters and Exceptional Value Streams

Flood Prone Locations

Adams County, Pennsylvania



Legend

Primary Problem

- Roadway/ Bridge Inundation
- Property Flooding
- Stormwater Runoff
- Storm Sewer Overflow
- Clogs from Debris
- State Road
- Local or Private Road
- Streams
- 100 Year Flood Plain - FEMA 2009

Miles

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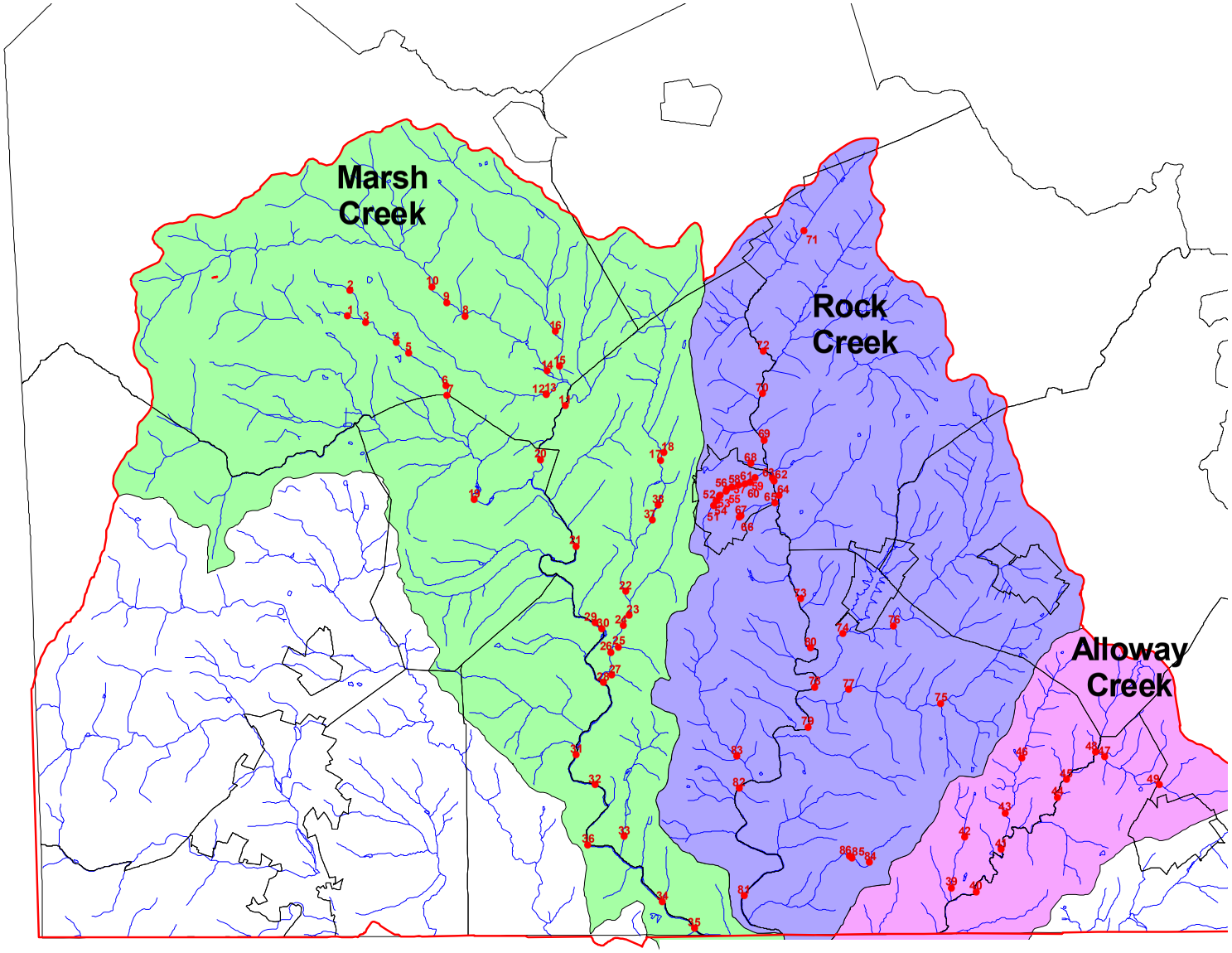
ADAMS COUNTY STORMWATER MANAGEMENT PLAN

Prepared By: Adams County Office of Planning & Development, March 2009
Revised: February 2011, November 8, 2011
Input provided through Stormwater PAC survey responses and staff input
GIS Data Provided By: Adams County GIS/ Mapping Office

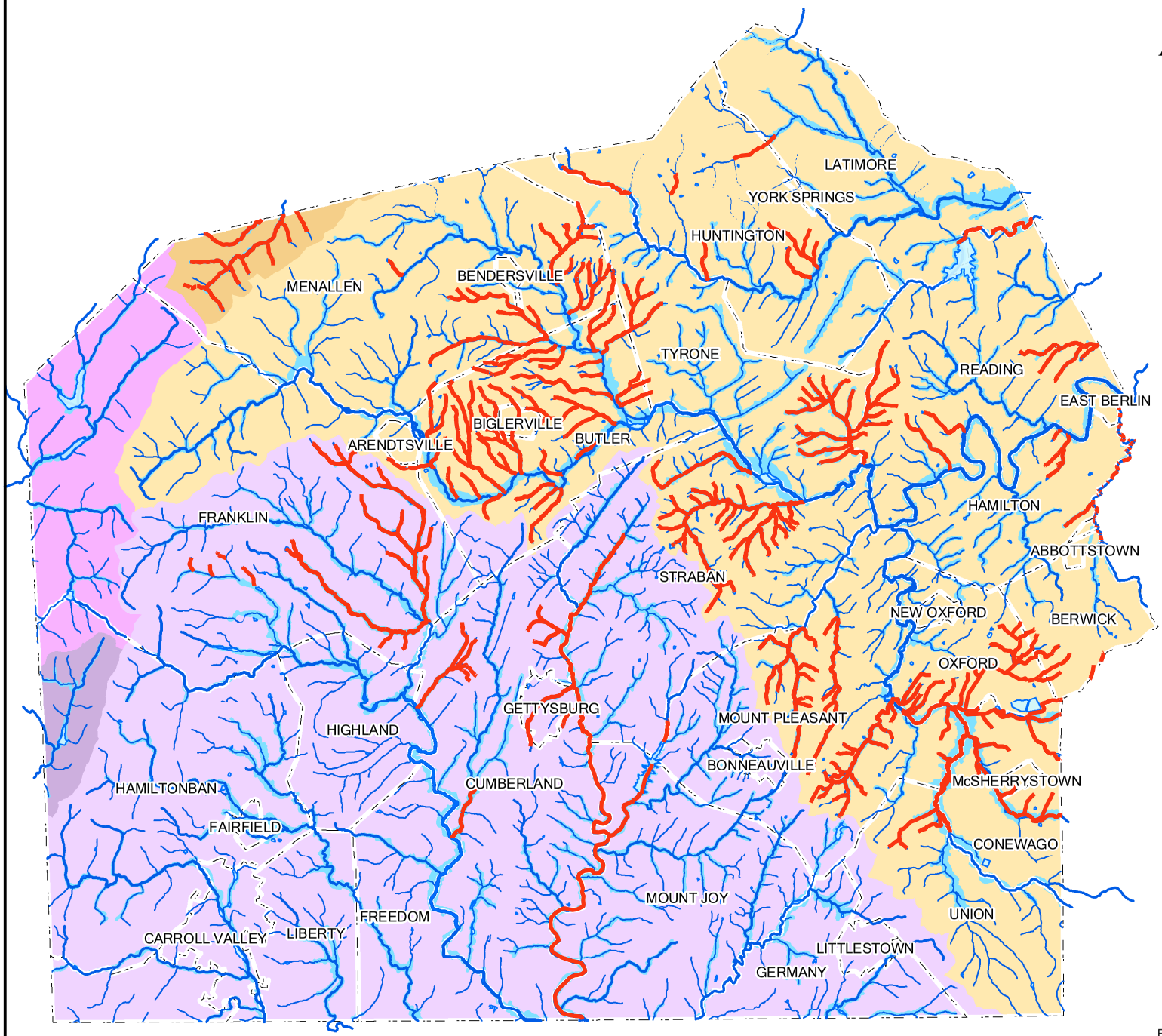


Monocacy River Watershed
Stormwater Management Plan

Figure III-14
Adams County Monocacy River Watershed
Measured Stream Obstructions

Impaired Streams

Adams County, Pennsylvania



N
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- Impaired Stream Segment
- Streams
- Waterbody
- 1% Annual Chance Flood

WATERSHED

- W. Conewago Creek - Susquehanna River
- Mountain Creek - Susquehanna River
- Antietam Creek - Potomac River
- Conococheague Creek - Potomac River
- Monocacy River - Potomac River

DEP assesses quality of waters in PA and identifies streams that are not attaining designated and existing uses as "impaired". Water quality reports are required under section 305 (b) of the Federal Clean Water Act. Section 303 (d) of the Act requires all states to list impaired streams.

Miles

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ADAMS COUNTY STORMWATER MANAGEMENT PLAN

Prepared By: Adams County Office of Planning & Devpt, March 2009
GIS Data Provided By: Adams County GIS/ Mapping Office, DEP

Appendix C
Simplified Approach

STORMWATER MANAGEMENT DESIGN ASSISTANCE MANUAL

For Minor Land Development Activities in Adams County, Pennsylvania

Simplified Approach

TABLE OF CONTENTS

Introduction

This design manual has been created as a tool to help property owners manage stormwater on their property and streamline the process of designing on-site stormwater management facilities for new, relatively minor residential and accessory structure projects. Through the use of this manual, residents have the ability to determine the appropriate facilities for their property, project and budget. This design method is not intended to be used with large-scale subdivision/ land development or activities that include infrastructure such as roadways.

The best management practices (BMPs) listed in this manual should be used as a guide and are not a comprehensive list of options. Residents should contact the municipality or Conservation District to discuss alternative solutions for site specific applications.

Importance of Stormwater Management

Stormwater is the runoff produced by precipitation, snow melt, or ice melt. When land is developed or changed, the flow patterns of water and quality of water are also changed. Land development activities can affect characteristics of stormwater runoff, including the rate of runoff, volume of runoff, and quality of runoff. When runoff is not managed, the increased volume may aggravate flooding.

The objective of stormwater management is to prevent or mitigate the adverse impacts of the increase in rate and volume of stormwater runoff, while also protecting health, safety, and property. Stormwater Best Management Practices aim to maintain water quality, encourage infiltration in appropriate areas, promote groundwater recharge, maintain the natural drainage characteristics of the site to the maximum extent practicable, and protect stream banks and beds.

Standard Terms Used in the Manual

Best Management Practice (BMP) - Activities, facilities, designs, measures, or procedures used to manage stormwater impacts from regulated activities, to meet state water quality requirements, to promote groundwater recharge, and to otherwise meet the purposes of this Ordinance.

Disconnected Impervious Area (DIA) - An impervious or impermeable surface that is disconnected from any stormwater drainage or conveyance system and is redirected or directed to a pervious area, which allows for infiltration, filtration, and increased time of concentration.

Disturbed Area - An unstabilized land area where an earth disturbance activity is occurring or has occurred.

Flow Path – The path that stormwater flows from the discharge point to the nearest property line or channelized flow (ie stream, drainage ditch, etc.). The length of the path is measured along the ground slope.

Impervious Surface (Impervious Area) - A surface that prevents the infiltration of water into the ground. Impervious surfaces and areas include but are not limited to roofs, additional indoor living spaces, patios and decks, garages, storage sheds and similar structures, streets, driveways, access drives, parking areas, and sidewalks. Any areas designed to be covered by loose surfacing materials such as gravel, stone and/or crushed stone, and intended for storage of and/or travel by vehicles, or pedestrians shall be considered impervious. Surfaces or areas designed, constructed and maintained to permit infiltration may be considered pervious.

Karst - A type of topography or landscape characterized by surface depressions, sinkholes, rock pinnacles/uneven bedrock surface, underground drainage, and caves. Karst is formed on carbonate rocks, such as limestone or dolomite.

Minor Stormwater Site Plan – A site plan prepared and submitted to the municipality for proposed projects which qualify to use the Simplified Approach. The plan depicts existing conditions on the property, proposed impervious areas, and, if required, the location of proposed BMPs.

Regulated Activit(ies)y - Any earth disturbing activity or any activity that involves the alteration or development of land in a manner that may affect stormwater runoff.

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

Determining What Type of Stormwater Management Plan is Needed

The chart on the following page provides a guide to determine what type of stormwater plan is needed. Some projects will be exempt from preparing a stormwater management plan, but documentation of the project must still be filed with the municipality. Completion of the **Municipal Stormwater Management Worksheets** will determine what type of documentation is required for each project.

This manual is designed to assist those with projects that qualify for the use of a minor stormwater site plan. If a formal stormwater management plan is required, **please consult a qualified person (ex. Engineer, Surveyor)!**

SMP Plan Requirement	Impervious Area	Disturbed Area*	Next Steps
Exempt	Up to 1,000 ft²	Less than 1 acre	File Municipal Stormwater Management Worksheet with municipality
May be Exempt	1,000 to ≤ 10,000 ft², if disconnected from impervious areas	Less than 1 acre	File Municipal Stormwater Management Worksheet with municipality
Minor Stormwater Site Plan	1,000 ft² to ≤ 5,000 ft² IF connected to impervious areas	Less than 1 acre	Prepare a Minor Stormwater Site Plan
Formal Stormwater Management Plan	Greater than 5,000 ft²	Greater than 1 ac.	Consult a Qualified Person

Using Municipal Stormwater Management Worksheets

Determining the impervious area of a proposed project is the first step in using this Manual. Municipal Stormwater Management Worksheets have been included in the Simplified Approach, which will assist the property owner, or applicant, and municipality determine the impervious area of a proposed project and provide guidance through the next steps.

Step 1 of the Municipal Stormwater Management Worksheet provides a table and directions on how to figure out the impervious area created. If the total proposed surface area is up to 1,000 square feet, the project may be exempt from the requirements in this guide. The owner will sign the Acknowledgement at the top of the sheet and file it with the municipality. The municipality will use this as a record of exempt projects and keep a running total of proposed impervious area since the adoption of the Stormwater Management Ordinance.

If the proposed impervious area is between 1,000 square feet and 10,000 square feet, the applicant will go on to Step 2 to determine the Disconnected Impervious Area (DIA). DIA is explained on page C-6. The applicant will need to prepare a minor stormwater site plan to show how far the proposed project is from things like property lines and existing impervious surfaces. If DIA requirements can be met, projects of this size may be exempt from the requirement to prepare and submit a formal stormwater management (SWM) site plan. The applicant should take the worksheets and plan to the municipality for review and approval.

If stormwater runoff needs to be managed on the property, Best Management Practices (BMPs) will have to be installed if the project is between 1,000 square feet and 5,000 square feet. If the project is between 5,000 and 10,000 square feet and the entire volume of stormwater runoff cannot be managed within the property without using BMPs, then the project is not qualified to use the Simplified Approach. The applicant should fill out the rest of the worksheets and determine which BMPs will be used. The size and location

of proposed BMPs will be added to the minor stormwater site plan. The worksheets, site plan, and Owner Acknowledgement are brought to the municipality for approval. Each municipality has an approval process for exemptions and the minor stormwater site plans. The municipality may also require the submission of the Stormwater Management/ BMP Facilities & Maintenance Agreement.

Minor Stormwater Site Plan Requirements

A minor stormwater site plan depicts the existing conditions of a property and the location of proposed impervious surfaces. Depicting the relationship between the proposed activities and distances to things like property lines, streams, and vegetated areas will help determine if the stormwater runoff created by the proposed project can be managed naturally within the property or if additional best management practices (BMPs) are needed to accommodate the stormwater runoff.

If a project qualifies for use of a minor stormwater site plan, the applicant may prepare and submit to the Municipality a minor stormwater site plan and the Municipal Stormwater Management Worksheet. The Adams County GIS Office can also provide assistance to applicants to obtain property maps of existing features. A minor stormwater site plan depicting the key features of the site must be drawn, or depicted, to scale to show the following:

- Property boundary.
- Location of all existing and proposed structures (house, shed, addition, etc.) and any proposed downspouts. Include the dimensions of proposed structures.
- Site conditions (grassed areas, agricultural fields, direction of slope and stormwater flow on the property).
- Distance from proposed downspouts to property line.
- All existing and proposed driveways and impervious areas (stone and gravel driveways are considered impervious).
- Natural features such as streams, wetlands, tree lines and other vegetation on the property and within 50 feet of the property line for lots smaller than 5 acres.
- Distance from proposed structures or downspouts along the stormwater flow path to any stream or wooded area.
- Any other pertinent information that may be significant to the project site (existing drainage ways, steep slopes, etc.).
- Wells and on-site septic systems.

If BMPs are required, the following information must also be shown on the plan:

- Location and size of proposed stormwater BMPs.

Other Considerations for Minor Plans:

- While soil testing is not mandatory for the simplified approach, soil testing is highly recommended to select and apply the appropriate stormwater BMPs. The use of soil maps, infiltration tests, and/ or perc tests may provide the applicant basic information about soil characteristics.
- Proposed stormwater management facilities must be designed to handle flows from the contributing area.
- The site shall not have any pre-existing stormwater drainage-related problems (as verified by the municipality), at the discretion of the Municipality.
- Water quality shall be protected per Chapter 93 of PA Code.
- The municipality may inspect all BMPs during and after construction/ installation.
- Infiltration BMPs should not be constructed nor receive runoff until the entire contributory drainage area has achieved final stabilization.
- Ensure that infiltration in geologically susceptible areas such as, but not limited to, carbonate geology/ karst topography do not cause adverse effects. The minor stormwater site plan should incorporate steps to ensure that salt or chloride will not contaminate the groundwater.
- Selected BMPs shall be designed, constructed, and maintained in accordance with the manufacturer's recommendation, the BMP Manual, or other written guidance acceptable to the municipality.
- Proposed sump pumps shall discharge to infiltration or vegetative BMPs to the maximum extent practicable.

DISCONNECTED IMPERVIOUS AREA (DIA)

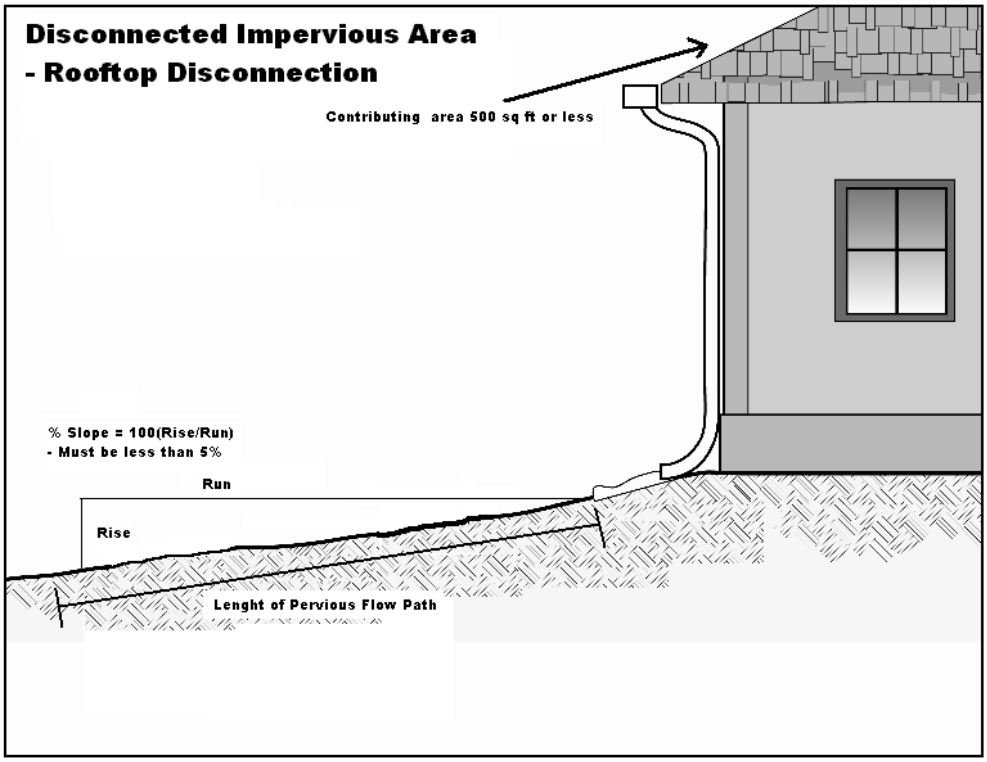
When impervious surface areas like rooftops and paved areas are directed to a pervious area that allows for infiltration, filtration, and increased time of concentration, the impervious surface areas may qualify to be treated as Disconnected Impervious Area (DIAs).

Impervious Area is defined as: A surface that prevents the infiltration of water into the ground. Impervious surfaces and areas shall include roofs, home additions, patios and

decks, garages, storage sheds and similar structures, driveways, access drives, parking areas, walkways and sidewalks. Any areas designed to be covered by loose surfacing materials such as gravel, stone and/or crushed stone, and intended for storage of and/or travel by vehicles, or pedestrians shall be considered impervious. Surfaces or areas designed, constructed and maintained to permit infiltration may be considered pervious.

Rooftop Disconnection A rooftop is considered to be completely disconnected if it meets the requirements listed below:

- The contributing area of rooftop to each disconnected discharge (downspout) is 500 square feet or less.
- The overland flow path from roof runoff discharge point has a positive slope of five percent (5%) or less.
- The length of the overland flow path is greater than 75 feet.
- Soils along the overland flow path are not classified as hydrologic group "D" (See Plan Appendix B). i.e. infiltration is at least 1 inch per 24-hour day.
- The receiving pervious area shall not include another person's property unless written permission has been obtained from the affected property owner.



Note: Downspout not required.

Determining Status of DIA

Step 1: Determine contributing area of the roof to each disconnected discharge (downspout). If it's 500 ft^2 or less, continue to step 2. If it's greater than 500 ft^2, the area does not qualify as DIA.

Step 2: Determine the length of down slope pervious flow path available for each disconnected discharge.

Step 3: Determine the % slope of the pervious flow path, % slope = (rise/ run) x 100. Must be 5% or less.

Step 4: See the table on the next page to determine the percentage of the area that can be treated as disconnected. If the available length of the flow path is equal to or greater than 75 ft, the discharge qualifies as entirely disconnected.

Partial Rooftop Disconnection		
Length of Pervious Flow Path* (ft) Lots 10,000 ft^2 and Under	**Length of Pervious Flow Path* (ft)**	**Roof Area Treated as Disconnected**
0 – 7.9	0 – 14	0%
8 – 15.9	15 – 29	20%
16 – 22.9	30 – 44	40%
23 – 29.9	45 – 59	60%
30 – 34.9	60 – 74	80%
35 or more	75 or more	100%
*Pervious flow path must be at least 15 feet from any impervious surface and cannot include impervious surfaces.		

Paved Disconnection When runoff from paved surfaces is directed to a pervious area that allows for infiltration, filtration, and increased time of concentration, the contributing pavement area may qualify as disconnected. This applies generally to only small or narrow pavement structures such as driveways and walkways. Paved surfaces can be considered disconnected if they, or the adjacent areas, meet the following requirements:

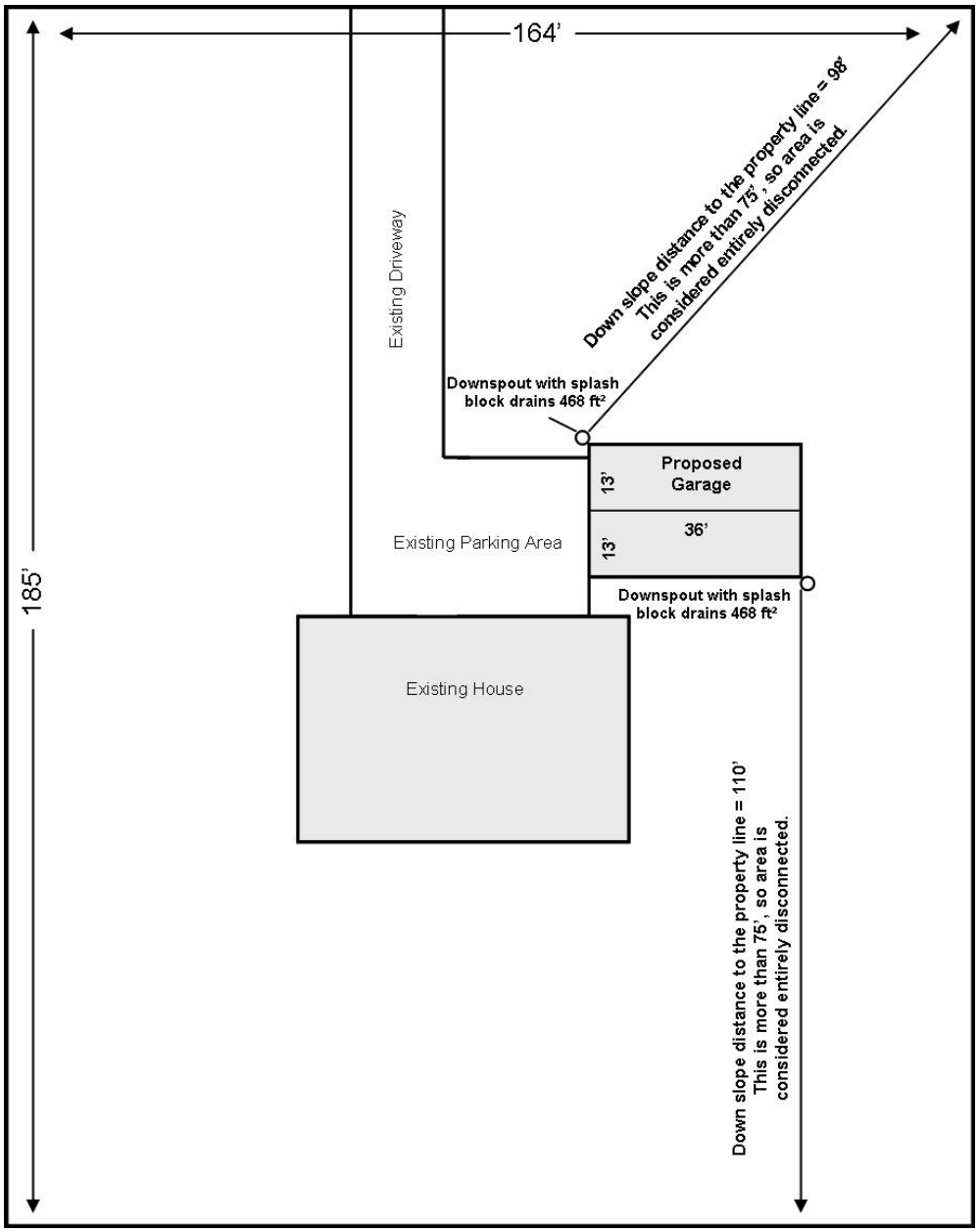
- The contributing flow path over the impervious area is not more than 75 feet
- The length of overland flow is greater than or equal to the maximum length of flow over the impervious area
- The slope of the contributing impervious area is five percent (5%) or less
- The slope of the overland flow path is five percent (5%) or less

- If discharge is concentrated at one or more discrete points, no more than 500 ft² may discharge to any one point. In addition, a gravel strip or other spreading device is required for concentrated discharges. For non-concentrated discharges along the entire edge of paved surface, a level spreader is not required; however, there must be provisions for the establishment of vegetation along the paved edge and temporary stabilization of the area until the vegetation is established.

REFERENCE: Philadelphia Water Department. 2006 & 2011. Stormwater Management Guidance Manual. Section 4: Integrated Site Design. Philadelphia, PA.

The following example determines the status of DIA for a proposed 936 ft² garage.

This example meets the criteria to use the Simplified Approach.



Step 1: Determine the area to each disconnected discharge. The area draining to each downspout is 468 ft^2. This is less than 500 ft^2, proceed to step 2.

Step 2: The discharge on the north side of the garage has a 98 ft pervious flow path available. The south discharge has 110 ft pervious flow path available.

Step 3: The rise of the north discharge is 2 ft and the run is 75 ft for a slope of 2.6%. This is 5% or less so it qualifies. For the south discharge the rise is 4 ft and the run is 100 ft equaling a slope of 4%. This is 5% or less, so it qualifies.

Step 4: Both of these discharges have pervious flow paths greater than 75 ft, so they qualify as entirely disconnected.

Selecting BMPs

If BMPs are required, the Owner/ Designer should review the compiled information in the enclosed "Guide to Choosing Stormwater BMPs", as taken from the *PA Handbook of Best Management Practices for Developing Areas* and the *PA Stormwater Management BMP Manual*. These documents identify stormwater BMPs that have been deemed to be of a nature and cost that will accomplish the goals of the Adams County Stormwater Management Plan, while not unduly burdening the residents. It will then be the Owner's responsibility to select a facility, determine the appropriate size and agree to construct and maintain that facility or facilities. The property owner is encouraged to utilize both multiple and hybrid versions of the facilities, as outlined in the documents mentioned above.

Municipal Stormwater Management Worksheets

Municipal Stormwater Management Worksheet

For Municipal Use and Record of Project Area

Property Owner's Name _____

Address of Property_____

Parcel ID #_____ Municipality _____

Phone Number _____ New Impervious Area Associated with this Project _____

Stormwater Project Type: _____ Exempt _____ Minor Plan _____ Project Requires Formal SWM Plan

Total New Impervious Area Since Adoption of SWM Plan _____

Acknowledgement - I declare that I am the property owner, or representative of the owner, and that the information provided is accurate to the best of my knowledge. I understand that stormwater may not adversely affect adjacent properties or be directed onto another property without written permission. I also understand that false information may result in a stop work order or revocation of permits. Municipal representatives are also granted reasonable access to the property for review and/ or inspection of this project if necessary.

Signature _____ Date _____

Step 1: Determine the amount of new impervious area created by the proposed project. This includes any new surface areas that prevent infiltration of stormwater into the ground. New stone and gravel areas are considered impervious. Impervious areas existing before November 23, 2011 are not included in this calculation. Use additional sheets if necessary

Calculate new impervious area by completing this table.

Surface	Length (ft)	x	Width (ft)	=	Impervious Area (ft²)
Buildings		x		=	
Driveway		x		=	
Parking Areas		x		=	
Patios/ walkways		x		=	
Other		x		=	
Total Proposed Impervious Surface Area (Sum of all impervious areas)					

- If the total new impervious surface area is **up to 1,000 ft²**, the project is exempt from the requirement to submit a plan for approval. Sign Acknowledgement and file this sheet with municipality.
- If total impervious surface area is **1,001 ft² to 10,000 ft²**, continue to Step 2.

  - If project area can be entirely disconnected, sign Acknowledgement and file worksheets with municipality.
  - If project is between 1,000 ft² and 5,000 ft² and requires BMPs, complete step 3.
  - If project area is 5,000 ft² - 10,000 ft² and can't be disconnected, the project does not qualify for the Simplified Approach.

Municipal Stormwater Management Worksheet

Step 2: Determine Disconnected Impervious Area (DIA). All or parts of proposed impervious surfaces may qualify as Disconnected Impervious Area if runoff is directed to a pervious area that allows for infiltration, filtration, and increased time of concentration. The volume of stormwater that needs to be managed could be reduced through DIA. Prepare a minor stormwater site plan (see pg C-5 for requirements).

Criteria

- Overland flow path from the discharge area or impervious area has a positive slope of 5% or less.
- Contributing area to each rooftop discharge (downspout) is 500 ft² or less.
- Soils are not classified as hydrologic soil group "D".
- The receiving pervious area shall not include another person's property unless written permission has been obtained from the affected property owner.

Partial Rooftop Disconnection		
Length of Pervious Flow Path (ft) Lots ≤ 10,000 ft²	**Length of Pervious Flow Path (ft)**	**DIA Credit Factor**
35 or more	75 or more	0
30 – 34.9	60 – 74	0.2
23 – 29.9	45 – 59	0.4
16 – 22.9	30 – 44	0.6
8 – 15.9	15 – 29	0.8
0 – 7.9	0 - 14	1.0
Pervious flow path must be at least 15 feet from any impervious surface		

Paved Disconnection Criteria: Paved surfaces (driveways, walkways, etc.) and gravel can be considered disconnected if it meets the criteria above and:

- Runoff does not flow over impervious area for more than 75 feet.
- The length of overland flow is greater than or equal to the contributing flow path.
- The slope of the contributing impervious areas is 5% or less.
- If discharge is concentrated at one or more discrete points, no more than 1,000 ft² may discharge to any one point. In addition, a gravel strip or other spreading device is required for concentrated discharges. Non-concentrated discharges along the entire edge of paved surface must include provisions for the establishment of vegetation along the paved edge and temporary stabilization of the area until the vegetation is established.
- If these criteria can be met, the DIA credit = 0

Using the calculations from Step 1, complete the table below. This will determine the impervious area that may be excluded from the area that needs to be managed through stormwater BMPs. If the total impervious area to be managed =0, the area can be considered entirely disconnected.

Surface	Proposed Impervious Area	x	DIA Credit	=	Impervious Area (ft²) to be Managed
Buildings (area to each downspout)		x		=	
Driveway		x		=	
Parking Areas		x		=	
Patios/ walkways		x		=	
Other		x		=	
Total Proposed Impervious Surface Area to be managed (Sum of all impervious areas)					

If total surface area to be managed if greater than 0, continue to Step 3.

Municipal Stormwater Management Worksheet

Step 3: Calculate the volume of stormwater runoff created by proposed impervious surfaces or see Simple BMP Sizing in Step 4.

Impervious Area (ft^2) to be Managed (Sum of Step 2)	X	3.0 in/12 in = 0.25 (3.0 in is 2-year 24-hour rainfall amount)	=	Amount of Stormwater to be Managed (ft^3)
	X	0.25	=	

Best Management Practices need to be used to manage the volume of stormwater created by the proposed impervious areas. The cubic feet of stormwater that need to be managed may also be further reduced by planting new trees. If the criteria below can be met, the amount of stormwater to be managed can be reduced per the following:

Deciduous Trees = 6 ft^3 per tree **Evergreen Trees = 10 ft^3 per tree**

Criteria:

- Trees must be PA native species (See PA Stormwater BMP Manual for a list)
- Trees shall be a minimum 1" caliper tree and 3 feet tall shrub (min)
- Trees shall be adequately protected during construction
- No more than 25% of the required capture volume can be mitigated through the use of trees
- Dead trees shall be replaced by the property owner within 12 months
- Please consider the specifications for each tree species when determining location and spacing

Amount of Stormwater to be Managed (ft^3) (Sum of Step 3)	-	Tree Planting Credit (ft^3)	=	Amount of Stormwater to be Managed (ft^3)
	-		=	

Step 4: Select BMPs and size according to the volume of stormwater that needs to be managed. The Guide to Choosing Stormwater BMPs, included in the Simplified Approach, includes sizing calculations for specific techniques. ***Simple BMP Sizing -*** Sizing BMPs may also be simplified through the use of this chart. Take the sum of Step 2 and match it to the "Amount of New Impervious Area to be Managed" in white boxes in the table below (rounding **up** to the next value if the number is between two values). Then look in the light grey box to determine the cubic footage based on the type of BMP (bioretention or infiltration). For example, if a proposed 1,000 square foot impervious area must handle 240 cubic feet of stormwater in a bioretention system, a 13'x 13'x 1.5' rain garden or a 36'x 2'x 3.5' vegetated swale could be used. Show the location and size of proposed BMPs on the minor stormwater site plan. (The following was based on a chart from the Lycoming Co. Planning Dept)

BMP Type		Simple BMP Sizing - Amount New Impervious Area to be Managed (ft^2)											
		250	500	750	1000	1500	2000	2500	3000	3500	4000	4500	5000
Bioretention	Ex. Rain garden, Vegetated swale	60 ft^3 or	120 ft^3 or	180 ft^3 or	240 ft^3 or	360 ft^3 or	480 ft^3 or	600 ft^3 or	720 ft^3 or	840 ft^3 or	960 ft^3 or	1,080 ft^3 or	1,200 ft^3 or
Infiltration	Ex. Dry well, Infiltration trench	180 ft^3	360 ft^3	540 ft^3	720 ft^3	1,080 ft^3	1,440 ft^3	1,800 ft^3	2,160 ft^3	2,520 ft^3	2,880 ft^3	3,240 ft^3	3,600 ft^3

Bring the worksheets, plan, Owner Acknowledgement, and BMP Facilities and Maintenance Agreement (if applicable) to your municipality. If an area greater than 5,000 square feet of earth is disturbed, an erosion and sedimentation (E & S) control plan must be prepared. The municipality may require that the E&S plan be submitted to, reviewed, and approved by the Adams County Conservation District.

Municipal Stormwater Management Worksheet

The minor stormwater site plan assists the owner / applicant in preparing the necessary information for the municipality to review and approve.

OWNER ACKNOWLEDGMENT

(Municipality may decide if the Owner Acknowledgement should be notarized and/ or recorded, based on municipal process)

- Development activities shall begin only after the municipality approves the plan.
- The installed BMPs will not adversely affect any property, septic systems, or drinking water wells on this or any other property.
- If a stormwater management alternative to the approved minor stormwater site plan is used, the applicant will submit a revised plan to the municipality for approval. If a site requires a more complex system or if problems arise, the applicant may need the assistance of a licensed professional.
- The applicant acknowledges that the proposed stormwater management BMPs will be a permanent fixture of the property that can not be altered or removed without approval by the Township.

I (we) _____, hereby acknowledge the above statements and agree to assume full responsibility for the implementation, construction, operation, and maintenance of the proposed stormwater management facilities. Furthermore, I (we) also acknowledge that the steps, assumptions, and guidelines provided in this simplified approach package (minor stormwater site plan & Municipal Stormwater Worksheet(s)) will be adhered to.

Signature: _____ Date: _____

Signature: _____ Date: _____

STORMWATER MANAGEMENT/ BMP FACILITIES & MAINTENANCE AGREEMENT

STORMWATER MANAGEMENT/ BMP

FACILITIES & MAINTENANCE AGREEMENT

THIS AGREEMENT, made and entered into this ____ day of _____, 20___, by and between _____ hereinafter called the "Landowner", and < Municipality>, Adams County, Pennsylvania, hereinafter called the "Municipality".

WHEREAS, the Landowner is the owner of certain real property described as (Adams County tax Map/Parcel Identification Number) _____ as recorded by deed in the land records of Adams County, Pennsylvania, Book _____ Page _____, hereinafter called the "Property".

WHEREAS, the Landowner is proceeding to build on and develop the property; and WHEREAS, the minor stormwater site plan hereinafter called the "Plan", which is expressly made a part hereof, as approved or to be approved by the Municipality, provides for detention of stormwater within the confines of the property through the use of Best Management Practices (BMPs); and

WHEREAS, the Municipality and the Landowner, its successors and assigns, agree that the health, safety, and welfare of the residents of Adams County, Pennsylvania, require that on-site stormwater management/ BMP facilities be constructed and maintained on the Property; and

WHEREAS, the Municipality requires that on-site stormwater management/ BMP facilities as shown on the Plan be constructed and adequately maintained by the Landowner, its successors and assigns. Any additional requirements imposed by the Municipality are considered part of the Plan.

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

1. The Landowner in accordance with the specifications identified within the Plan shall construct the onsite BMP facilities.

2. The Landowner, its successors and assigns, shall adequately maintain the BMP facilities. This includes all pipes and channels built to convey stormwater to the facility, as well as all structures, improvements, and vegetation provided to control the quantity and quality of the stormwater. Adequate maintenance is herein defined as good working condition so that these facilities are performing their design functions.

3. The Landowner, its successors and assigns, shall inspect the BMP facility after all rainfall events exceeding one inch of precipitation in a 24-hour period.

4. The Landowner, its successors and assigns, hereby grant permission to the Municipality, its authorized agents and employees, to enter upon the Property without prior notification at reasonable times and upon presentation of proper identification to inspect the BMP facilities whenever the Municipality deems necessary.

5. In the event the Landowner, its successors and assigns, fails to maintain the BMP facilities as shown on the Plan and in good working condition, the Municipality may enter upon the Property and take whatever action is deemed necessary to maintain said BMP facilities and to charge the costs of such repairs to the Landowner, its successors and assigns. This provision shall not be construed to allow the Municipality to erect any structure of permanent nature on the land of the Landowner unless such structures were part of the approved Plan. It is expressly understood and agreed that the Municipality is under no obligation to routinely maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the Municipality.

6. 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 within thirty (30) days of receipt of invoice for all expenses incurred. The municipality has the right to file a municipal lien for unpaid costs and expenses that have not been reimbursed thirty (30) days after receipt of invoice.

7. The intent and purpose of this Agreement is to ensure the proper maintenance of the BMP facilities by the Landowner. This Agreement shall not be deemed to create any additional liability of any party for damage alleged to result from or be caused by nonpoint source pollution runoff. This Agreement imposes no liability of any kind whatsoever on the Municipality and the Landowner agrees to hold the Municipality harmless from any liability in the event the stormwater management BMP facilities fail to operate properly. 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 shall be allowed, the Landowner shall pay all costs and expenses regarding said judgment.

8. This Agreement shall be binding to the Landowner, its administrators, executors, assigns, heirs and any other successors in interests, in perpetuity.

Landowner signatures:

_____ _____
(Print Landowner Name)

_____ _____
(Print Landowner Name)

Witnessed By:

_____ _____
(Municipal Representative)

Guide to Choosing Stormwater BMPs

STORMWATER MANAGEMENT DESIGN ASSISTANCE MANUAL

Guide to Choosing Stormwater BMPs

Simplified Approach

STORMWATER MANAGEMENT DESIGN ASSISTANCE MANUAL

Guide to Choosing Stormwater BMPs

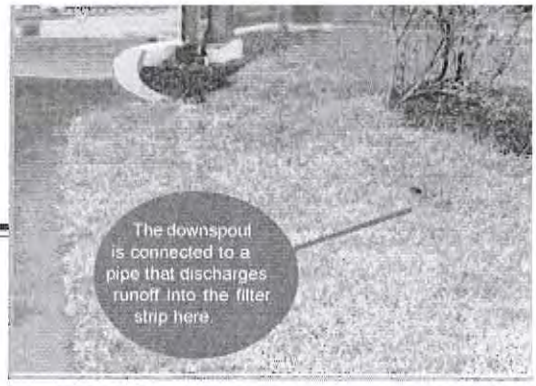
The information in this guide has been complied from several sources including the Pennsylvania Handbook of Best Management Practices for Developing Areas (PA Association of Conservation Districts) and is intended to help homeowners select an appropriate stormwater best management practice (BMP) for qualifying minor projects. These printouts represent facilities that have been deemed to be of a nature and cost that will accomplish the goals of the Adams County Stormwater Management Plan, while not unduly burdening the residents.

Additional information may also be found in Chapter 6 & Chapter 7 of the Pennsylvania Stormwater Best Practices Manual (DEP):

http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-8305
or http://www.stormwaterpa.org/43

Best Management Practices Fact Sheet

Filter Strip



PURPOSE: Filter strips remove sediment and other pollutants from runoff before they are carried into storm sewer systems or streams. Filter strips also aid with reducing the flow rate of runoff and allowing runoff to infiltrate into the soil to recharge the groundwater supply.

Filter strips are gently sloping, densely vegetated areas used to treat stormwater runoff, acting as a buffer between impervious areas and storm sewer systems or streams.

The filter strip's ability to increase water quality depends on the varieties and mix of vegetation (grass, shrubs or trees) selected. It is important to note that filter strips are only effective when runoff flows in sheets; concentrated flow leads to erosion, which will result in failure of the filter strip. Level spreading devices, such as a gravel-filled trench, curb stops, or berms, are recommended to convert runoff into sheetflow that washes evenly over the filter strip. As runoff flows across the filter strip, its vegetated top layer filters sediment and pollutants, such as pesticides, from runoff. Vegetation also slows the rate of runoff, which allows for increased absorption into the underlying soil for additional filtering and some infiltration to the groundwater supply.

Filter strips can be designed to collect and convey filtered runoff to other types of BMPs, such as vegetated swales, infiltration basins and natural buffer areas.

NOTE: Roof drainage discharged to filter strips should be at least ten feet from the building foundation to prevent water damage.

General Design Considerations

- Length of filter strip is a function of the slope, vegetated cover and soil type
- Effective for areas with slope less than 8%; grades more than 5% will require more dense vegetation to effectively dissipate energy from flow
- Recommended for drainage areas of less than 5 acres
- For every acre of drainage, filter strip width should be 100 feet perpendicular to flow of runoff and 50 feet long
- Design for wooded areas should include a healthy layer of mulch
- Ratio of drainage area to filter strip area must not exceed 6:1
- Lateral slope of filter strip is 1%
- Use of a level spreading device is recommended to provide sheet flow conditions
- Filter strips should be protected against pedestrian and vehicular traffic
- Length and slope of contributing drainage should be considered to avoid erosion of filter strip
- Minimize excessive soil compaction and land disturbance during construction
- Follow erosion control procedures
- Inspect regularly for clogging, rills or gullies caused by erosion, damage by foot traffic

Benefits and Uses

- Filters contaminants from runoff prior to its discharge to the storm sewer system
- Reduces peak velocity and volume of stormwater runoff delivered to storm sewer system or stream
- Provides some recharge to groundwater supply
- Can be used to treat runoff along residential streets, stream corridors, and small parking lots
- Provides an ideal habitat for wildlife, depending on vegetation selected
- Inexpensive to install and maintain
- Enhances aesthetics of local landscape
- Area can be used for snow storage during winter
- Applicable to all types of sites (residential/ commercial/industrial)

Additional Resources

PA Department of Environmental Protection
- www.dep.state.pa.us
- Pennsylvania Stormwater Best Management Practices Manual

US Environmental Protection Agency
www.epa.gov

Stormwater Manager's Resource Center
www.stormwatercenter.net

Diagram of Vegetated Filter Strip Application

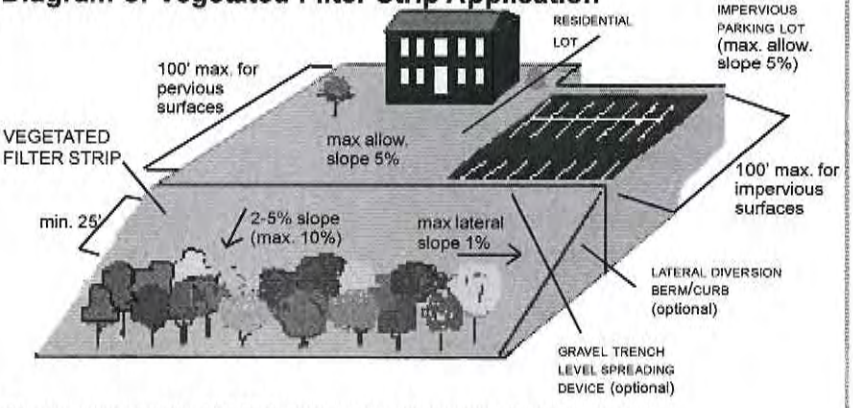
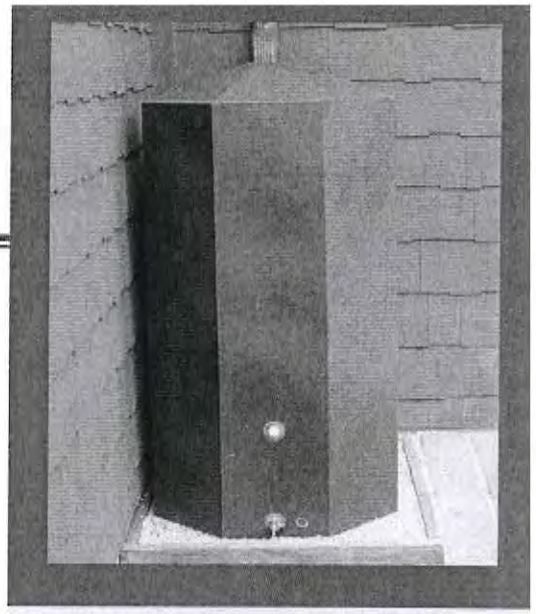


Diagram courtesy of the PA DEP Stormwater Best Management Practices Manual

Produced by:
Dauphin County Conservation District
1451 Peters Mountain Road Dauphin, PA 17018
www.dauphincd.org p: (717) 921.8100

Best Management Practices Fact Sheet

Rain Barrel

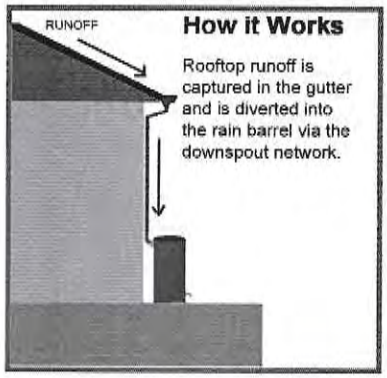


PURPOSE: Rain barrels reduce the amount of stormwater runoff flowing to an area by collecting roof runoff and storing the water for future use.

Rain barrels are an effective means of capturing and storing runoff collected from roofs of any size and function (commercial or residential). Manufactured containers range from units as small as 20 gallons to units capable of holding 600 gallons. Cisterns and polymer storage units with pumps are other types of storage that function the same as rain barrels.

The rain barrel is placed near a roof downspout outlet on a base of compacted dirt, pre-treated wood, or a concrete pad. The barrel is then connected to the downspout by a section of elbow pipe. Runoff is diverted into the rain barrel via the downspout.

Units specifically designed to function as rain barrels feature a cover for preventing animals, mosquitoes, dust, and light from contaminating stored water. A drain valve located near the base of the barrel releases collected runoff that can be used to water gardens or wash cars, reducing the consumption of tap water for this purpose. Some models include a mesh screen near the intake trough for filtering leaves and other rooftop debris. Rain barrels should feature a diverter that allows large quantities of runoff to bypass the unit during major storm events. Some units are designed to be connected in a series to increase capacity.



NOTE: Water collected in a rain barrel contains pollutants and is unfit for human consumption.

Benefits and Uses

- Cost-effective alternative to using tap water for watering yards and gardens
- Reduces peak volume and velocity of stormwater runoff to streams and storm sewer systems
- Helps to reduce peak water demand during summer months
- Applicable to all types of sites (residential/ commercial/industrial)
- Takes advantage of already existing source of fresh rainwater
- Inexpensive to install and maintain

General Design Considerations

- Calculate roof area to select rain barrel size to accommodate runoff volume
- During winter, open drain valve or disconnect system to prevent stored water from ice expansion, which could damage the container
- Position the rain barrel close to the downspout, where land slopes away from the foundation
- Collected water must be used or discharged before the next storm event unless a diverted unit is installed to allow excess water to bypass the unit
- Do not connect rain barrel system to any drinking water system
- Pipes or storage units should be marked "Caution: Do Not Drink"
- First flush runoff may be diverted away from storage to minimize sediment
- Storage tank should be protected from direct sunlight to minimize algae growth
- Cover should fit tight
- Unit should include a diverter to allow excess stormwater to bypass the rain barrel
- Containers should be flushed periodically to remove sediment
- Keep lid closed to reduce evaporation and prevent mosquito breeding

Additional Resources

PA Department of Environmental Protection
www.depweb.state.pa.us - search Pennsylvania Stormwater Best Management Practices Manual

US Environmental Protection Agency
www.epa.gov

Chesapeake Bay Foundation
www.cbf.org

Low Impact Development Center
- www.lid-stormwater.net - click on Site Map and select Rain Barrels and Cisterns
- www.lowimpactdevelopment.org

Maryland Department of Natural Resources
www.dnr.state.md.us/ed/rainbarrel.html

Stormwater Manager's Resource Center
www.stormwatercenter.net

Rain Barrel Guide Online
www.rainbarrelguide.com

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SIMPLE COMPUTATION FOR SIZING OF RAIN BARRELS FOR COLLECTION AND REUSE

ONE INCH OF RAIN THAT FALLS OVER ONE SQUARE FOOT OF IMPERVIOUS SURFACE CREATES 0.6 GALLONS OF WATER.

EXAMPLE: A ROOF OF 2000 SQUARE FEET WOULD PRODUCE 1200 GALLONS OF WATER PER ONE INCH STORM. (2000 X 0.6 = 1200 GALLONS).

Best Management Practices Fact Sheet

Vegetative Stabilization

PURPOSE: Permanent vegetation can prevent erosion by wind or water, and improves wildlife habitat and aesthetics. Vegetation reduces velocity and volume of runoff, and protects bare soil from the impact of rain.

Vegetative stabilization is the practice of preserving existing vegetation at a site during construction. Traditionally, sites are cleared of vegetation in preparation for construction activities. More vegetation is often removed than is necessary, which leads to a greater amount of exposed soil that is prone to erosion by wind and rain.

To prevent damage to the trees selected to remain during construction and their root systems, protective measures must be implemented. Following is a list of guidelines for assessing a site to determine the most effective implementation of this practice.

- ***Design to protect vegetated areas*** - consider protecting wooded areas, vegetated slopes, etc. as site development plans are prepared.
- ***Mark construction zone boundaries*** - on the site development plan, identify areas of disturbance, including the location of proposed buildings, pavement, material storage areas and paths used by construction equipment. Use stakes and string to mark boundaries at the site; clearly mark trees to be preserved.
- ***Inventory tree health and select trees to be saved*** - remove diseased trees; consider alternative site designs to maximize retention of healthy trees.
- ***Designate areas that are off limits*** - use bright colored polypropylene tape to mark a boundary around the area that is not to be disturbed, including room for root systems; photograph the area before construction begins.
- ***Prepare trees for construction disturbance*** - address water and nutrient deficiencies prior to construction to aid with tree survival after construction.
- ***Protect soil for future tree planting*** - apply a six-inch layer of wood chips on areas used for materials storage or equipment paths to alleviate soil compaction.
- ***Monitor tree health during construction*** - irrigate trees regularly and inspect for any damage to branches, trunks and roots.
- ***Final site inspection*** - remove protective tape/fencing after all work is complete; continue regular maintenance, i.e. watering, pruning, fertilization, etc.

General Design Considerations

- Vegetation is effective for stabilizing flow with a stream channel velocity of up to 5 feet per second
- May be used in conjunction with structural measures to provide effective erosion control
- Young, small trees tend to survive disturbance better than large trees
- Use erosion control measures around perimeter of preserved area to maintain adequate water flow and drainage conditions
- Disturb no more than 25% of roots within each tree's dripline
- Heavily wooded sites should be thinned over a period of time to prevent stress
- Avoid changes in soil pH
- Avoid disruptions to the site's natural contour
- Cut exposed roots cleanly to promote quick wound closure

Benefits and Uses

- Prevents erosion at construction site
- Applicable to all types of sites, including floodplains, wetlands and steep-sloped areas
- Enhances aesthetics of local landscape
- Provides habitat for wildlife
- Able to handle higher quantities of runoff than newly seeded areas
- Immediately effective
- Requires less maintenance than newly planted vegetation
- Provides noise buffer and screens construction activity

Additional Resources

PA Department of Environmental Protection
- www.dep.state.pa.us
- Pennsylvania Stormwater Best Management Practices Manual

US Environmental Protection Agency
www.epa.gov

Cahill Associates
www.thcahill.com - click on "Technologies" for project examples and general information

Low Impact Development Center
www.lowimpactdevelopment.org

University of Minnesota Extension Service
"Homeowner's Guide to Protecting Trees from Construction Damage" - www.extension.umn.edu/distribution/housingandclothing/DK6135.html

Stormwater Manager's Resource Center
www.stormwatercenter.net

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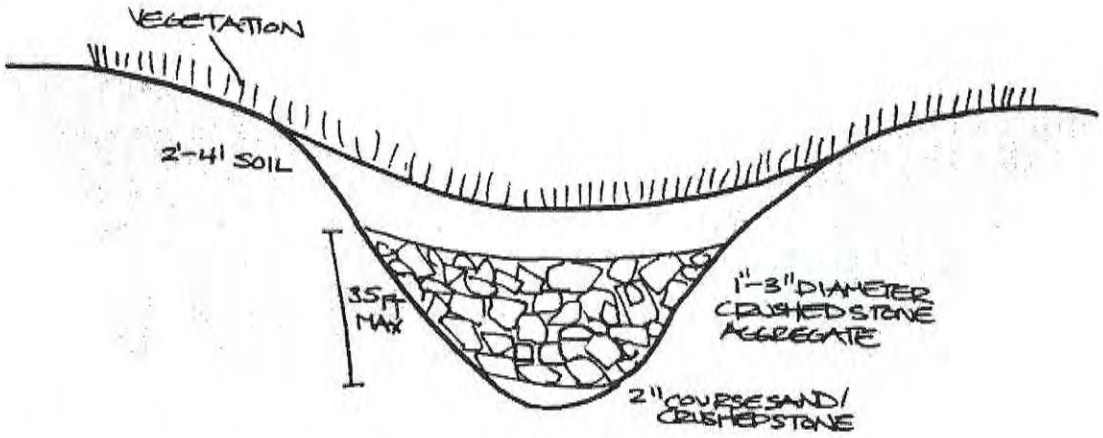
Vegetated Swale

A vegetated swale is a planted channel that infiltrates runoff and filters pollutants. They handle impervious surfaces like driveways, patios, and walkways. Vegetated swales can be simple, purely bioretention systems (like a rain garden), or they can include an infiltration trench.

Sizing
Sizing a vegetated swale is similar to sizing an Infiltration Trench (Page 15).
Determine Volume of stormwater Swale must handle (Step 2), use this value as the Swale Required Dimensions.

1. Swale Required Dimensions = Swale Void Volume / 40% Void Ratio (result of gaps in gravel)
   ½ of driveway stormwater volume (161.25 ft cu) = Swale Required Dimensions
   161.25ft cu = Swale Void Volume/40%
   Swale Void Volume = 64.5 ft cu

2. Swale Void Volume = width (.5ft - 1.5ft) x length x depth (max 3.5ft) x ½ (Triangle shape)
   64.5 ft cu = 1 ft (width) x length x 3.5 ft (depth) x ½
   Length = 36.9 ft
   Final Swale Dimensions are 36.9' x 1' x 3.5'



Installation
Dig swale pit. Triangular shapes are most effective. Swale depth should be 2'-5' from surface. Simple veg. swales should be filled with well-drained soils, planted like a rain garden, and mulched.
If you would like to add an infiltration system to your vegetated swale, as shown above, line bottom of pit with course sand or finely crushed stone. Fill 1'-2' with 1-3" diameter stone aggregate. Lay over 2-4' of permeable soil, and plant.
When planting vegetation, consult planting tips in rain garden section, and use the plant list supplement in this pamphlet (p21). Grasses are particularly effective at purifying and infiltrating stormwater runoff.

Maintenance
Vegetation must be maintained, and checked regularly for health. Inspect swale for litter and debris, and mow or weed when necessary. Be sure to water swale during dry periods, especially after initial planting.

Costs
Swales are a much cheaper and longer-lasting option than traditional curbs and gutters. Costs for grass swales range 30-70 cents per square foot, but vary greatly with plant choice. Grassed swales are cheaper than swales vegetated with shrubs and wildflowers.

Best Management Practices Fact Sheet

Vegetated Swale

PURPOSE: Vegetated swales are an alternative to traditional storm sewer systems that use pipes to convey stormwater runoff. Vegetation planted along the swale enhances infiltration of runoff into the soil, and can aid in the settling and filtering of pollutants from runoff.

The swale itself is an open, U-shaped channel, planted with grass, shrubs or trees along the base and sides of the swale. Vegetation provides an initial filter, as well as a means for slowing the rate of runoff. The vegetated or grassed top layer is underlain by a thick layer of highly organic, permeable soil, which further filters runoff. An additional layer of aggregate laid under the soil layer can significantly reduce the peak volume and conveyance rate of stormwater.

In areas with steeper slopes (greater than three percent), the addition of a check dam to a swale works to slow or "check" the speed of runoff as it courses through the swale, which allows for increased infiltration. Placing the dam near the source of runoff vastly reduces its speed. The ponding area created on the back side of the dam enables sediment to settle out of runoff. Check dams can be placed in series to increase their effectiveness. Materials suitable for check dams include: wood, concrete, stone, and earth.

NOTE: Grass-only swales provide less infiltration and pollutant removal capabilities than swales planted with a mix of shrub and tree vegetation. Swales should be located at least 100 feet from drinking water sources to avoid contamination.

Benefits and Uses

- Filters some contaminants from runoff prior to its discharge to streams and storm sewer systems
- Provides some recharge to groundwater supply
- Reduces peak volume and velocity of stormwater runoff to streams and storm sewer systems
- Helps alleviate flooding and erosion downstream
- Applicable to all types of sites (residential/ commercial/industrial)
- Inexpensive to install and maintain
- Enhances aesthetics of local landscape
- Can be incorporated along roadways and parking lots as an alternative to curbs

Additional Resources

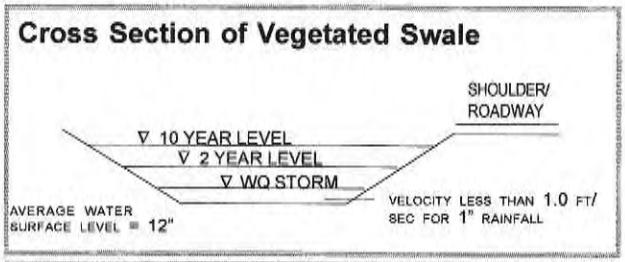
PA Department of Environmental Protection
- www.dep.state.pa.us
- Pennsylvania Stormwater Best Management Practices Manual

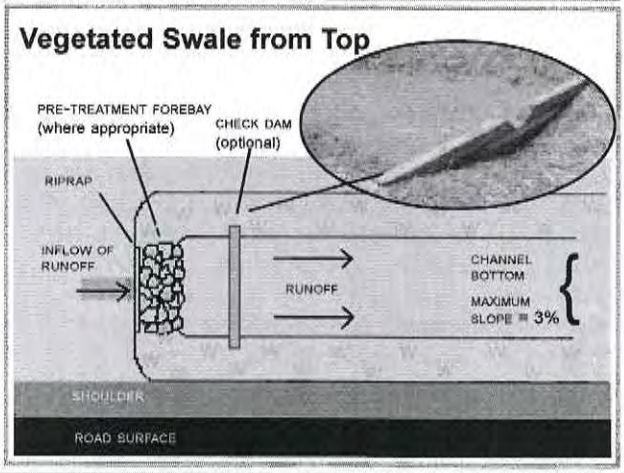
US Environmental Protection Agency
www.epa.gov

Stormwater Manager's Resource Center
www.stormwatercenter.net

General Design Considerations

- Design should incorporate existing site features, land use, size of drainage area, soil type and slope to maximize effectiveness
- Minimum infiltration rate of permeable soil media should be at least 0.5 inch per hour
- Slope for length of swale should be 2% to 6%; side slope should be 3:1 or 4:1
- Bottom width of swale from 2 to 8 feet
- Design for maximum ponding depth of 18 inches; maximum ponding time of 48 hours
- Construct swales in areas of uncompacted soil where possible
- Soil media should contain a high level of organic material to assist with pollutant removal
- Permeable soil layer should be at least 30 inches deep within the ponding area created by the check dam
- Allow for a 12 to 24-inch base layer of stone aggregate to reduce peak rate and volume
- Height of check dam can be designed for various frequency storms (ex. 10-year)
- Maximum amount of filtering occurs for water depths below six inches
- Select dense, low-growing native vegetation that is tolerant of varying water level conditions
- Vegetation should not be submerged for prolonged periods of time
- Mature tree cover should allow light to pass through to other vegetation
- Follow guidelines for erosion control and runoff velocity/flow depth
- Incorporating a swale with an infiltration trench or wetland aids with pollutant removal; follow design guidelines for constructing each specific type of BMP
- Consider pretreatment options, such as a filter strip, if a swale is the sole means of treatment for runoff
- Routinely inspect for pooling water, eroded vegetation, litter and blockages
- Reseed sparse areas as necessary





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Bio-retention BMPs: The following BMPs utilize bio-retention to mange stormwater on your site.

Rain Garden

Rain gardens are a shallow depression planted with native vegetation that capture, filter, and infiltrate stormwater. They work well infiltrating rooftop, driveway, path, and patio runoff. Rain gardens are versatile and attractive, and can take a variety of shapes and forms.

Sizing

1. Determine Total Impervious Surfaces
   ie ¼ Rooftop runoff: 12.5 ft x 37.5 ft = 468.75 ft sq

2. Using a loading ratio of **5:1(impervious to rain garden),** determine minimum size of rain garden Bed:
   (Impervious Area)/5= (468.75)/5=93.75 ft sq
   Size of Rain Garden Bed = 93.75 ft sq
   This means, the rain garden's dimensions can be 9.7ft x 9.7ft, or 3ft by 31 ft, or any dimension that contains 93.75 ft sq

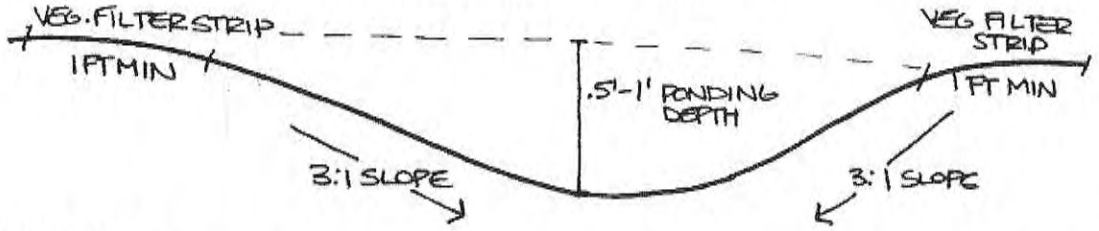
3. Sizing of Rain Garden
Total Volume of rain garden = Surface storage + soil storage

   a. Surface Storage Volume (ft3) = Bed Area (ft2) x Average Design Water Depth (12")
   Surface Storage Volume (ft3) = 93.75 ft sq x 1 ft = 93.75 ft cu

   b. Soil Storage Volume (ft3) = Bed Area (ft2) x Depth of Amended Soil (ft) x Holding Capacity (typically 10-20% can be greater if soils amended with organic matter)

   Soil Storage Volume (ft3) = 93.75 ft sq x 2.5 ft x 15% = 35.16 ft cu

Total Volume of rain garden = Surface storage + soil storage
Total Volume of rain garden = 93.75 ft cu + 35.16 ft cu = 128.91 ft cu



Installation

Select an area at least 10 feet from your house, ideally in a naturally occurring low spot. The rain garden should have full to partial sun.
Mark out the size of your garden, and start to dig. Try to create a level area around the outer edge of the rain garden, to create sheet flow and act as a filter strip. You can use some of the cut soil to create a small berm around the garden. The slopes of the sides should be fairly gradual, or about 3:1.

Create the ponding area. Avoid creating a surface pond depth lower than 12"s, for safety and maintenance reasons. The ponding area should meet the required storage volume without exceeding 12"s.

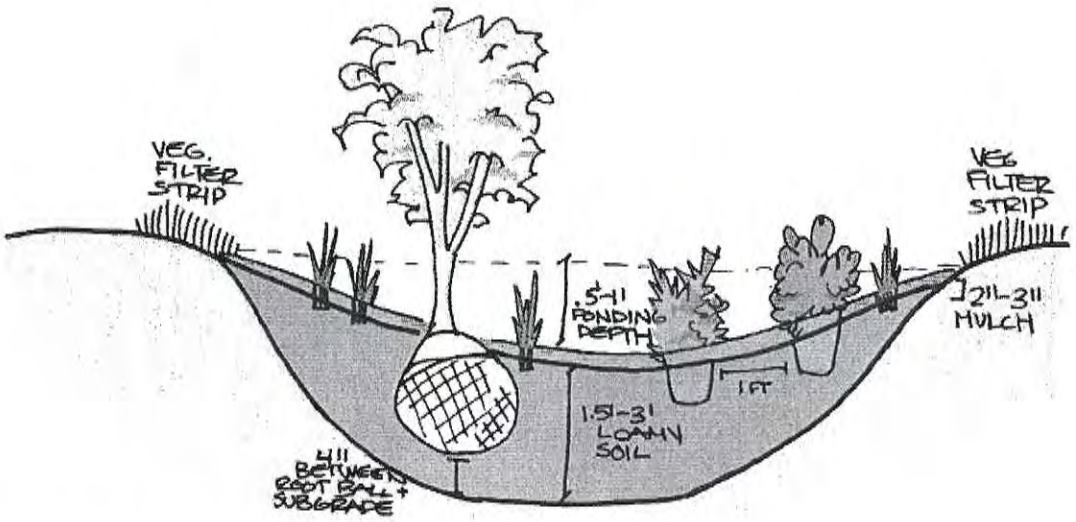
Planting soil depth should be about 18"s, or deeper with different tree species. Planting soil should be loam, and 20-30% organic material/compost. Planting soil should be about 4" deeper than the bottom of the largest root ball.

Planting
Plant a vegetated filter strip around the slopes of the ponding area to keep the rain garden healthy (see page 13)

Select native floodplain species to make up the rain garden area. See the recommended plant list (p 21) for tips about plant selection. A mix of trees and shrubs is recommended, with about one tree for every three shrubs. Plants native to Pennsylvania are most effective, as they are lower maintenance and resist disease. Get creative with your plant palette, and select different plants with interesting textures and colors.

Plant trees and shrubs first, about a foot apart, and fill in with plugs of grasses and flowers. Seeding isn't effective in rain gardens, so plugs are recommended.

Mulch helps filter pollutants and protect soil. Compost or leaf mulch is preferred, and wood mulch should be shredded. Mulch layer should be no thicker than 2-3".



Maintenance
Rain gardens require a little initial maintenance to stay healthy. For the first 2 weeks, water the garden every other day (unless it rains). For the first year, the garden requires weeding, and about an inch of water a week.
A rain garden also needs to be re-mulched annually, and raked regularly, to prevent weed-growth. Once during spring and fall dead vegetation should also be removed from the rain garden, and replacement plants should be planted.

Costs
Rain gardens are a fairly low-cost BMP, with their simple installation and maintenance. Most of the costs come from the price of plants.
Creating your own rain garden costs $3 to $5 per square foot, but if a landscaper is hired to do everything, it will cost $10 to $12 per square foot.
Building the example rain garden yourself would cost $280 to $470, while hiring a landscaper to install it would cost $940 to $1100.
See the plant chart in the back for individual plants price estimates.

Stormwater Best Management Practices Fact Sheet

Rain Garden

PURPOSE: Rain gardens are small-scale bioretention areas that benefit water quality by removing pollutants from runoff. They also reduce the speed of runoff and promote infiltration of runoff into the groundwater supply.

Rain gardens are designed to mimic the layered conditions of a forest floor, which naturally filters pollutants from water. The rain garden consists of a vegetated or stone ponding area, a mulch layer, a planting soil layer, a sand bed, and a gravel base. The multiple layers work together to filter pollutants from water, allowing it to infiltrate into the groundwater supply uncontaminated.

Rain gardens are well-suited for use on individual residential sites, as they provide for stormwater management on a lot-by-lot basis. The vegetated or stone surface layer initially slows the velocity of runoff and provides temporary storage for runoff before water either evaporates or infiltrates the soil. Plant material aids with evapotranspiration of water, and plant roots create pathways for water to infiltrate soil. Water retained in the ponding area is absorbed into the mulch layer, where bacteria that live among plant roots digest pollutants, even petroleum-based solvents. Mulch also aids with preventing erosion, protects underlying soil from drying, and provides a medium for biological growth and decomposition of organic matter. The soil layer provides water and nutrients to plants. Voids within the soil are where runoff is stored prior to infiltration to deeper ground. Addition of a subsurface infiltration bed will help to move water from the surface ponding area into the ground, and will aid with aerating the soil layers in order to enable them to absorb additional runoff. Runoff then filters through a layer of nonwoven geotextile material before seeping into a bed of sand for additional filtering. Lastly, water is received into a stone base, which allows the water to drain into the ground below.

Unlike bioretention areas, rain gardens traditionally do not include an underdrain feature to convey water to a storm sewer system because their purpose is to allow runoff to infiltrate the groundwater supply.

Rain gardens can be used in conjunction with porous paved parking areas, infiltration trenches, and filter strips for pretreatment of stormwater runoff.

Benefits and Uses

- Filters contaminants from runoff prior to its discharge to the storm sewer system or streams
- Reduces peak velocity and volume of stormwater runoff delivered to storm sewer system or streams
- Alleviates flooding and erosion downstream
- Inexpensive to install and maintain
- Enhances aesthetics of local landscape
- Recharges groundwater supply
- Applicable to all types of sites (residential/ commercial/industrial)
- Can be used to treat runoff from streets, parking lots and driveways
- Provides habitat for wildlife
- Reduces mosquito breeding by removing standing water in yards
- Reduces potential of home flooding

Additional Resources

PA Department of Environmental Protection
www.depweb.state.pa.us - search Pennsylvania Stormwater Best Management Practices Manual

Alliance for the Chesapeake Bay
www.AllianceChesBay.org

Cahill Associates
www.thcahill.com - click on "Technologies" for project examples and general information

Rain Garden Network
www.raingardennetwork.com

Stormwater Manager's Resource Center
www.stormwatercenter.net

General Design Considerations

- Effective for draining areas of less than 5 acres
- Effective for nearly all types of soils and topography; best suited for areas with moderate permeability, more than 0.25 inch per hour
- Allow space between basin bottom and water table and bedrock to prevent groundwater contamination
- Design should include overflow drainage to remove excess stormwater
- Not suitable for receiving runoff with high levels of sediment
- Underdrains should not be used in rain garden design (see *bioretention area* for drainage)
- Recommended side slope is 3:1, or 2:1 in areas where space is limited
- Select native vegetation that is tolerant of varying water conditions (see reverse side)
- Plant depth should be at least 24 inches for herbaceous plants
- Soil should be a loam, loam/sand mix or sandy loam capable of supporting vegetative cover; modify soil with compost if needed
- Use a maximum of 2 to 3 inches of mulch
- Replace mulch annually• Restrict ponding depth to 6 inches or less
- Pruning and weeding should be performed as necessary
- Rain gardens may require watering during dry periods
- Follow erosion control procedures
- Inspect regularly for clogging, litter, or rills or gullies caused by erosion

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Native Vegetation

Native vegetation refers to plants, shrubs and trees that have existed in an area before it was settled by Europeans. More than 2,100 native plant species grow in Pennsylvania.

Using native plants is beneficial, as they are acclimated to the local climate and therefore, require less maintenance than introduced species. Native plants also contribute to the preservation of Pennsylvania's plant heritage.

Cultivars are varieties of native plants bred for a particular characteristic (size, color, etc.). Cultivars may be used in place of a native species.

Other Native Plants

Examples of some other types of native plants include:

Flowers

Wild Columbine	Jack-in-the-Pulpit
Wood Geranium	Common Milkweed
Phlox	Sundrops
Common Blue Violet	Partridge-berry
Virginia Bluebell	May-apple
Cardinal Flower	Trillium

Grasses

Virginia Wild Rye	Switch Grass
Indian Grass	Bottlebrush Grass
Lurid Sedge	Big Bluestem

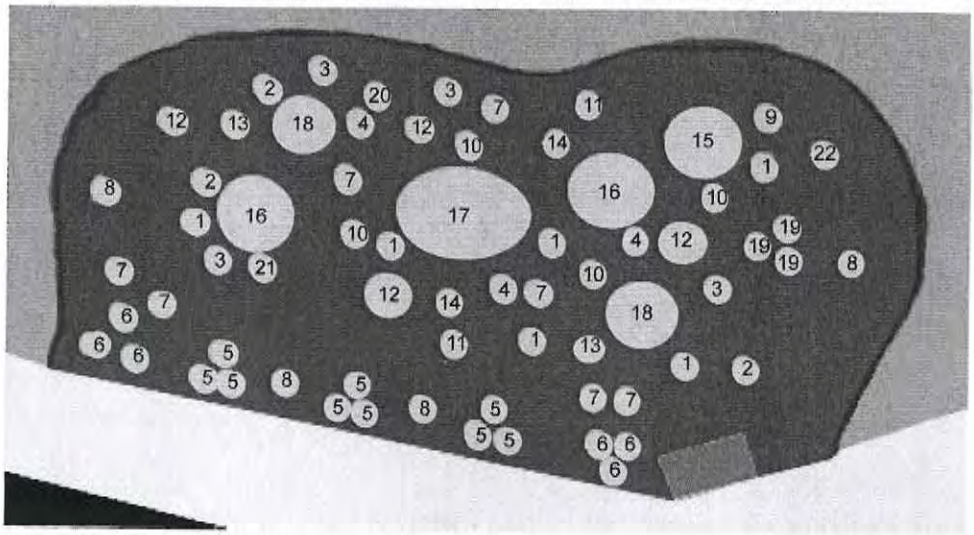
Shrubs

Red Chokeberry	Silky Dogwood
Black Chokeberry	Flowering Dogwood
Winterberry	Wild Plum
Fragrant Sumac	Virginia creeper
Mountain Laurel	Redbud

Trees

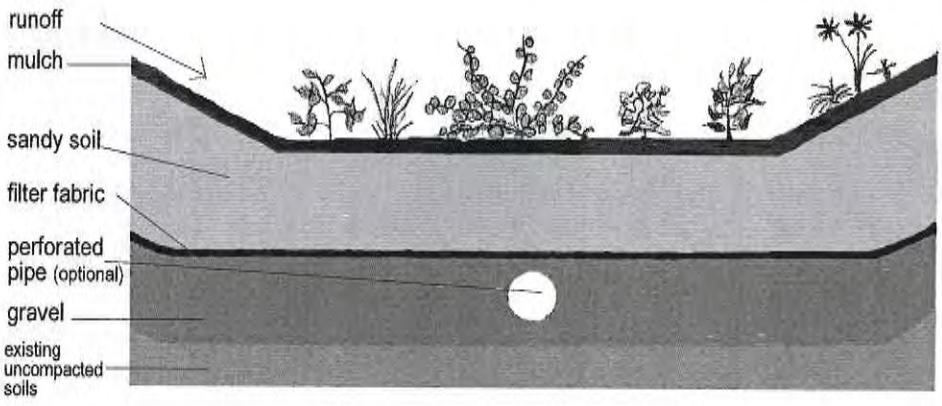
Red Maple	Sugar Maple
Tulip Poplar	Eastern White Pine
American Beech	Sycamore
Swamp White Oak	Chestnut Oak
White Oak	Red Oak
Black Birch	Yellow Birch

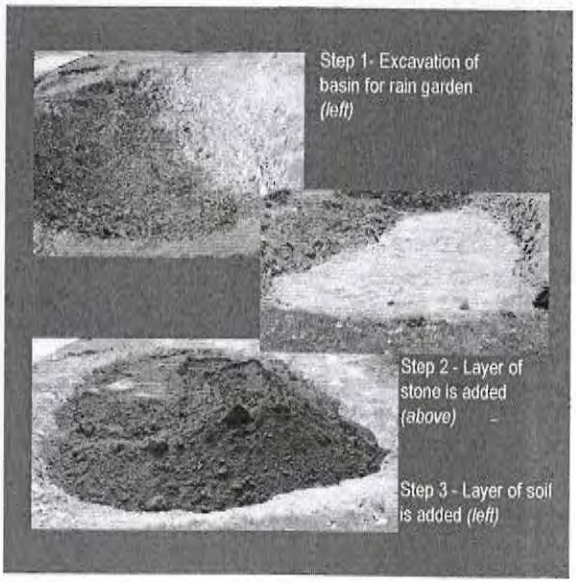
Native Vegetation planted in the BMP Tour Rain Garden



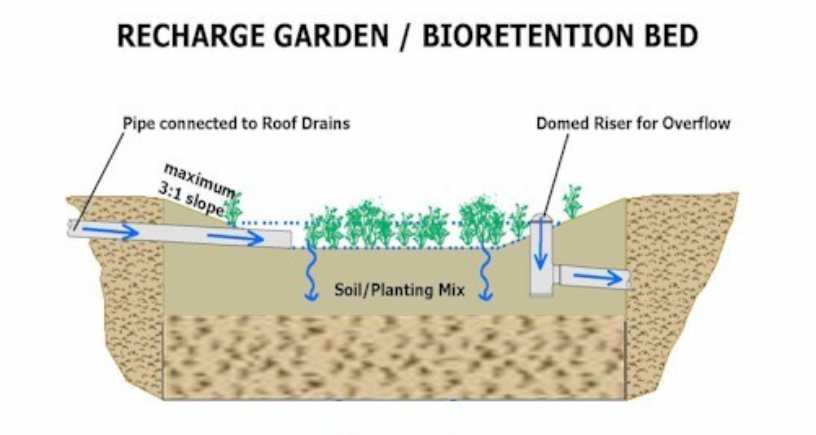
Key	Flowers/Shrubs	Latin Name	Flowering time
1	Foxglove Beardtongue	*Penstemon digitalis*	May-July
2	Swamp Sunflower	*Helianthus angustifolium*	Aug-Oct
3	Swamp Milkweed	*Asclepias incarnata*	July-Oct
4	Dogtooth Daisy/Sneezeweed	*Helenium autumnale*	Aug-Nov
5	Mouse-eared tickseed cultivar	*Coreopsis auriculata* 'Nana'	May-Sept
6	Black-eyed Susan cultivar	*Rudbeckia speciosa* 'Goldsturm'	Aug-Oct
7	Marsh Blazing Star	*Liatris spicata*	July-Sept
8	Stout Blue-eyed Grass	*Sisyrinchium angustifolium*	May-July
9	Evening primrose cultivar	*Oenothera fruiticosa* 'Lemondrops'	May-Aug
10	New England Aster	*Aster novi-angliae*	Aug-Oct
11	New England Aster cultivar	*Aster novi-angliae* 'Purple Dome'	Aug-Oct
12	Spiderwort cultivar	*Tradescantia ohiensis* 'Mrs. Loewer'	June-July
13	Simler's Joy/Blue Vervain	*Verbena hastata*	June-Oct
14	Boneset	*Eupatorium perfolatum*	July-Sept
15	Elderberry	*Sambucus canadensis*	June
16	Virginia Sweet Spire cultivar	*Itea virginica* 'Henry's Garnet'	June-July
17	Red Osier Dogwood	*Cornus sericea*	June-July
18	Summer Sweet cultivar	*Clethra alnifolia* 'Ruby Spice'	July-Sept
19	Goldenrod cultivar	*Solidago sphacelata* 'Golden Fleece'	Aug-Oct
20	Great Blue Lobelia	*Lobelia siphilitica*	Aug-Oct
21	Eastern Joe-pye Weed	*Eupatorium dubium*	June-Sept
22	Narrow-leaf Echinacea	*Echinacea angustifolia*	June-Aug

A Closer Look at the Layers of a Rain Garden





BMP 6.4.5: Rain Garden/Bioretention



A Rain Garden (also called Bioretention) is an excavated shallow surface depression planted with specially selected native vegetation to treat and capture runoff.

Key Design Elements

- Flexible in terms of size and infiltration
- Ponding depths generally limited to 12 inches or less for aesthetics, safety, and rapid draw down. Certain situations may allow deeper ponding depths.
- Deep rooted perennials and trees encouraged
- Native vegetation that is tolerant of hydrologic variability, salts and environmental stress
- Modify soil with compost.
- Stable inflow/outflow conditions
- Provide positive overflow
- Maintenance to ensure long-term functionality

Potential Applications

Residential:	Yes
Commercial:	Yes
Ultra Urban:	Yes
Industrial:	Yes
Retrofit:	Yes
Highway/Road:	Yes

Stormwater Functions

Volume Reduction:	Medium
Recharge:	Med./High
Peak Rate Control:	Low/Med.
Water Quality:	Med./High

Water Quality Functions

TSS:	TP: 85%	85%
	NO3: 30%	

Other Considerations

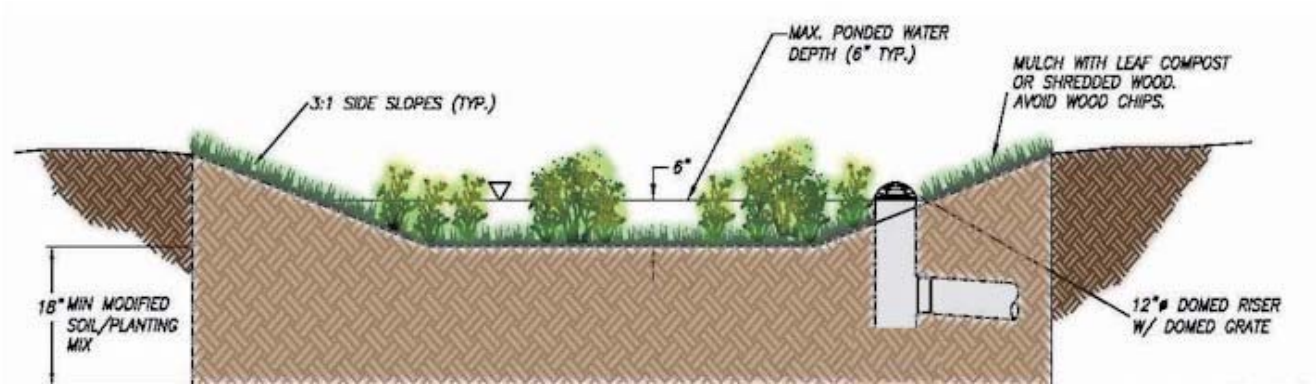
- **Protocol 1. Site Evaluation and Soil Infiltration Testing** and **Protocol 2. Infiltration Systems Guidelines** should be followed, see Appendix C

Description

Bioretention is a method of treating stormwater by pooling water on the surface and allowing filtering and settling of suspended solids and sediment at the mulch layer, prior to entering the plant/soil/microbe complex media for infiltration and pollutant removal. Bioretention techniques are used to accomplish water quality improvement and water quantity reduction. Prince George's County, Maryland, and Alexandria, Virginia have used this BMP since 1992 with success in many urban and suburban settings.

Bioretention can be integrated into a site with a high degree of flexibility and can balance nicely with other structural management systems, including porous asphalt parking lots, infiltration trenches, as well as non-structural stormwater BMPs described in Chapter 5.

The vegetation serves to filter (water quality) and transpire (water quantity) runoff, and the root systems can enhance infiltration. The plants take up pollutants; the soil medium filters out pollutants and allows storage and infiltration of stormwater runoff; and the bed provides additional volume control. Properly designed bioretention techniques mimic natural ecosystems through species diversity, density and distribution of vegetation, and the use of native species, resulting in a system that is resistant to insects, disease, pollution, and climatic stresses.



Rain Gardens / Bioretention function to:

- Reduce runoff volume
- Filter pollutants, through both soil particles (which trap pollutants) and plant material (which take up pollutants)
- Recharge groundwater by infiltration
- Reduce stormwater temperature impacts
- Enhance evapotranspiration
- Enhance aesthetics
- Provide habitat

Primary Components of a Rain Garden/Bioretention System

The primary components (and subcomponents) of a rain garden/bioretention system are:

Pretreatment (optional)

- Sheet flow through a vegetated buffer strip, cleanout, water quality inlet, etc. prior to entry into the Rain Garden

Flow entrance

- Varies with site use (e.g., parking island versus residential lot applications)
- Water may enter via an inlet (e.g., flared end section)
- Sheet flow into the facility over grassed areas
- Curb cuts with grading for sheet flow entrance
- Roof leaders with direct surface connection
- Trench drain
- Entering velocities should be non-erosive.

Ponding area

- Provides temporary surface storage of runoff
- Provides evaporation for a portion of runoff
- Design depths allow sediment to settle
- Limited in depth for aesthetics and safety

Plant material

- Evapotranspiration of stormwater
- Root development and rhizome community create pathways for infiltration
- Bacteria community resides within the root system creating healthy soil structure with water quality benefits
- Improves aesthetics for site
- Provides habitat for animals and insects
- Reinforces long-term performance of subsurface infiltration
- Should be tolerant of salts if in a location that would receive snow melt chemicals

Organic layer or mulch

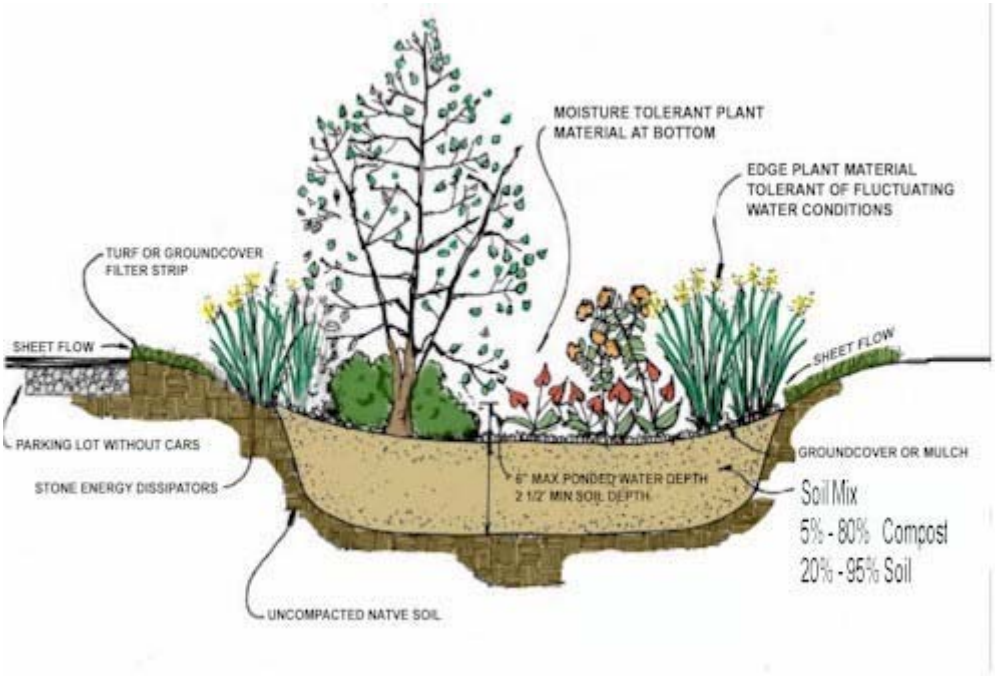
- Acts as a filter for pollutants in runoff
- Protects underlying soil from drying and eroding
- Simulates leaf litter by providing environment for microorganisms to degrade organic material
- Provides a medium for biological growth, decomposition of organic material, adsorption and bonding of heavy metals
- Wood mulch should be shredded - compost or leaf mulch is preferred.

Planting soil/volume storage bed

- Provides water/nutrients to plants
- Enhances biological activity and encourages root growth
- Provides storage of stormwater by the voids within the soil particles

Positive overflow

- Will discharge runoff during large storm events when the storage capacity is exceeded. Examples include domed riser, inlet, weir structure, etc.
- An underdrain can be included in areas where infiltration is not possible or appropriate.



Variations

Generally, a Rain Garden/Bioretention system is a vegetated surface depression that provides for the infiltration of relatively small volumes of stormwater runoff, often managing stormwater on a lot-by-lot basis (versus the total development site). If greater volumes of runoff need to be managed or stored, the system can be designed with an expanded subsurface infiltration bed or the Bioretention area can be increased in size.

The design of a Rain Garden can vary in complexity depending on the quantity of runoff volume to be managed, as well as the pollutant reduction objectives for the entire site. Variations exist both in the components of the systems, which are a function of the land use surrounding the Bioretention system.

The most common variation includes a gravel or sand bed underneath the planting bed. The original intent of this design, however, was to perform as a filter BMP utilizing an under drain and subsequent discharge. When a designer decides to use a gravel or sand bed for volume storage under the planting bed, then additional design elements and changes in the vegetation plantings should be provided.

Flow Entrance: Curbs and Curb Cuts

Flow Entrance: Trench Drain

Positive Overflow: Domed Riser

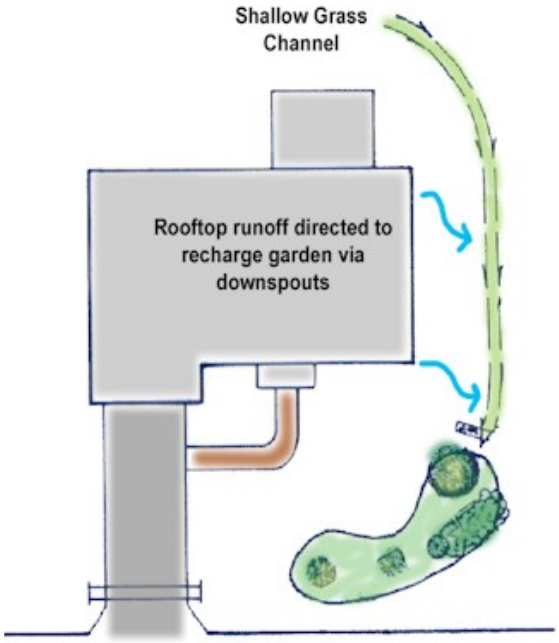
Positive Overflow: Inlet

Applications

Bioretention areas can be used in a variety of applications: from small areas in residential lawns to extensive systems in large parking lots (incorporated into parking islands and/or perimeter areas).

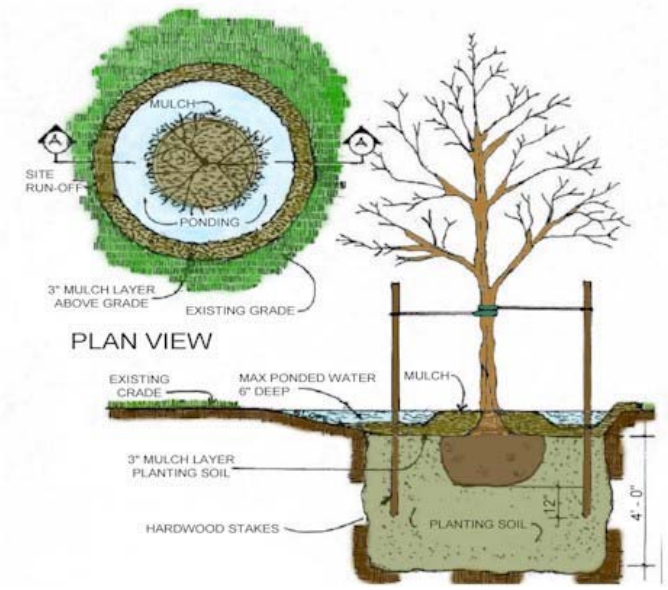
- **Residential On-lot**

  Rain Garden (Prince George's County)
  Simple design that incorporates a planting bed in the low portion of the site

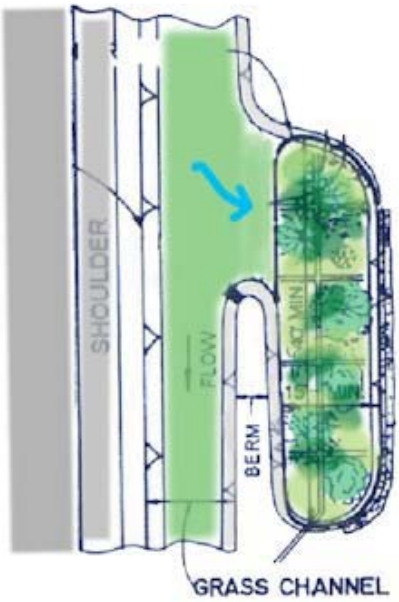


- **Tree and Shrub Pits**
  Stormwater management technique that intercepts runoff and provides shallow ponding in a dished mulched area around the tree or shrub.

  Extend the mulched area to the tree dripline



- **Roads and highways**



- **Parking Lots**
- **Parking Lot Island Bioretention**

- **Commercial/Industrial/Institutional**

In commercial, industrial, and institutional situations, stormwater management and greenspace areas are limited, and in these situations, Rain Gardens for stormwater management and landscaping provide multifunctional options.

- **Curbless (Curb cuts) Parking Lot Perimeter Bioretention**
  The Rain Garden is located adjacent to a parking area with no curb or curb cuts , allowing stormwater to sheet flow over the parking lot directly into the Rain Garden. Shallow grades should direct runoff at reasonable velocities; this design can be used in conjunction with depression storage for stormwater quantity control.

- **Curbed Parking Lot Perimeter Bioretention**

- **Roof leader connection from adjacent building**

Design Considerations

Rain Gardens are flexible in design and can vary in complexity according to water quality objectives and runoff volume requirements. Though Rain Gardens are a structural BMP, the initial siting of bioretention areas should respect the Integrating Site Design Procedures described in Chapter 4 and integrated with the preventive non-structural BMPs.

It is important to note that bioretention areas are not to be confused with constructed wetlands or wet ponds which permanently pond water. Bioretention is best suited for areas with at least moderate infiltration rates (more than 0.1 inches per hour). In extreme situations where permeability is less than 0.1 inches per hour, special variants may apply, including under drains, or even constructed wetlands.

Rain Gardens are often very useful in retrofit projects and can be integrated into already developed lots and sites. An important concern for all Rain Garden applications is their long-term protection and maintenance, especially if undertaken in multiple residential lots where individual homeowners provide maintenance. In such situations, it is important to provide some sort of management that insures their long-term functioning (deed restrictions, covenants, and so forth).

1. **Sizing criteria**

   a. Surface area is dependent upon storage volume requirements but should generally not exceed a maximum loading ratio of 5:1 (impervious drainage area to infiltration area; see Protocol 2. Infiltration Systems Guidelines (Appendix C) for additional guidance on loading rates.)

   b. Surface Side slopes should be gradual. For most areas, maximum 3:1 side slopes are recommended, however where space is limited, 2:1 side slopes may be acceptable.

   c. Surface Ponding depth should not exceed 6 inches in most cases and should empty within 72 hours.

   d. Ponding area should provide sufficient surface area to meet required storage volume without exceeding the design ponding depth. The subsurface storage/infiltration bed is used to supplement surface storage where feasible.

   e. Planting soil depth should generally be at least 18” where only herbaceous plant species will be utilized. If trees and woody shrubs will be used, soil media depth may be increased, depending on plant species.

2. **Planting Soil** should be a loam soil capable of supporting a healthy vegetative cover. Soils should be amended with a composted organic material. A typical organic amended soil is combined with 20-30% organic material (compost), and 70-80% soil base (preferably topsoil). Planting soil should be approximately 4 inches deeper than the bottom of the largest root ball.

3. **Volume Storage Soils** should also have a pH of between 5.5 and 6.5 (better pollutant adsorption and microbial activity), a clay content less than 10% (a small amount of clay is beneficial to adsorb pollutants and retain water), be free of toxic substances and unwanted plant material and have a 5 –10% organic matter content. Additional organic matter can be added to the soil to increase water holding capacity (tests should be conducted to determine volume storage capacity of amended soils).

4. Proper **plant selection** is essential for bioretention areas to be effective. Typically, native floodplain plant species are best suited to the variable environmental conditions encountered. If shrubs and trees are included in a bioretention area (which is recommended), at least three species of shrub and tree should be planted at a rate of approximately 700 shrubs and 300 trees per acre (shrub to tree ratio should be 2:1 to 3:1). An experienced landscape architect is recommended to design native planting layout.

5. Planting periods will vary, but in general trees and shrubs should be planted from mid-March through the end of June, or mid-September through mid-November

6. A maximum of 2 to 3 inches of shredded **mulch** or leaf compost (or other comparable product) should be uniformly applied immediately after shrubs and trees are planted to prevent erosion, enhance metal removals, and simulate leaf litter in a natural forest system. Wood chips should be avoided as they tend to float during inundation periods. Mulch / compost layer should not exceed 3" in depth so as not to restrict oxygen flow to roots.

7. Must be designed carefully in areas with **steeper slopes** and should be aligned parallel to contours to minimize earthwork.

8. Under drains should not be used except where in-situ soils fail to drain surface water to meet the criteria in Chapter 3.

Detailed Stormwater Functions

Infiltration Area

Volume Reduction Calculations

The storage volume of a Bioretention area is defined as the sum total of 1. and the smaller of 2a or 2b below. The surface storage volume should account for at least 50% of the total storage. Inter-media void volumes may vary considerably based on design variations.

1. Surface Storage Volume (CF) = Bed Area (ft^2) x Average Design Water Depth

2a. Infiltration Volume = Bed Bottom area (sq ft) x infiltration design rate (in/hr) x infiltration period (hr) x 1/12.
2b. Volume = Bed Bottom area (sq ft) x soil mix bed depth x void space.

Peak Rate Mitigation

See Chapter 8 for Peak Rate Mitigation methodology, which addresses link between volume reduction and peak rate control.

Water Quality Improvement

See Chapter 8 for Water Quality Improvement methodology, which addresses pollutant removal effectiveness of this BMP.

Construction Sequence

The following is a typical construction sequence; however, alterations might be necessary depending on design variations.

1. Install temporary sediment control BMPs as shown on the plans.

2. Complete site grading. If applicable, construct curb cuts or other inflow entrance but provide protection so that drainage is prohibited from entering construction area.

3. Stabilize grading within the limit of disturbance except within the Rain Garden area. Rain garden bed areas may be used as temporary sediment traps provided that the proposed finish elevation of the bed is 12 inches lower than the bottom elevation of the sediment trap.

4. Excavate Rain Garden to proposed invert depth and scarify the existing soil surfaces. Do not compact in-situ soils.

5. Backfill Rain Garden with amended soil as shown on plans and specifications. Overfilling is recommended to account for settlement. Light hand tamping is acceptable if necessary.

6. Presoak the planting soil prior to planting vegetation to aid in settlement.

7. Complete final grading to achieve proposed design elevations, leaving space for upper layer of compost, mulch or topsoil as specified on plans.

8. Plant vegetation according to planting plan.

9. Mulch and install erosion protection at surface flow entrances where necessary.

Maintenance Issues

Properly designed and installed Bioretention areas require some regular maintenance.

- While vegetation is being established, pruning and weeding may be required.
- Detritus may also need to be removed every year. Perennial plantings may be cut down at the end of the growing season.
- Mulch should be re-spread when erosion is evident and be replenished as needed. Once every 2 to 3 years the entire area may require mulch replacement.
- Bioretention areas should be inspected at least two times per year for sediment buildup, erosion, vegetative conditions, etc.
- During periods of extended drought, Bioretention areas may require watering.
-
- Trees and shrubs should be inspected twice per year to evaluate health.

Cost Issues

Rain Gardens often replace areas that would have been landscaped and are maintenance-intensive so that the net cost can be considerably less than the actual construction cost. In addition, the use of Rain Gardens can decrease the cost for stormwater conveyance systems at a site. Rain Gardens cost approximately $5 to $7 (2005) per cubic foot of storage to construct.

Specifications

The following specifications are provided for informational purposes only. These specifications include information on acceptable materials for typical applications, but are by no means exclusive or limiting. The designer is responsible for developing detailed specifications for individual design projects in accordance with the project conditions.

1Vegetation - See Appendix B

2 Execution

a. Subgrade preparation

1. Existing sub-grade in Bioretention areas shall NOT be compacted or subject to excessive construction equipment traffic.
2. Initial excavation can be performed during rough site grading but shall not be carried to within one feet of the final bottom elevation. Final excavation should not take place until all disturbed areas in the drainage area have been stabilized.
3. Where erosion of sub-grade has caused accumulation of fine materials and/or surface ponding in the graded bottom, this material shall be removed with light

equipment and the underlying soils scarified to a minimum depth of 6 inches with a York rake or equivalent by light tractor.

4. Bring sub-grade of bioretention area to line, grade, and elevations indicated. Fill and lightly regrade any areas damaged by erosion, ponding, or traffic compaction. All bioretention areas shall be level grade on the bottom.
5. Halt excavation and notify engineer immediately if evidence of sinkhole activity or pinnacles of carbonate bedrock are encountered in the bioretention area.

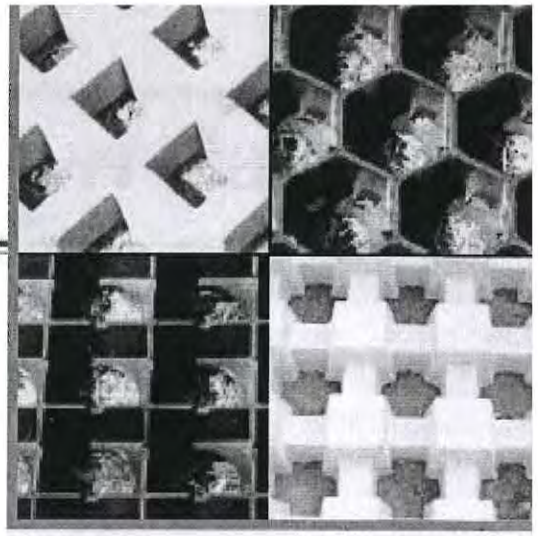
b. Rain Garden Installation

1. Upon completion of sub-grade work, the Engineer shall be notified and shall inspect at his/her discretion before proceeding with bioretention installation.
2. For the subsurface storage/infiltration bed installation, amended soils should be placed on the bottom to the specified depth.
3. Planting soil shall be placed immediately after approval of sub-grade preparation/bed installation. Any accumulation of debris or sediment that takes place after approval of sub-grade shall be removed prior to installation of planting soil at no extra cost to the Owner.
4. Install planting soil (exceeding all criteria) in 18-inch maximum lifts and lightly compact (tamp with backhoe bucket or by hand). Keep equipment movement over planting soil to a minimum – **do not over compact**. Install planting soil to grades indicated on the drawings.
5. Plant trees and shrubs according to supplier's recommendations and only from mid-March through the end of June or from mid-September through mid-November.
6. Install 2-3" shredded hardwood mulch (minimum age 6 months) or compost mulch evenly as shown on plans. Do not apply mulch in areas where ground cover is to be grass or where cover will be established by seeding.
7. Protect Rain Gardens from sediment at all times during construction. Hay bales, diversion berms and/or other appropriate measures shall be used at the toe of slopes that are adjacent to Rain Gardens to prevent sediment from washing into these areas during site development.
8. When the site is fully vegetated and the soil mantle stabilized the plan designer shall be notified and shall inspect the Rain Garden drainage area at his/her discretion before the area is brought online and sediment control devices removed.
9. Water vegetation at the end of each day for two weeks after planting is completed.

Contractor should provide a one-year 80% care and replacement warranty for all planting beginning after installation and inspection of all plants.

Best Management Practices Fact Sheet

Turf Pavers



PURPOSE: Turf pavers used in place of traditional impervious paving materials reduce the total amount of impervious surface area, promote infiltration of runoff into the ground, and can aid with reducing peak runoff velocity and volume.

Turf pavers are an innovative alternative to conventional impervious paving, which contributes a significant amount of runoff to storm sewers and waterways, especially in urban areas. This type of paver is a matrix of polymer, concrete or cement blocks designed to form a void space that is filled with grass, sand, or gravel, which allows runoff to infiltrate into the soil. The material used for the paver itself is resistant to weathering and the effects of prolonged sunlight.

Turf pavers are well-suited for areas that receive pedestrian and light vehicular traffic, such as walkways, bike paths, overflow parking lots, fire lanes and golf cart paths. The paver grid provides extra support to prevent vegetated areas from being destroyed by tires.

Installation of pavers begins with a level base of existing soil. A layer of crushed gravel may be spread over the soil base to provide a reservoir for holding runoff prior to infiltration. Incorporating a gravel base will add the benefits of reducing peak runoff velocity and volume. Next, a layer of sand or sand/gravel mix is placed and compacted to the required depth. The pavers are laid in place, then filled with another layer of compacted concrete sand or sand/soil mix to the depth called for in the paver manufacturer's specifications. Finally, a cover of turf or grass seed is spread on top of the paver cells. *Manufacturer's specifications should be followed as to the materials used for the base and surface.*

NOTE: Sand-filled openings provide greater infiltration rates than grass openings. Some turf pavers are designed for use on sloped areas; consult the product specifications to determine the type of paver suitable for sloped site conditions.

General Design Considerations

- Use in areas with soil permeability between 0.5 and 3.0 inches per hour
- Existing soil and/or stone reservoir base must be graded flat
- Install at least two to five feet above seasonal high groundwater table to prevent contamination of groundwater
- Location should be at least 100 feet from drinking water wells to avoid contamination
- Thickness of gravel base may vary according to designated use of area (ex. a thicker base may be required to sustain weight of fire trucks)
- Design should include overflow drainage to remove excess stormwater
- Gravel used in sand/gravel mix should be no larger than 3/4 inch in diameter
- Follow manufacturer's specifications for depth of sand underneath pavers
- Pavers should be swept clean of fill prior to adding grass seed or turf
- Remove any invasive vegetation, including small tree seedlings, from paver grids
- Maintenance includes regular mowing
- Use snow plows, sand and salt with caution during snow removal
- Installation in areas of high traffic or heavy contamination not recommended (ex. service stations)

Benefits and Uses

- Reduces total amount of impervious cover
- Enhances aesthetics of local landscape
- Recharges groundwater supply
- Reduces peak velocity and volume of stormwater runoff delivered to storm sewer system
- Alleviates flooding and erosion downstream
- Prevents soil compaction by vehicle weight and promotes healthy root growth
- Applicable to all types of sites

Additional Resources

PA Department of Environmental Protection
- www.dep.state.pa.us
- Pennsylvania Stormwater Best Management Practices Manual

US Environmental Protection Agency
www.epa.gov

Cahill Associates
www.thcahill.com - click on "Technologies" for project examples and general information

Low Impact Development Center
www.lid-stormwater.net - click on Site Map and select Permeable Paving

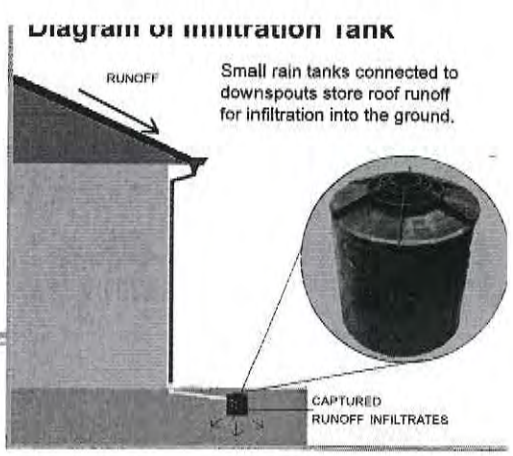
Metropolitan Council Environmental Services
www.metrocouncil.org - click on "Environmental Services" to find the link to the *Urban Small Sites BMP Manual*

Stormwater Manager's Resource Center
www.stormwatercenter.net

Produced by:
Dauphin County Conservation District
1451 Peters Mountain Road Dauphin, PA 17018
www.dauphincd.org p: (717) 921.8100

Best Management Practices Fact Sheet

Sub-Surface Infiltration Areas

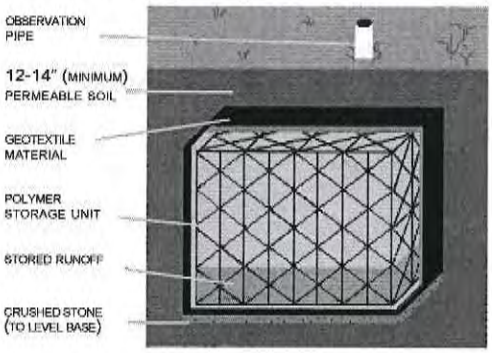


PURPOSE: Sub-surface infiltration areas reduce the volume of stormwater runoff leaving a site by capturing runoff for storage underground. Over time, the stored runoff percolates down through the soil to recharge the groundwater supply.

Sub-surface infiltration applications range from simple tanks that are suited to individual house sites to large-scale, high-tech commercial and industrial installations. Some of the products and materials used for underground stormwater storage are manufactured polymer cells and tanks, arched chambers, pipes, and stone. Storage capacities for these products range from 95% of the total storage area for polymer units to 40% or less for crushed stone.

Construction consists of excavating a trench or pit, placing the storage media, then covering the storage area with soil. Polymer cell units are wrapped with geotextile material to keep dirt from filling in the storage area. Stormwater can be directed to the infiltration area from roofs, paved areas, or any other impermeable surface. Infiltration rates vary from site to site, dependent upon soils, depth to groundwater, and other site conditions.

Diagram of Infiltration Area using Polymer Storage Cells



General Design Considerations

- Excavate bottom of infiltration bed level to slope of less than 1%
- Sub-grade should not be compacted to permit maximum infiltration
- Soil should consist of less than 20% clay content, and less than 40% clay/silt content
- Infiltration areas work best in porous soils, and do not function as efficiently in areas of dense clay soils, as they are prone to clogging
- Allow three feet of vertical buffer between the bed bottom and seasonal high-water table to prevent contamination of groundwater; allow two feet of vertical buffer above bedrock
- Design should include overflow drainage to remove excess stormwater
- Large residential/commercial/industrial site installations should be designed by a design professional
- A homeowner doing a single retrofit installation would not need to hire a design professional as long as overflow drainage is included
- Do not install infiltration bed within 10 feet of basement walls or where sub-surface drainage may run toward a basement
- Space above the infiltration bed can be paved or planted with vegetation
- Regular maintenance is required to prevent the system from clogging

Benefits and Uses

- Recharges groundwater supply
- Reduces peak velocity and volume of stormwater runoff to streams and storm sewer systems
- Alleviates flooding and erosion downstream
- Reduces space required for stormwater detention/retention basins
- Minimal to moderate cost to install and maintain
- Space above infiltration bed is usable as lawn, landscaped area, courtyard, etc.
- Applicable to all types of sites (residential/commercial/industrial)
- Small tank units (featured above) are easily adapted to most existing individual home sites

Additional Resources

PA Department of Environmental Protection
www.depweb.state.pa.us - search for Pennsylvania Stormwater Best Management Practices Manual

US Environmental Protection Agency
www.epa.gov

Cahill Associates
www.thcahill.com - click on "Technologies" for project examples and general information

Low Impact Development Center
www.lowimpactdevelopment.org

Stormwater Manager's Resource Center
www.stormwatercenter.net

Metropolitan Council Environmental Services
www.metrocouncil.org - click on "Environmental Services" to find the link to the *Urban Small Sites BMP Manual*

Produced by:
Dauphin County Conservation District
1451 Peters Mountain Road Dauphin, PA 17018
www.dauphincd.org p: (717) 921.8100

Infiltration BMPs: The following BMPs infiltrate Stormwater on site.

Dry Well

Dry wells are an infiltration type Best Management Practice, and effective at infiltrating roof runoff. A drywell can be either a preconstructed chamber, or a dug pit filled with aggregate.

Sizing

First, calculate the amount of impervious surface on site, and then the cubic volume of storm water you need to manage. (See "calculate stormwater volume"). We'll call this the Drywell Required Volume.

If the drywell is filled with stone, use a 40% void ratio

1. Divide drywell required volume by 40%

   Ex required volume =75ft cu
   75ft cu/40%= **190ft cu**

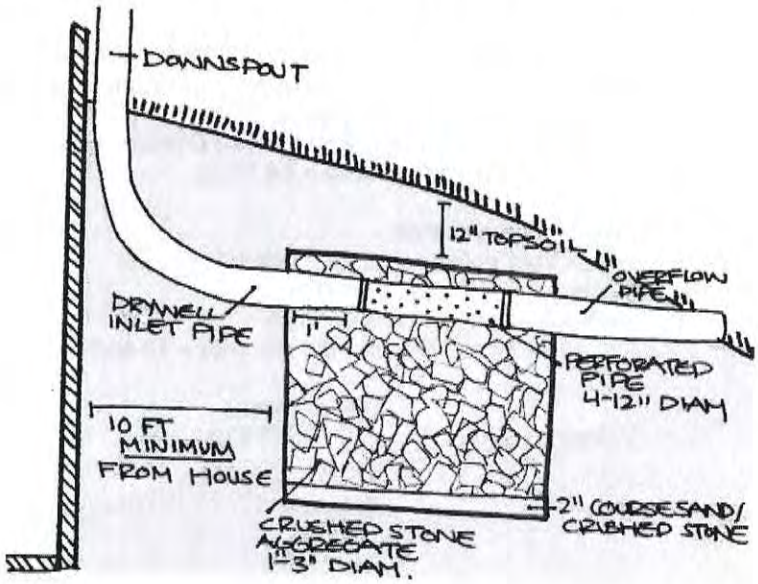
2. A drywell's Actual Volume is calculated by (width x length x depth)

   (Remember L x W / D = < 4)

3. Since depth can be 3.5 ft max, calculate the drywell area

   190 ft cubed/3.5ft= 54.3 ft2

So the example drywell dimensions are 3'6" depth, 7'4"lenth, 7'4"width



Installation

Excavate drywell bottom to a uniform level. Select a location at least 10 feet from your home, to avoid flooding. Avoid compaction of soil during construction, and know that drywells deeper than 3 1/2 feet aren't recommended. Remember to dig 12" deeper than your measurements for the depth of your drywell, so you have space to cover the drywell in 12" of topsoil.

Cover drywell floor with 2" sand or finely crushed stone. Install drywell inlet pipe and perforated pipe, which connect to roof downspouts. Inlet pipes run underground, and overflow pipes run horizontally until they emerge above ground, and they should have a cap on the end. Overflow pipes allow for easier maintenance and help avoid flooding damage during very large storms.

Fill the dry well with stone aggregate. Aggregate fill should be 1" to 3" diameter. Cover with a layer of topsoil (12"s), and seed and vegetate topsoil to stabilize and aid infiltration.

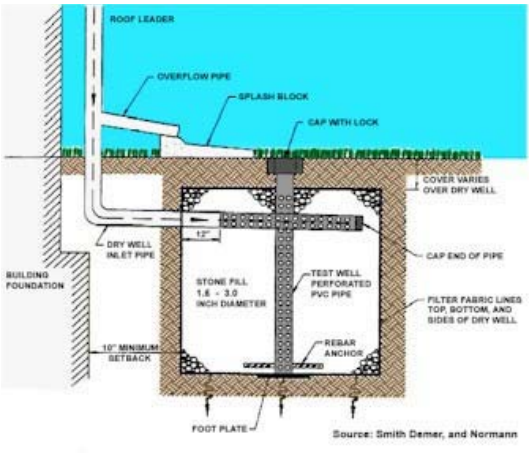
Maintenance

Drywells should be inspected seasonally and after large-storms for debris build-up. The builder may want to install a monitoring pipe.

Costs

Drywells typically cost from $4 to $9 per cubic foot, and most drywell costs are associated with the amount of gravel. The example drywell from this section would cost $800 to $1500.
Drywell installation kits for pre-sized drywells are also available. Online, prices are around $150 to $200.

BMP 6.4.6: Dry Well / Seepage Pit



A Dry Well, or Seepage Pit, is a variation on an Infiltration system that is designed to temporarily store and infiltrate rooftop runoff.

Key Design Elements

- Fllow Infiltration System Guidelines in Appendix C
- Maintain minimum distance from building foundation (typically 10 feet)
- Provide adequate overflow outlet for large storms
- Depth of Dry Well aggregate should be between 18 and 48 inches
- At least one observation well; clean out is recommended
- Wrap aggregate with nonwoven geotextile
- Maintenance will require periodic removal of sediment and leaves from sumps and cleanouts
- Provide pretreatment for some situations

Potential Applications

Residential: Yes
Commercial: Yes
Ultra Urban: Yes
Industrial: Limited
Retrofit: Yes
Highway/Road: No

Stormwater Functions

Volume Reduction: Medium
Recharge: High
Peak Rate Control: Medium
Water Quality: Medium

Water Quality Functions

TSS: TP: 85% 85%
NO3: 30%

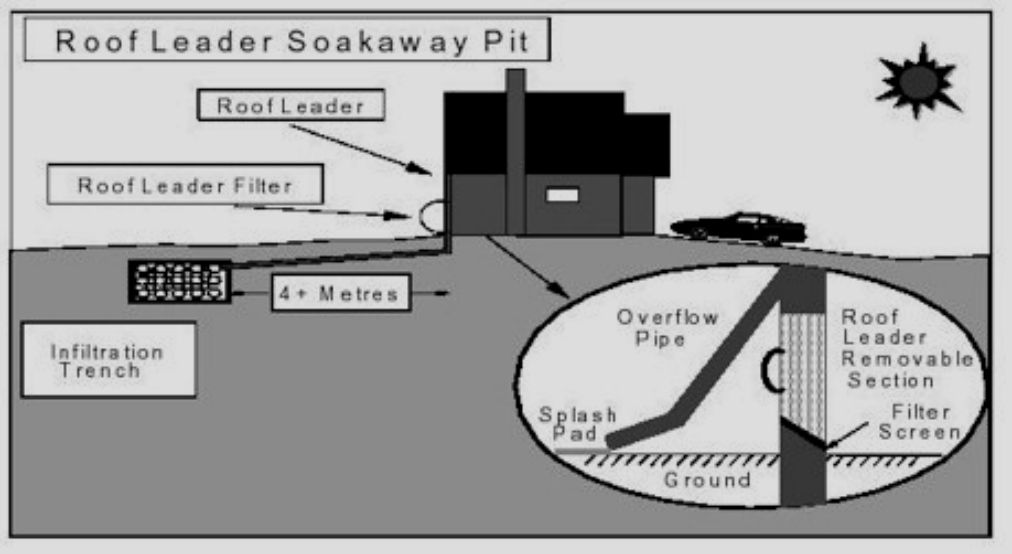
Other Considerations

- **Protocol 1. Site Evaluation and Soil Infiltration Testing** and **Protocol 2. Infiltration Systems Guidelines** should be followed, see Appendix C

Description

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

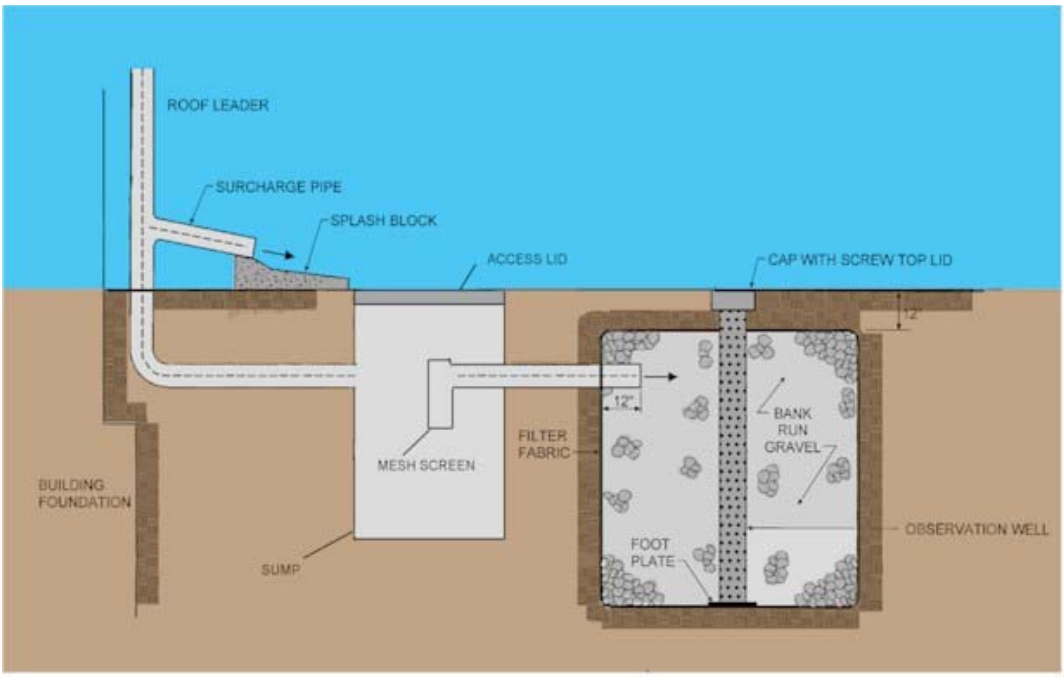
By capturing runoff at the source, Dry Wells can dramatically reduce the increased volume of stormwater generated by the roofs of structures. Though roofs are generally not a significant source of runoff pollution, they are still one of the most important sources of new or increased runoff volume from developed areas. By decreasing the volume of stormwater runoff, Dry Wells can also reduce runoff rate and improve water quality. As with other infiltration practices, Dry Wells may not be appropriate for "hot spots" or other areas where high pollutant or sediment loading is expected without additional design considerations. Dry Wells are not recommended within a specified distance to structures or subsurface sewage disposal systems. (see Appendix C, Protocol 2)



Variations

Intermediate "Sump" Box – Water can flow through an intermediate box with an outflow higher to allow the sediments to settle out. Water would then flow through a mesh screen and into the dry well.

Drain Without Gutters – For structures without gutters or downspouts, runoff is designed to sheetflow off a pitched roof surface and onto a stabilized ground cover (surface aggregate, pavement, or other means). Runoff is then directed toward a Dry Well via stormwater pipes or swales.



Prefabricated Dry Well – There are a variety of prefabricated, predominantly plastic subsurface storage chambers on the market today that can replace aggregate Dry Wells. Since these systems have significantly greater storage capacity than aggregate, space requirements are reduced and associated costs may be defrayed. Provided the following design guidelines are followed and infiltration is still encouraged, prefabricated chambers can prove just as effective as standard aggregate Dry Wells.

Applications

Any roof or impervious area with relatively low sediment loading

Design Considerations

1. Dry Wells are sized to temporarily retain and infiltrate stormwater runoff from roofs of structures. A dry well usually provides stormwater management for a limited roof area. Care should be taken not to hydraulically overload a dry well based on bottom area and drainage area. (See Appendix C, Protocol 2 for guidance)

2. Dry Wells should drain-down within the guidelines set in Chapter 3. Longer drain-down times reduce Dry Well efficiency and can lead to anaerobic conditions, odor and other problems.

3. Dry Wells typically consist of 18 to 48 inches of clean washed, uniformly graded aggregate with 40% void capacity (AASHTO No. 3, or similar). Dry Well aggregate is wrapped in a nonwoven geotextile, which provides separation between the aggregate and the surrounding soil. At least 12 inches of soil is then placed over the Dry Well. An alternative form of Dry Well is a subsurface, prefabricated chamber. A variety of prefabricated Dry Wells are currently available on the market.

4. Dry Wells are not recommended when their installation would create a significant risk for basement seepage or flooding. In general, 10 feet of separation is recommended between Dry Wells and building foundations. However, this distance may be shortened at the discretion of the designer. Shorter separation distances may warrant an impermeable liner to be installed on the building side of the Dry Well.

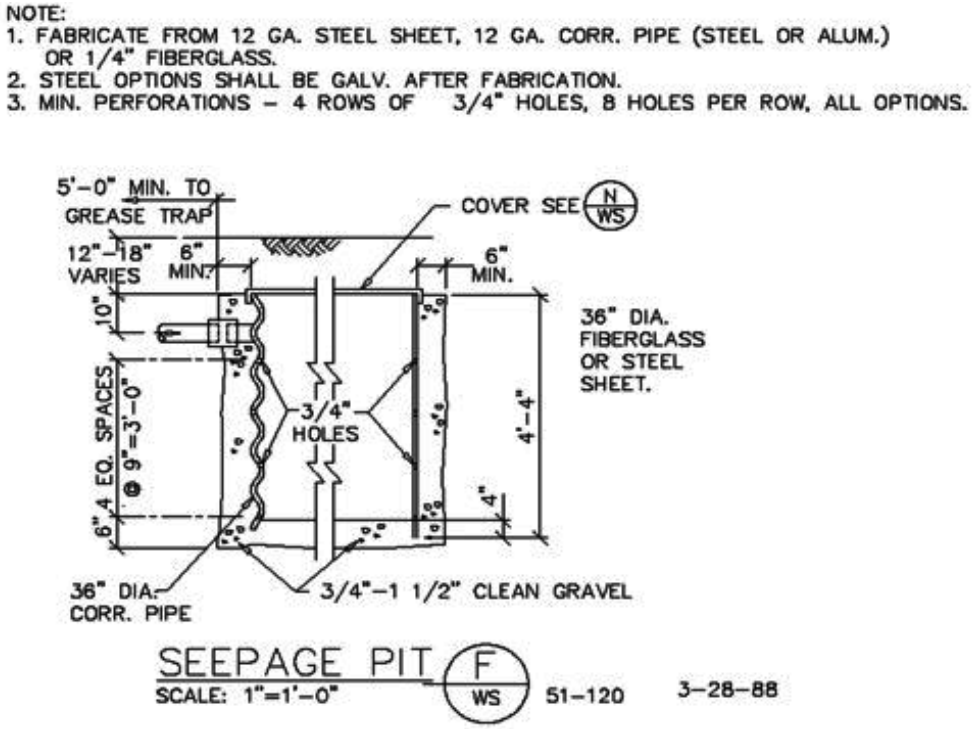
5. All Dry Wells should be able to convey system overflows to downstream drainage systems. System overflows can be incorporated either as surcharge (or overflow) pipes extending from roof leaders or via connections to more substantial infiltration areas.

6. The design depth of a Dry Well should take into account frost depth to prevent frost heave.

7. A removable filter with a screened bottom should be installed in the roof leader below the surcharge pipe in order to screen out leaves and other debris.

8. Adequate inspection and maintenance access to the Well should be provided. Observation wells not only provide the necessary access to the Well, but they also provide a conduit through which pumping of stored runoff can be accomplished in case of slowed infiltration.

9. Though roofs are generally not a significant source of runoff pollution, they can still be a source of particulates and organic matter, as well as sediment and debris during construction. Measures such as roof gutter guards, roof leader clean-out with sump, or an intermediate sump box can provide pretreatment for Dry Wells by minimizing the amount of sediment and other particulates that may enter it.



Detailed Stormwater Functions

Volume Reduction Calculations
The storage volume of a Dry Well is defined as the volume beneath the discharge invert. The following equation can be used to determine the approximate storage volume of an aggregate Dry Well:

Dry Well Volume = Dry well area (sf) x Dry well water depth (ft) x 40% (if stone filled)

Infiltration Area: A dry well may consider both bottom and side (lateral) infiltration according to design.

Peak Rate Mitigation Calculations
See Chapter 8 for corresponding peak rate reduction.

Water Quality Improvement
See Chapter 8

Construction Sequence

1. Protect infiltration area from compaction prior to installation.

2. If possible, install Dry Wells during later phases of site construction to prevent sedimentation and/or damage from construction activity.

3. Install and maintain proper Erosion and Sediment Control Measures during construction as per the Pennsylvania Erosion and Sediment Pollution Control Program Manual (March 2000, or latest edition).

4. Excavate Dry Well bottom to a uniform, level uncompacted subgrade free from rocks and debris. Do NOT compact subgrade. To the greatest extent possible, excavation should be performed with the lightest practical equipment. Excavation equipment should be placed outside the limits of the Dry Well.

5. Completely wrap Dry Well with nonwoven geotextile. (If sediment and/or debris have accumulated in Dry Well bottom, remove prior to geotextile placement.) Geotextile rolls should overlap by a minimum of 24 inches within the trench. Fold back and secure excess geotextile during stone placement.

6. Install continuously perforated pipe, observation wells, and all other Dry Well structures. Connect roof leaders to structures as indicated on plans.

7. Place uniformly graded, clean-washed aggregate in 6-inch lifts, lightly compacting between lifts.

8. Fold and secure nonwoven geotextile over trench, with minimum overlap of 12-inches.

9. Place 12-inch lift of approved Topsoil over trench, as indicated on plans.

10. Seed and stabilize topsoil.

11. Connect surcharge pipe to roof leader and position over splashboard.

12. Do not remove Erosion and Sediment Control measures until site is fully stabilized.

Maintenance Issues

As with all infiltration practices, Dry Wells require regular and effective maintenance to ensure prolonged functioning. The following represent minimum maintenance requirements for Dry Wells:

- Inspect Dry Wells at least four times a year, as well as after every storm exceeding 1 inch.
- Dispose of sediment, debris/trash, and any other waste material removed from a Dry Well at suitable disposal/recycling sites and in compliance with local, state, and federal waste regulations.
- Evaluate the drain-down time of the Dry Well to ensure the maximum time of 72 hours is not being exceeded. If drain-down times are exceeding the maximum, drain the Dry Well via pumping and clean out perforated piping, if included. If slow drainage persists, the system may need replacing.
- Regularly clean out gutters and ensure proper connections to facilitate the effectiveness of the dry well.
- Replace filter screen that intercepts roof runoff as necessary.
- If an intermediate sump box exists, clean it out at least once per year.

Cost Issues

The construction cost of a Dry Well/Seepage Pit can vary greatly depending on design variability, configuration, location, site-specific conditions, etc. Typical construction costs in 2003 dollars range from $4 - $9 per cubic foot of storage volume provided (SWRPC, 1991; Brown and Schueler, 1997). Annual maintenance costs have been reported to be approximately 5 to 10 percent of the capital costs (Schueler, 1987). The cost of gutters is typically included in the total structure cost, as opposed

Specifications

The following specifications are provided for information purposes only. These specifications include information on acceptable materials for typical applications, but are by no means exclusive or limiting. The designer is responsible for developing detailed specifications for individual design projects in accordance with the project conditions.

1. Stone for infiltration trenches shall be 2-inch to 1-inch uniformly graded coarse aggregate, with a wash loss of no more than 0.5%, AASHTO size No. 3 per AASHTO Specifications, Part I, 19th Ed., 1998, or later and shall have voids 40% as measured by ASTM-C29.

2. Nonwoven Geotextile shall consist of needled nonwoven polypropylene fibers and meet the following properties:

a. Grab Tensile Strength (ASTM-D4632) ³ 120 lbs
b. Mullen Burst Strength (ASTM-D3786) ³ 225 psi
c. Flow Rate (ASTM-D4491) ³ 95 gal/min/ft^2
d. UV Resistance after 500 hrs (ASTM-D4355) ³ 70%
e. Heat-set or heat-calendared fabrics are not permitted
Acceptable types include Mirafi 140N, Amoco 4547, and Geotex 451.

3. Topsoil See Appendix C

4. Pipe shall be continuously perforated, smooth interior, with a minimum inside diameter of 4-inches. High-density polyethylene (HDPE) pipe shall meet AASHTO M252, Type S or AASHTO M294, Type S. 12 gauge aluminum or corrugated steel pipe may be used in seepage pits.

5. Gutters and splashboards shall follow Manufacturer's specifications.

References

New Jersey Department of Environmental Protection. *New Jersey Stormwater Best Management Practices Manual*. 2004.

New York Department of Environmental Conservation. *New York State Stormwater Management Design Manual.* 2003.

French Drains. http://www.unexco.com/french.html . 2004.

SWRPC, The Use of of Best Management Practices(BMPs) in Urban Watersheds, US Environmental Protection Agency,1991.

Brown and Schueler, *Stormwater Management Fact Sheet: Infiltration Trench.* 1997.

Schueler, T., 1987. *Controlling urban runoff: a practical manual for planning and designing urban BMPs*, Metropolitan Washington Council of Governments, Washington, DC

Infiltration Trench

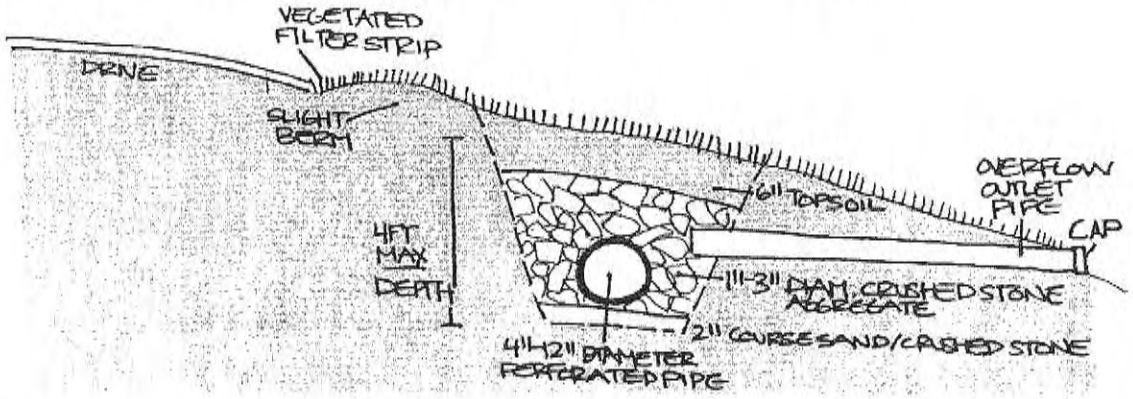
An infiltration trench is a stone-filled trench that stores, infiltrates, and cleans stormwater runoff. Infiltration trenches work well for catching water from small impervious areas, such as a disconnected patio, path, driveway, or even rooftop. Infiltration trenches MUST be adjacent to a vegetated filter strip, to help purify water.

Sizing

1. Find the Stormwater Runoff Volume (Step 2). Use this number to determine how much stormwater you must manage. We'll call this volume Trench Required Dimensions"

2. "Trench Required Dimensions" = Trench Void Volume / 40% void ratio*
*(void ratio is a result of the gaps between stone aggregate)
161.25ft cu = stormwater volume of half of the example driveway
161.25 ft cu (Trench Required Dimensions)= Trench Void Volume /40%
Trench Void Volume = 64.5ft cu

3. Sizing of the Trench
Trench Void Volume = width** x length x depth*
*maximum depth should be 3.5'
**average trench width is about .5'
64.5ft cu (Trench Void Volume) = 1ft width x 3.5 ft depth x 18.42 ft length



Installation

Avoid soil compaction during the construction process. Excavate the trench, according to calculated sizing, creating a level un-compacted bottom. It is very important that the bottom of the trench is very flat.
Line the trench with 2" sand or finely crushed stone. Place inside a level perforated pipe, and consider overflow pipe that runs horizontally until above ground, like one on a drywell. The overflow outlet pipe should have a cap on the end.
Fill with stone aggregate. Aggregate fill should be 1" to 3" diameter. Place 6" of topsoil on top of trench, and re-seed the topsoil.

Maintenance

Vegetation along the surface of the trench, and on the filter strip, should be maintained. Avoid driving on or compacting soil on top of an infiltration trench. Inspect the overflow pipe regularly to check for leakage.

Cost

Typical construction costs tend to be $4 to $9 per cubic foot. Costs are associated with the labor (if used) and materials.
The cost of the example trench would be $650 to $1400.

BMP 6.4.3: Subsurface Infiltration Bed

Subsurface Infiltration Beds provide temporary storage and infiltration of stormwater runoff by placing storage media of varying types beneath the proposed surface grade. Vegetation will help to increase the amount of evapotranspiration taking place.

Key Design Elements

- Maintain a minimum 2-foot separation to bedrock and seasonally high water table, provide distributed infiltration area (5:1 impervious area to infiltration area - maximum), site on natural, uncompacted soils with acceptable infiltration capacity, and follow other guidelines described in Protocol 2: Infiltration Systems Guidelines
- Beds filled with stone (or alternative) as needed to increase void space
- Wrapped in nonwoven geotextile
- Level or nearly level bed bottoms
- Provide positive stormwater overflow from beds
- Protect from sedimentation during construction
- Provide perforated pipe network along bed bottom for distribution as necessary
- Open-graded, clean stone with minimum 40% void space
- Do not place bed bottom on compacted fill
- Allow 2 ft. buffer between bed bottom and seasonal high groundwater table and 2 ft. for bedrock.

Potential Applications

Residential: Yes
Commercial: Yes
Ultra Urban: Yes
Industrial: Yes
Retrofit: Yes
Highway/Road: Limited

Stormwater Functions

Volume Reduction: High
Recharge: High
Peak Rate Control: Med./High
Water Quality: High

Water Quality Functions

TSS: 85%
TP: 85%
NO3: 30%

Other Considerations

- **Protocol 1. Site Evaluation and Soil Infiltration Testing** and **Protocol 2. Infiltration Systems Guidelines** should be followed, see Appendix C

Description

A Subsurface Infiltration Bed generally consists of a vegetated, highly pervious soil media underlain by a uniformly graded aggregate (or alternative) bed for temporary storage and infiltration of stormwater runoff. Subsurface Infiltration beds are ideally suited for expansive, generally flat open spaces, such as lawns, meadows, and playfields, which are located downhill from nearby impervious areas. Subsurface Infiltration Beds can be stepped or terraced down sloping terrain provided that the base of the bed remains level. Stormwater runoff from nearby impervious areas (including rooftops, parking lots, roads, walkways, etc.) can be conveyed to the subsurface storage media, where it is then distributed via a network of perforated piping.

The storage media for subsurface infiltration beds typically consists of clean-washed, uniformly graded aggregate. However, other storage media alternatives are available. These alternatives are generally variations on plastic cells that can more than double the storage capacity of aggregate beds, at a substantially increased cost. Storage media alternatives are ideally suited for sites where potential infiltration area is limited.

If designed, constructed, and maintained as per the following guidelines, Subsurface Infiltration features can stand-alone as significant stormwater runoff volume, rate, and quality control practices. These systems can also maintain aquifer recharge, while preserving or creating valuable open space and recreation areas. They have the added benefit of functioning year-round, given that the infiltration surface is typically below the frost line.

Variations

As its name suggests, Subsurface Infiltration is generally employed for temporary storage and infiltration of runoff in subsurface storage media. However, in some cases, runoff may be temporarily stored on the surface (to depths less than 6 inches) to enhance volume capacity of the system. The overall system design should ensure that within the criteria in Chapter 3, the bed is completely empty.

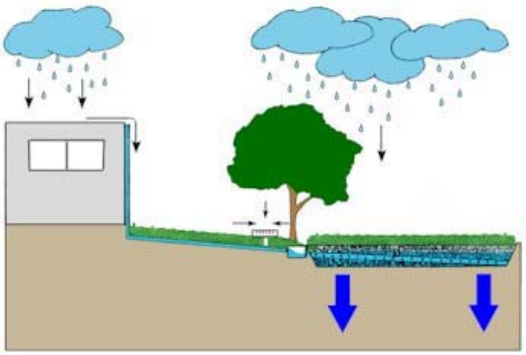
Applications

Connection of Roof Leaders

Runoff from nearby roofs may be directly conveyed to subsurface beds via roof leader connections to perforated piping. Roof runoff generally has relatively low sediment levels, making it ideally suited for connection to an infiltration bed. However, cleanout(s) with a sediment sump are still recommended between the building and infiltration bed.

Connection of Inlets

Catch Basins, inlets, and area drains may be connected to Subsurface Infiltration beds. However, sediment and debris removal should be provided. Storm structures should therefore include sediment trap areas below the inverts of discharge pipes to trap solids and debris. In areas of high traffic or excessive generation of sediment, litter, and other similar materials, a water quality insert or other pretreatment device may be needed.



Under Recreational Fields

Subsurface Infiltration is very well suited below playfields and other recreational areas. Special consideration should be given to the engineered soil mix in those cases.

Under Open Space

Subsurface Infiltration is also appropriate in either existing or proposed open space areas. Ideally, these areas are vegetated with native grasses and/or vegetation to enhance site aesthetics and landscaping. Aside from occasional clean-outs or outlet structures, Subsurface Infiltration systems are essentially hidden stormwater management features, making them ideal for open space locations (deed-restricted open space locations are especially desirable because such locations minimize the chance that Subsurface Infiltration systems will be disturbed or disrupted accidentally in the future).

Other Applications

Other applications of Subsurface Infiltration beds may be determined by the Design Professional as appropriate.

Design Considerations

1. Soil Investigation and Infiltration Testing is needed (Appendix C).

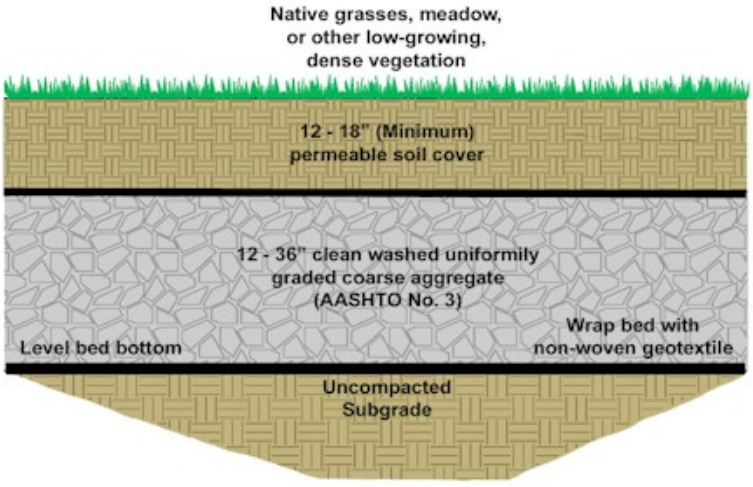
2. Guidelines for Infiltration Systems should be met (Appendix C).

3. The overall site should be evaluated for potential Subsurface Infiltration areas early in the design process, as effective design requires consideration of existing site characteristics (topography, natural features/drainage ways, soils, geology, etc.).

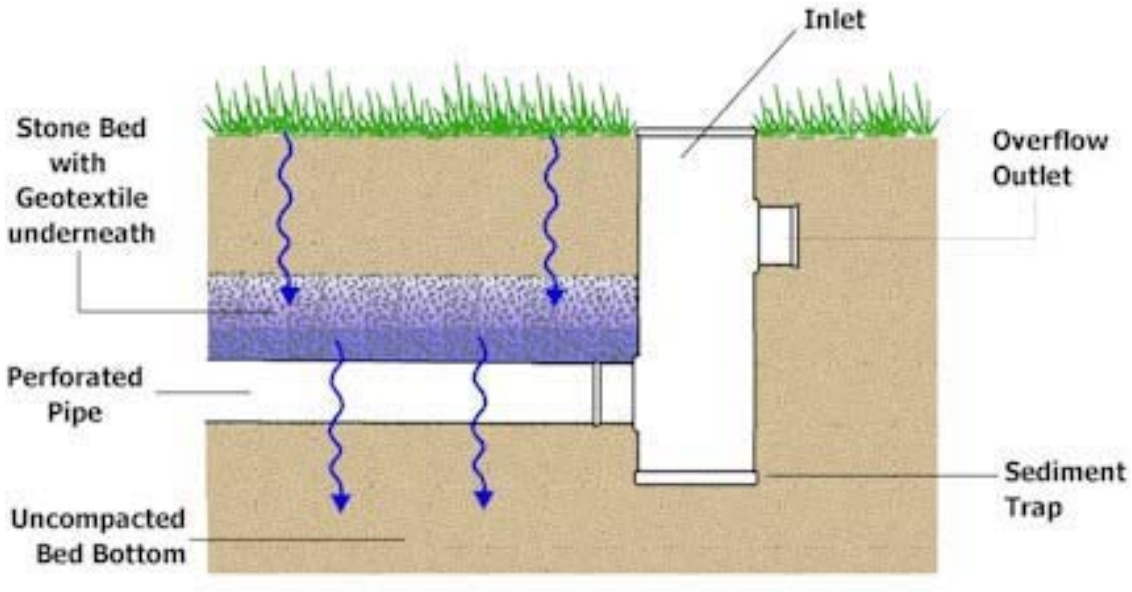
4. Control of Sediment is critical. Rigorous installation and maintenance of erosion and sediment control measures is needed to prevent sediment deposition within the stone bed. Nonwoven geotextile may be folded over the edge of the bed until the site is stabilized.

5. The Infiltration bed should be wrapped in non-woven geotextile filter fabric.

6. Subsurface Infiltration areas should not be placed on areas of recent fill or compacted fill. Any grade adjustments requiring fill should be done using the stone subbase material, or alternative. Areas of historical fill (>5 years) may be considered if other criteria are met.



7. The subsurface infiltration bed is typically comprised of a 12 to 36 inch section of aggregate, such as AASHTO No.3, which ranges 1-2 inches in gradation. Depending on local aggregate availability, both larger and smaller size aggregate has been used. The critical requirements are that the aggregate be uniformly graded, clean-washed, and contain at least 40% void space. The depth of the bed is a function of stormwater storage requirements, frost depth considerations, and site grading. Infiltration beds are typically sized to mitigate the increased runoff volume from the design storm.



8. Water Quality Inlet or Catch Basin with Sump is needed for all surface inlets, should be designed to avoid standing water for periods greater than the criteria in Chapter 3.

9. Infiltration beds may be placed on a slope by benching or terracing infiltration levels. The slope of the infiltration bed bottom should be level or with a slope no greater than 1%. A level bottom assures even water distribution and infiltration.

10. Perforated pipes along the bottom of the bed can be used to evenly distribute runoff over the entire bed bottom. Continuously perforated pipes may connect structures (such as cleanouts and inlet boxes). Pipes should lay flat along the bed bottom and provide for uniform distribution of water. Depending on size, these pipes may provide additional storage volume.

11. Cleanouts or inlets should be installed at a few locations within the bed and at appropriate intervals to allow access to the perforated piping network and or storage media.

12. All infiltration beds should be designed with an overflow for extreme storm events. Control in the beds is usually provided in the form of an outlet control structure. A modified inlet box with an internal concrete weir (or weir plate) and low-flow orifice is a common type of control structure. The specific design of these structures may vary, depending on factors such as rate and storage requirements, but it must always include positive overflow from the system. The overflow structure is used to maximize the water level in the stone bed, while providing sufficient cover for overflow pipes. Generally, the top of the outlet pipe should be 4 inches below the top of the aggregate to prevent saturated soil conditions in remote areas of the bed. As with all

infiltration practices, multiple discharge points are recommended. These may discharge to the surface or a storm sewer system.

13. Adequate soil cover (generally 12 - 18 inches) should be maintained above the infiltration bed to allow for a healthy vegetative cover.

14. Open space overlying infiltration beds can be vegetated with native grasses, meadow mix, or other low-growing, dense vegetation. These plants have longer roots than traditional grass and will likely benefit from the moisture in the infiltration bed, improving the growth of these plantings and, potentially increasing evapotranspiration.

15. Fertilizer use should be minimized.

16. The surface (above the stone bed) should be compacted as minimally as possible to allow for surface percolation through the engineered soil layer and into the stone bed.

17. When directing runoff from roadway areas into the beds, measures to reduce sediment should be used.

18. Surface grading should be relatively flat, although a relatively mild slope between 1% and 3% is recommended to facilitate drainage.

19. In those areas where the threat of spills and groundwater contamination exists, pretreatment systems, such as filters and wetlands, may be needed before any infiltration occurs. In Hot Spot areas, such as truck stops and fueling stations, the suitability of Subsurface Infiltration must be considered.

20. In areas with poorly-draining soils, Subsurface Infiltration areas may be designed to slowly discharge to adjacent wetlands or bioretention areas.

21. While most Subsurface Infiltration areas consist of an aggregate storage bed, alternative subsurface storage products may also be employed. These include a variety of proprietary, interlocking plastic units that contain much greater storage capacity than aggregate, at an increased cost.

22. The subsurface bed and overflow may be designed and evaluated in the same manner as a detention basin to demonstrate the mitigation of peak flow rates. In this manner, detention basins may be eliminated or significantly reduced in size.

23. During Construction, the excavated bed may serve as a Temporary Sediment Basin or Trap. This can reduce overall site disturbance. The bed should be excavated to at least 1 foot above the final bed bottom elevation for use as a sediment trap or basin. Following construction and site stabilization, sediment should be removed and final grades established. In BMPs that will be used for infiltration in the future, use of construction equipment should be limited as much as possible.

Detailed Stormwater Functions

Infiltration Area

Loading rate quidelines in Appendix C should be consulted**.**

The Infiltration Area is the bottom area of the bed, defined as:

Length of bed x Width of bed = Infiltration Area (if rectangular)

Volume Reduction Calculations

Volume = Depth* (ft) x Area (sf) x Void Space
*Depth is the depth of water stored during a storm event, depending on the drainage area and conveyance to the bed.

Infiltration Volume = Bed Bottom Area (sf) x Infiltration design rate (in/hr)
x Infiltration period* (hr) x (1/12)
*Infiltration Period is equal to 2 hours or the time of concentration, whichever is larger.

Additional storage/volume reduction can be calculated for the overlying soil as appropriate.

Peak Rate Mitigation Calculations

See in Chapter 8 for Peak Rate Mitigation methodology which addresses link between volume reduction and peak rate control.

Water Quality Improvement: See in Chapter 8 for Water Quality Improvement methodology, which addresses pollutant removal effectiveness of this BMP.

Construction Sequence

1. Due to the nature of construction sites, Subsurface Infiltration should be installed toward the end of the construction period, if possible. (Infiltration beds may be used as temporary sediment basins or traps as discussed above).

2. Install and maintain adequate Erosion and Sediment Control Measures (as per the Pennsylvania Erosion and Sedimentation Control Program Manual) during construction.

3. The existing subgrade under the bed areas should NOT be compacted or subject to excessive construction equipment traffic prior to geotextile and stone bed placement.

4. Where erosion of subgrade has caused accumulation of fine materials and/or surface ponding, this material should be removed with light equipment and the underlying soils scarified to a minimum depth of 6 inches with a York rake (or equivalent) and light tractor. All fine grading should be done by hand. All bed bottoms should be at level grade.

5. Earthen berms (if used) between infiltration beds should be left in place during excavation. These berms do not require compaction if proven stable during construction.

6. Install upstream and downstream control structures, cleanouts, perforated piping, and all other necessary stormwater structures.

7. Geotextile and bed aggregate should be placed immediately after approval of subgrade preparation and installation of structures. Geotextile should be placed in accordance with manufacturer's standards and recommendations. Adjacent strips of geotextile should overlap a minimum of 16 inches. It should also be secured at least 4 feet outside of bed in order to prevent any runoff or sediment from entering the storage bed. This edge strip should remain in place until all bare soils contiguous to beds are stabilized and vegetated. As the site is fully stabilized, excess geotextile along bed edges can be cut back to the edge of the bed.

8. Clean-washed, uniformly graded aggregate should be placed in the bed in maximum 8-inch lifts. Each layer should be lightly compacted, with construction equipment kept off the bed bottom as much as possible.

9. Approved soil media should be placed over infiltration bed in maximum 6-inch lifts.

10. Seed and stabilize topsoil.

11. Do not remove inlet protection or other Erosion and Sediment Control measures until site is fully stabilized.

Maintenance Issues

Subsurface Infiltration is generally less maintenance intensive than other practices of its type. Generally speaking, vegetation associated with Subsurface Infiltration practices is less substantial than practices such as Recharge Gardens and Vegetated Swales and therefore requires less maintenance. Maintenance activities required for the subsurface bed are similar to those of any infiltration system and focus on regular sediment and debris removal. The following represents the recommended maintenance efforts:

- All Catch Basins and Inlets should be inspected and cleaned at least 2 times per year.

- The overlying vegetation of Subsurface Infiltration features should be maintained in good condition, and any bare spots revegetated as soon as possible.

- Vehicular access on Subsurface Infiltration areas should be prohibited, and care should be taken to avoid excessive compaction by mowers. If access is needed, use of permeable, turf reinforcement should be considered.

Cost Issues

The construction cost of Subsurface Infiltration can vary greatly depending on design variations, configuration, location, desired storage volume, and site-specific conditions, among other factors. Typical construction costs are about $5.70 per square foot, which includes excavation, aggregate (2.0 feet assumed), non-woven geotextile, pipes and plantings.

Specifications

The following specifications are provided for information purposes only. These specifications include information on acceptable materials for typical applications, but are by no means exclusive or limiting. The designer is responsible for developing detailed specifications for individual design projects in accordance with the project conditions.

1. **Stone** for infiltration beds shall be 2-inch to 1-inch uniformly graded coarse aggregate, with a wash loss of no more than 0.5%, AASHTO size number 3 per AASHTO Specifications, Part I, 19th Ed., 1998, or later and shall have voids 40% as measured by ASTM-C29.

2. **Non-Woven Geotextile** shall consist of needled non-woven polypropylene fibers and meet the following properties:
   a. Grab Tensile Strength (ASTM-D4632) 120 lbs
   b. Mullen Burst Strength (ASTM-D3786) 225 psi
   c. Flow Rate (ASTM-D4491) 95 gal/min/ft^2
   d. UV Resistance after 500 hrs (ASTM-D4355) 70%
   e. Heat-set or heat-calendared fabrics are not permitted
      Acceptable types include Mirafi 140N, Amoco 4547, and Geotex 451.

3. **Topsoil** may be amended with compost (See soil restoration BMP 6.7.2)

4. **Pipe** shall be continuously perforated, smooth interior, with a minimum inside diameter of 6-inches. High-density polyethylene (HDPE) pipe shall meet AASHTO M252, Type S or AASHTO M294, Type S.

5. **Storm Drain Inlets and Structures**
   a. Concrete Construction: Concrete construction shall be in accordance with Section 1001, PennDOT Specifications, 1990 or latest edition.
   b. Precast Concrete Inlets and Manholes: Precast concrete inlets may be substituted for cast-in-place structures and shall be constructed as specified for cast-in-place.

      Precast structures may be used in only those areas where there is no conflict with existing underground structures that may necessitate revision of inverts. Type M standard PennDOT inlet boxes will be modified to provide minimum 12 inch sump storage and bottom leaching basins, open to gravel sumps in sub-grade, when situated in the recharge bed.
   c. All PVC Catch Basins/Cleanouts/Inline Drains shall have H-10 or H-20 rated grates, depending on their placement (H-20 if vehicular loading).
   d. Steel reinforcing bars over the top of the outlet structure shall conform to ASTM A615, grades 60 and 40.
   e. Permanent turf reinforcement matting shall be installed according to manufacturers' specifications.

6. **Alternative storage media:** Follow appropriate Manufacturers' specifications.

7. **Vegetation** see Local Native Plant List and Appendix B.

BMP 6.4.4: Infiltration Trench

An Infiltration Trench is a “leaky” pipe in a stone filled trench with a level bottom. An Infiltration Trench may be used as part of a larger storm sewer system, such as a relatively flat section of storm sewer, or it may serve as a portion of a stormwater system for a small area, such as a portion of a roof or a single catch basin. In all cases, an Infiltration Trench should be designed with a positive overflow.

Key Design Elements

- Continuously perforated pipe set at a minimum slope in a stone filled, level-bottomed trench
- Limited in width (3 to 8 feet) and depth of stone (6 feet max. recommended)
- Trench is wrapped in nonwoven geotextile (top, sides, and bottom)
- Placed on uncompacted soils
- Minimum cover over pipe is as per manufacturer.
- A minimum of 6" of topsoil is placed over trench and vegetated
- Positive Overflow always provided

Deed restrictions recommended
Not for use in hot spot areas without pretreatment

Potential Applications

Residential: Yes
Commercial: Yes
Ultra Urban: Yes
Industrial: Yes
Retrofit: Yes
Highway/Road: Yes

Stormwater Functions

Volume Reduction: Medium
Recharge: High
Peak Rate Control: Medium
Water Quality: High

Water Quality Functions

TSS: 85%
TP: 85%
NO3: 30%

Other Considerations

- **Protocol 1. Site Evaluation and Soil Infiltration Testing** and **Protocol 2. Infiltration Systems Guidelines** should be followed, see Appendix C

Description

An Infiltration Trench is a linear stormwater BMP consisting of a continuously perforated pipe at a minimum slope in a stone-filled trench (Figure 6.4-1). Usually an Infiltration Trench is part of a **conveyance system** and is designed so that large storm events are conveyed through the pipe with some runoff volume reduction. During small storm events, volume reduction may be significant and there may be little or no discharge. All Infiltration Trenches are designed with a **positive overflow** (Figure 6.4-2).

An Infiltration Trench differs from an Infiltration Bed in that it may be constructed without heavy equipment entering the trench. It is also intended to convey some portion of runoff in many storm events.

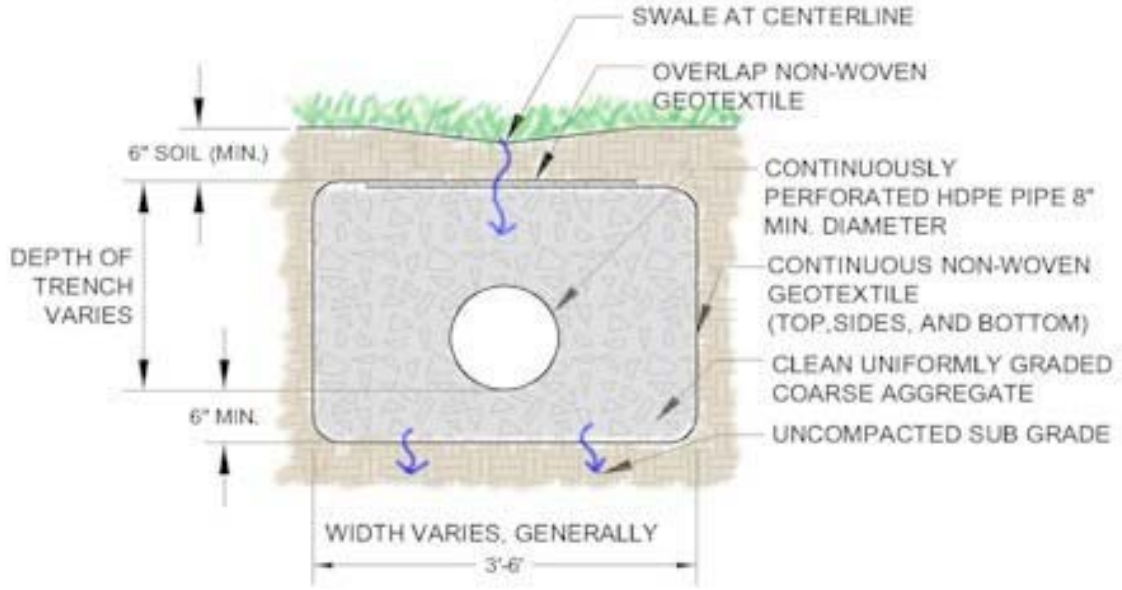


Figure 6.4-1

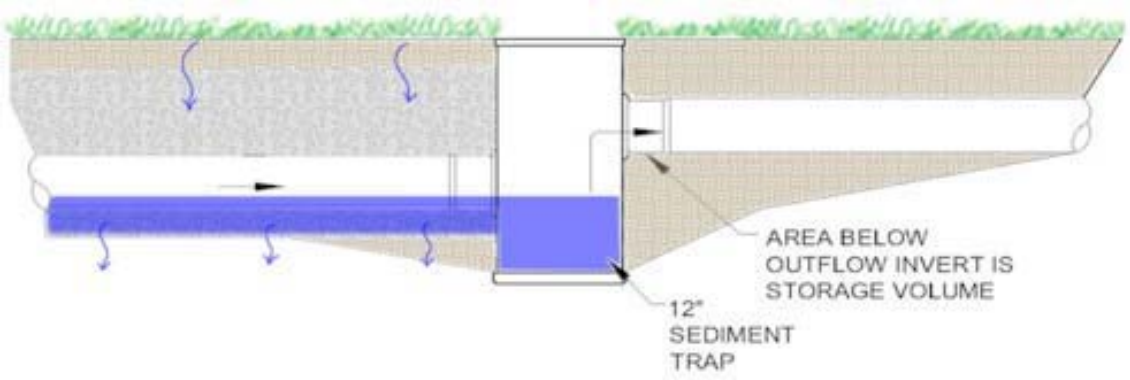


Figure 6.4-2

All Infiltration Trenches should be designed in accordance with Appendix C. Although the width and depth can vary, it is recommended that Infiltration Trenches be limited in depth to not more than six (6)

feet of stone. This is due to both construction issues and Loading Rate issues (as described in the Guidelines for Infiltration Systems). The designer should consider the appropriate depth.

Variations

Infiltration Trenches generally have a vegetated (grassed) or gravel surface. Infiltration Trenches also may be located alongside or adjacent to roadways or impervious paved areas with proper design. The subsurface drainage direction should be to the downhill side (away from subbase of pavement), or located lower than the impervious subbase layer. Proper measures should be taken to prevent water infiltrating into the subbase of impervious pavement.

Infiltration Trenches may also be located down a mild slope by "stepping" the sections between control structures as shown in Figure 6.4-3. A level or nearly level bottom is recommended for even distribution.

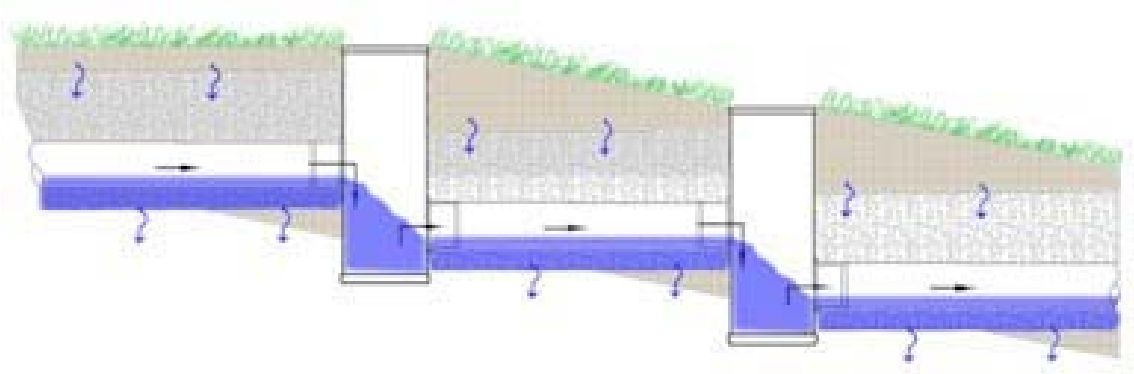
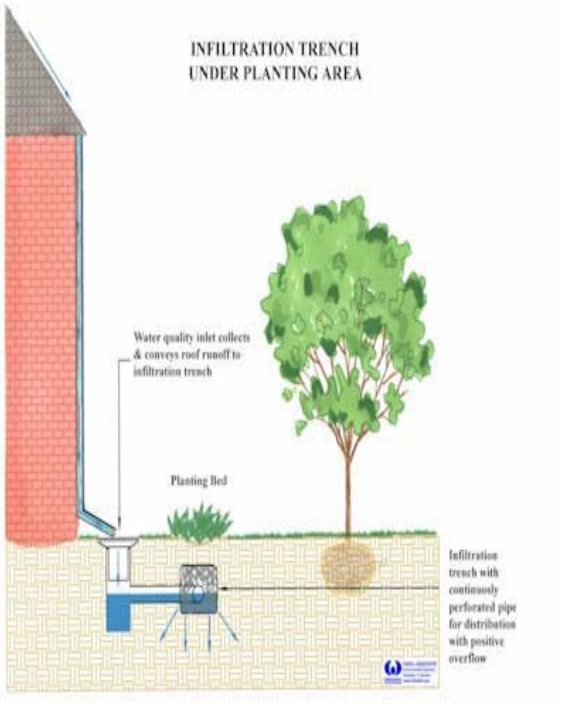


Figure 6.4-3

Applications

- **Connection of Roof Leaders**

Roof leaders may be connected to Infiltration Trenches. Roof runoff generally has lower sediment levels and often is ideally suited for discharge through an Infiltration Trench. A cleanout with sediment sump should be provided between the building and Infiltration Trench.



- **Connection of Inlets**

Catch Basins, inlets and area drains may be connected to Infiltration Trenches, however sediment and debris removal should be addressed. Structures should include a sediment trap area below the invert of the pipe for solids and debris. In areas of high traffic or areas where excessive sediment, litter, and other similar materials may be generated, a water quality insert or other pretreatment device is needed.

- **In Combination with Vegetative Filters**

An Infiltration Trench may be preceded by or used in combination with a Vegetative Filter, Grassed Swale, or other vegetative element used to reduce sediment levels

from areas such as high traffic roadways. Design should ensure proper functioning of vegetative system.

- **Other Applications**

Other applications of Infiltration Trenches may be determined by the design professional as appropriate.

Design Considerations

1. Soil Investigation and Percolation Testing is required (see Appendix C, Protocol 2)
2. Guidelines for Infiltration Systems should be met (i.e., depth to water table, setbacks, Loading Rates, etc. See Appendix C, Protocol 1)
3. Water Quality Inlet or Catch Basin with Sump (see Section 6.6.4) recommended for all surface inlets, designed to avoid standing water for periods greater than the criteria in Chapter 3.
4. A continuously perforated pipe should extend the length of the trench and have a positive flow connection designed to allow high flows to be conveyed through the Infiltration Trench.
5. The slope of the Infiltration Trench bottom should be level or with a slope no greater than 1%. The Trench may be constructed as a series of "steps" if necessary. A level bottom assures even water distribution and infiltration.
6. Cleanouts or inlets should be installed at both ends of the Infiltration Trench and at appropriate intervals to allow access to the perforated pipe.
7. The discharge or overflow from the Infiltration Trench should be properly designed for anticipated flows.

Detailed Stormwater Functions

Infiltration Area

The Infiltration Area is the bottom area of the Trench*, defined as:

Length of Trench x Width of Trench = Infiltration Area (Bottom Area)

This is the area to be considered when evaluating the Loading Rate to the Infiltration Trench.
* Some credit can be taken for the side area that is frequently inundated as appropriate.

Volume Reduction Calculations

Volume = Depth* (ft) x Area (sf) x Void Space

*Depth is the depth of the water surface during a storm event, depending on the drainage area and conveyance to the bed.

Infiltration Volume = Bed Bottom Area (sf) x Infiltration design rate (in/hr)
x Infiltration period* (hr) x (1/12)

*Infiltration Period is the time when bed is receiving runoff and capable of infiltration. Not to exceed 72 hours.

The void ratio in stone is approximately 40% for AASTO No 3. If the conveyance pipe is within the Storage Volume area, the volume of the pipe may also be included. All Infiltration Trenches should be designed to infiltrate or empty within 72 hours.

Peak Rate Mitigation Calculations
See Chapter 8 for Peak Rate Mitigation methodology which addresses link between volume reduction and peak rate control.

Water Quality Improvement
See Chapter 8 for Water Quality Improvement methodology which addresses pollutant removal effectiveness of this BMP.

Construction Sequence

1. Protect Infiltration Trench area from compaction prior to installation.
2. If possible, install Infiltration Trench during later phases of site construction to prevent sedimentation and/or damage from construction activity. After installation, prevent sediment laden water from entering inlets and pipes.
3. Install and maintain proper Erosion and Sediment Control Measures during construction.
4. Excavate Infiltration Trench bottom to a uniform, level uncompacted subgrade free from rocks and debris. Do NOT compact subgrade.
5. Place nonwoven geotextile along bottom and sides of trench*. Nonwoven geotextile rolls should overlap by a minimum of 16 inches within the trench. Fold back and secure excess geotextile during stone placement.
6. Install upstream and downstream Control Structures, cleanouts, etc.
7. Place uniformly graded, clean-washed aggregate in 8-inch lifts, lightly compacting between lifts.
8. Install Continuously Perforated Pipe as indicated on plans. Backfill with uniformly graded, clean-washed aggregate in 8-inch lifts, lightly compacting between lifts.
9. Fold and secure nonwoven geotextile over Infiltration Trench, with minimum overlap of 16-inches.
10. Place 6-inch lift of approved Topsoil over Infiltration Trench, as indicated on plans.
11. Seed and stabilize topsoil.
12. Do not remove Inlet Protection or other Erosion and Sediment Control measures until site is fully stabilized.
13. Any sediment that enters inlets during construction is to be removed within 24 hours.

(from left to right) Installation of Inlets and Control Structure; Non-woven Geotextile is folded over Infiltration Trench; Stabilized Site

(Clockwise from top left) Infiltration Trench is on downhill side of roadway; Infiltration Trench is installed; Infiltration Trench is paved with standard pavement material

Maintenance and Inspection Issues

- Catch Basins and Inlets should be inspected and cleaned at least 2 times per year.
- The vegetation along the surface of the Infiltration Trench should be maintained in good condition, and any bare spots revegetated as soon as possible.
- Vehicles should not be parked or driven on a vegetated Infiltration Trench, and care should be taken to avoid excessive compaction by mowers.

Cost Issues

The construction cost of infiltration trenches can vary greatly depending on the configuration, location, site-specific conditions, etc. Typical construction costs in 2003 dollars range from $4 - $9 per cubic foot of storage provided (SWRPC, 1991; Brown and Schueler, 1997). Annual maintenance costs have been reported to be approximately 5 to 10 percent of the capital costs (Schueler, 1987).

Specifications

The following specifications are provided for information purposes only. These specifications include information on acceptable materials for typical applications, but are by no means exclusive or limiting. The designer is responsible for developing detailed specifications for individual design projects in accordance with the project conditions.

1. Stone for infiltration trenches shall be 2-inch to 1-inch uniformly graded coarse aggregate, with a wash loss of no more than 0.5%, AASHTO size number 3 per AASHTO Specifications, Part I, 19th Ed., 1998, or later and shall have voids 40% as measured by ASTM-C29.

2. Non-Woven Geotextile shall consist of needled nonwoven polypropylene fibers and meet the following properties:

a. Grab Tensile Strength (ASTM-D4632)
b. Mullen Burst Strength (ASTM-D3786)
c. Flow Rate (ASTM-D4491)
d. UV Resistance after 500 hrs (ASTM-D4355) 70%
e. Heat-set or heat-calendared fabrics are not permitted
Acceptable types include Mirafi 140N, Amoco 4547, and Geotex 451.

3. Pipe shall be continuously perforated, smooth interior, with a minimum inside diameter of 8-inches. High-density polyethylene (HDPE) pipe shall meet AASHTO M252, Type S or AASHTO M294, Type S.

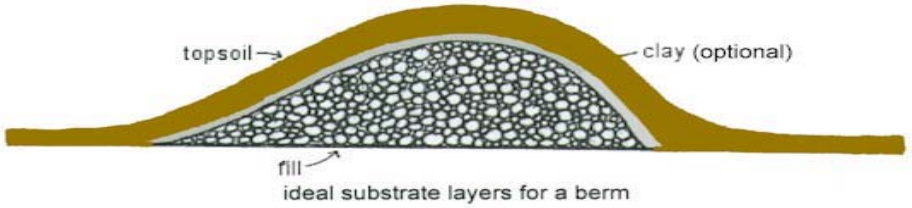
References

Brown and Schueler, *Stormwater Management Fact Sheet: Infiltration Trench.* 1997.

Schueler, T., 1987. *Controlling urban runoff: a practical manual for planning and designing urban BMPs*, Metropolitan Washington Council of Governments, Washington, DC

SWRPC, The Use of of Best Management Practices (BMPs) in Urban Watersheds, US Environmental Protection Agency,1991.

BMP 6.4.10: Infiltration Berm & Retentive Grading



An Infiltration Berm is a mound of compacted earth with sloping sides that is usually located along a contour on relatively gently sloping sites. Berms can also be created through excavation/removal of upslope material, effectively creating a Berm with the original grade. Berms may serve various stormwater drainage functions including: creating a barrier to flow, retaining flow and allowing infiltration for volume control, and directing flows. Grading may be designed in some cases to prevent rather than promote stormwater flows, through creation of "saucers" or "lips" in site yard areas where temporary retention of stormwater does not interfere with use.

Key Design Elements

- Maintain a minimum 2-foot separation to bedrock and seasonally high water table, provide distributed infiltration area (5:1 impervious area to infiltration area - maximum), site on natural, uncompacted soils with acceptable infiltration capacity, and follow other guidelines described in Protocol 2: Infiltration Systems Guidelines
- Berms should be relatively low, preferably no more than 24 inches in height.
- If berms are to be mowed, the berm side slopes should not exceed a ratio of 4:1 to avoid "scalping" by mower blades.
- The crest of the berm should be located near one edge of the berm, rather than in the middle, to allow for a more natural, asymmetrical shape.
- Berms should be vegetated with turf grass at a minimum, however more substantial plantings such as meadow vegetation, shrubs and trees are recommended.

Potential Applications

Residential: Yes
Commercial: Yes
Ultra Urban: Limited
Industrial: Yes
Retrofit: Yes
Highway/Road: Yes

Stormwater Functions

Volume Reduction: Low/Med.
Recharge: Low
Peak Rate Control: Medium
Water Quality: Med./High

Water Quality Functions

TSS: 60%
TP: 50%
NO3: 40%

Other Considerations

- **Protocol 1. Site Evaluation and Soil Infiltration Testing** and **Protocol 2. Infiltration Systems Guidelines** should be followed, see Appendix C

Description

Infiltration Berms are linear landscape features located along (i.e. parallel to) existing site contours in a moderately sloping area. They can be described as built-up earthen embankments with sloping sides, which function to divert, retain and promote infiltration, slow down, or divert stormwater flows. Berms are also utilized for reasons independent of stormwater management, such as to add interest to a flat landscape, create a noise or wind barrier, separate land uses, screen undesirable views or to enhance or emphasize landscape designs. Berms are often used in conjunction with recreational features, such as pathways through woodlands. Therefore, when used for stormwater management, berms and other retentive grading techniques can serve multifunctional purposes and are easily incorporated into the landscape.

Infiltration Berms create shallow depressions that collect and temporarily store stormwater runoff, allowing it to infiltrate into the ground and recharge groundwater. Infiltration berms may be constructed in series along a gradually sloping area.

1. Infiltration berms can be constructed on disturbed slopes and revegetated as part of the construction process. Infiltration berms should not be installed on slopes where soils having low shear strength (or identified as “slip prone” or “landslide prone”, etc.) have been mapped.
2. They can be installed along the contours within an existing woodland area to slow and infiltrate runoff from a development site.
3. May be constructed in combination with a subsurface infiltration trench at the base of the berm.

Infiltration Berms can provide runoff rate and volume control, though the level to which they do is limited by a variety of factors, including design variations (height, length, etc.), soil permeability rates, vegetative cover, and slope. Berms are ideal for mitigating runoff from relatively small impervious areas with limited adjacent open space (e.g. roads, small parking lots). Systems of parallel berms have been used to intercept stormwater from roadways or sloping terrain. Berms can sometimes be threaded carefully along contour on wooded hillsides, minimally disturbing existing vegetation and yet still gaining stormwater management credit from the existing woodland used. Conversely, berms are often incapable of controlling runoff from very large, highly impervious sites. Due to their relatively limited volume capacity, the length and/or number of berms required to retain large quantities of runoff make them impractical as the lone BMP in these cases. In these situations, berms are more appropriately used as pre- or additional-treatment for other more distributed infiltration systems closer to the source of runoff (i.e. porous pavement with subsurface infiltration).

Retentive grading may be employed in portions of sites where infiltration has been deemed to be possible and where site uses are compatible. Ideally, such retentive grading will serve to create subtle “saucers,” which contain and infiltrate stormwater flows. The “lip” of such saucers effectively function as a very subtle berm, which can be vertically impervious when vegetated and integrated into the overall landscape.

Variations

Diversion Berms

Diversion Berms can be used to protect slopes from erosion and to slow runoff rate. They can also be used to direct stormwater flow in order to promote longer flow pathways, thus increasing the time of concentration. Diversion berms often:

1. Consist of compacted earth ridges usually constructed across a slope in series to intercept runoff.
2. Can be incorporated within other stormwater BMPs to increase travel time of stormwater flow by creating natural meanders while providing greater opportunity for pollutant removal and infiltration.

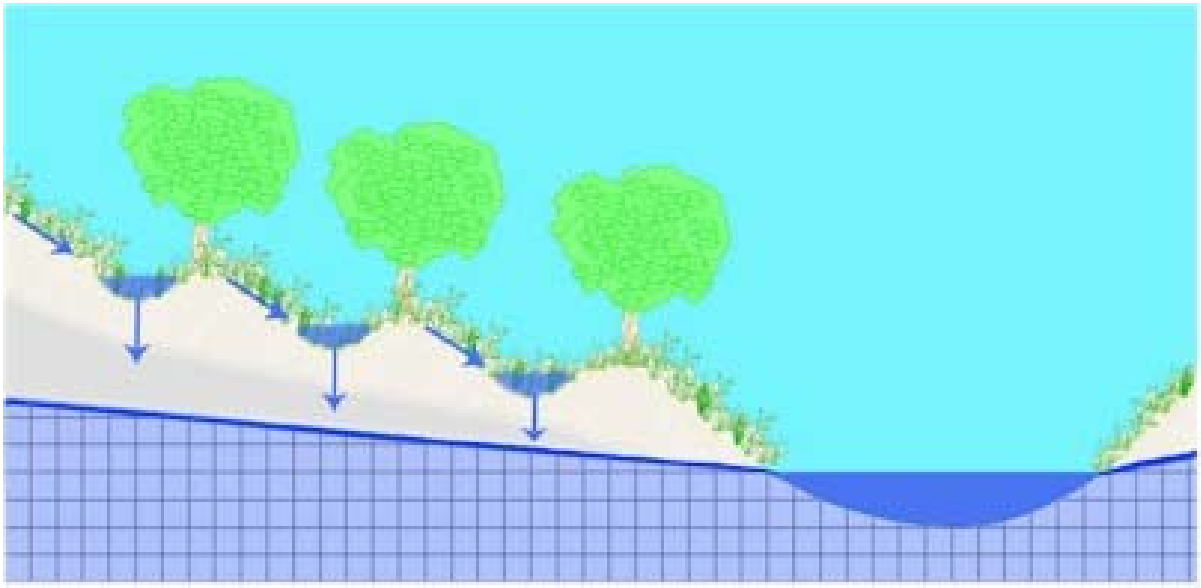
Applications

- **Meadow/Woodland Infiltration Berms**
  Infiltration Berms effectively control both the rate and volume of stormwater runoff. The berms are constructed along the contours and serve to collect and retain stormwater runoff, allowing it to infiltrate through the soil mantle and recharge the groundwater. Depressed areas adjacent to the berms should be level so that concentrated flow paths are not encouraged. Infiltration berms may have a variety of vegetative covers but meadow and woodland are recommended in order to reduce maintenance. If turf grass is used, berms in series should be constructed with enough space between them to allow access for maintenance vehicles. Also, berm side slopes should not exceed a 4:1 ratio. Woodland infiltration berms can sometimes be installed within existing wooded areas for additional stormwater management. Berms in wooded areas can even improve the health of existing vegetation, through enhanced groundwater recharge. Care should be taken during construction to ensure minimum disturbance to existing vegetation, especially tree roots.

- **Slope Protection**
  Diversion Berms can be used to help protect steeply sloping areas from erosion. Berms may divert concentrated discharge from a developed area away from the sloped area. Additionally, berms may be installed in series down the slope to retain flow and spread it out along multiple level berms to discourage concentrated flow.

- **Flow Pathway Creation**
  Berms may be utilized to create or enhance stormwater flow pathways within existing or proposed BMPs, or as part of an LID (Low Impact Development) strategy. Berms can be installed such that vegetated stormwater flow pathways are allowed to "meander" so that stormwater travel time is increased. For example, berms can be utilized within existing BMPs as part of a retrofit strategy to eliminate short-circuited inlet/outlet situations within detention basins provided care is taken to ensure the required storage capacity of the basin is maintained. Flow pathway creation can be utilized as part of an LID strategy to disconnect roof leaders and attenuate runoff, while increasing pervious flow pathways within developed areas. Berms should be designed to compliment the landscape while diverting runoff across vegetated areas and allowing for longer travel times to encourage pollutant removal and infiltration.

- **Constructed Wetland Berms**
  Berms are often utilized within constructed wetland systems in order to create elongated flow pathways with a variety of water depths. See BMP 6.6.1 – Constructed Wetlands.



Design Considerations

1. Sizing criteria are dependent on berm function, location and storage volume requirements.
   a. Low **berm height** (less than or equal to 24 inches) is recommended to encourage maximum infiltration and to prevent excessive ponding behind the berm. Greater heights may be used where berms are being used to divert flow or to create "meandering" or lengthened flow pathways. In these cases, stormwater is designed to flow adjacent to (parallel to), rather than over the crest of the berm. Generally, more berms of smaller size are preferable to fewer berms of large size.

b. **Berm length** is dependent on functional need and site size. Berms installed along the contours should be level and located across the slope. Maximum length will depend on width of the slope. Generally speaking, diversion berm length will vary with the size and constraints of the site in question.

2. **Infiltration Berms** should be constructed along (parallel to) contours at a constant elevation.

3. **Soil**. A berm may consist entirely of high quality topsoil. To reduce cost, only the top foot needs to consist of high quality Topsoil, with well-drained soil making up the remainder of the berm. The use of gravel is not recommended in the layers directly underneath the topsoil because of the tendency of the soil to wash through the gravel. In some cases, the use of clay may be required due to its cohesive qualities (especially where the berm height is high or relatively steeply sloped). However, well-compacted soil usually is sufficient provided that the angle of repose (see below) is not exceeded for the soil medium used.

   A more sustainable alternative to importing berm soil from off-site is to balance berm cut and fill material as much as possible, provided on-site soil is deemed suitable as per the Specifications below. Ideally, the concave segment (infiltration area) of the berm is excavated to a maximum depth of 12 inches and then used to construct the convex segment (crest of berm).

4. The **Angle of Repose of Soil** is the angle at which the soil will rest and not be subject to slope failure. The angle of repose of any soil will vary with the texture, water content, compaction, and vegetative cover. Typical angles of repose are given below:

   a. Non-compacted clay: 5-20%
   b. Dry Sand: 33%
   c. Loam: 35-40%
   d. Compacted clay: 50-80%

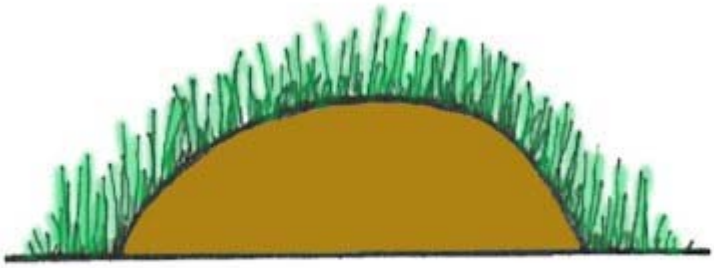
5. **Side Slopes**. The angle of repose for the soil used in the berm should determine the maximum slope of the berm with additional consideration to aesthetic, drainage, and maintenance needs. If a berm is to be mowed, the slope should not exceed a 4:1 ratio (horizontal to vertical) in order to avoid “scalping” by mower blades. If trees are to be planted on berms, the slope should not exceed a 5:1 ratio. Other herbaceous plants, which do not require mowing, can tolerate slopes of 3:1. Berm side slopes should not exceed a 2:1 ratio.

6. **Plant Materials.** It is important to consider the function and form of the berm when selecting plant materials. If using trees, plant them in a pattern that appears natural and accentuates the berm’s form. Consider tree species appropriate to the proposed habitat. If turf will be combined with woody and herbaceous plants, the turf should be placed to allow for easy maneuverability while mowing. Low maintenance plantings, such as trees and meadow plants, rather than turf and formal landscaping, are encouraged.

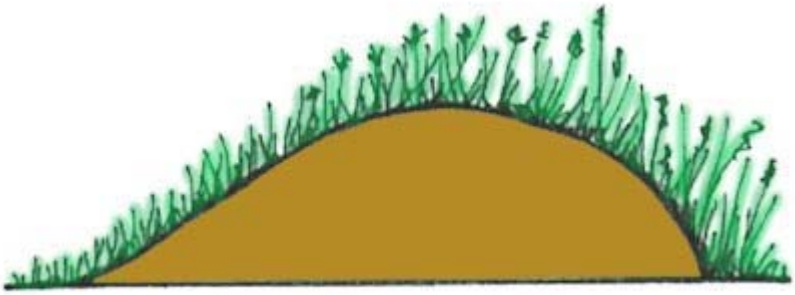
7. **Infiltration Design.** Infiltration berms located along slopes should be composed of low berms (less than 12 inches high) and should be vegetated. Subsurface soils should be uncompacted to encourage infiltration behind the berms. Soil testing is not required where berms are located within an existing woodland, but soil maps/data should be consulted when siting the berms. Where feasible, surface soil testing should be conducted in order to estimate potential infiltration rates.

8. **Infiltration Trench Option.** Soil testing is recommended for infiltration berms that will utilize a subsurface infiltration trench. Infiltration trenches are not recommended in existing woodland areas as excavation and installation of subsurface trenches could damage tree root systems. See BMP 6.4.4 – Infiltration Trench, for information on infiltration trench design.

9. **Aesthetics.** To the extent possible, berms should reflect the surrounding landscape. Berms should be graded so that the top of the berm is smoothly convex and the toes of the berms are smoothly concave. Natural, asymmetrical berms are usually more effective and attractive than symmetrical berms. The crest of the berm should be located near one end of the berm rather than in the middle.



undesirable shape for a berm



desirable shape for a berm

Detailed Stormwater Functions

Infiltration Area

The Infiltration Area is the ponding area behind the berm, defined as:
Length of ponding x Width ponding area = Infiltration Area (Ponding Area)

Volume Reduction Calculations

Storage volume can be calculated for Infiltration Berms. The storage volume is defined as the ponding area created behind the berm, beneath the discharge invert (i.e. the crest of the berm). Storage volume can be calculated differently depending on the variations utilized in the design.

Surface Storage Volume is defined as the volume of water stored on the surface at the ponding depth. This is equal to:
Cross-sectional area of ponded water x Berm length = Surface Storage Volume

Peak Rate Mitigation:

See Section 8 for Peak Rate Mitigation methodology which addresses link between volume reduction and peak rate control.

Water Quality Improvement:

See Section 8 for Water Quality Improvement methodology which addresses pollutant removal effectiveness of this BMP.

Construction Sequence

The following is a typical construction sequence for a infiltration berm without a subsurface infiltration trench, though alterations will be necessary depending on design variations.

1. Install temporary sediment and erosion control BMPs as per the Pennsylvania Erosion and Sediment Pollution Control Program Manual.

2. Complete site grading and stabilize within the limit of disturbance except where Infiltration Berms will be constructed; make every effort to minimize berm footprint and necessary zone of disturbance (including both removal of exiting vegetation and disturbance of empty soil) in order to maximize infiltration.

3. Lightly scarify the soil in the area of the proposed berm before delivering soil to site.

4. Bring in fill material to make up the major portion of the berm. Soil should be added in 8-inch lifts and compacted after each addition according to design specifications. The slope and shape of the berm should graded out as soil is added.

5. Protect the surface ponding area at the base of the berm from compaction. If compaction of this area does occur, scarify soil to a depth of at least 8 inches.

6. Complete final grading of the berm after the top layer of soil is added. Tamp soil down lightly and smooth sides of the berm. The crest and base of the berm should be at level grade.

7. Plant berm with turf, meadow plants, shrubs or trees, as desired.

8. Mulch planted and disturbed areas with compost mulch to prevent erosion while plants become established.

Maintenance Issues

Infiltration Berms have low to moderate maintenance requirements, depending on the design.

Infiltration Berms

- Regularly inspect to ensure they are infiltrating; monitor drawdown time after major storm events
- Inspect any structural components, such as inlet structures to ensure proper functionality
- If planted in turf grass, maintain by mowing. Other vegetation will require less maintenance. Trees and shrubs may require annual mulching, while meadow planting requires annual mowing and clippings removal.
- Avoid running heavy equipment over the infiltration area at the base of the berms. The crest of the berm may be used as access for heavy equipment when necessary to limit disturbance.
- .
- Routinely remove accumulated trash and debris.
- Remove invasive plants as needed
- Inspect for signs of flow channelization; restore level gradient immediately after deficiencies are observed

Diversion Berms

- Regularly inspect for erosion or other failures.
- Regularly inspect structural components to ensure functionality.
- Maintain turf grass and other vegetation by mowing and re-mulching.
-
- Remove invasive plants as needed.
- Routinely remove accumulated trash and debris.

Cost Issues

Infiltration berms can be less expensive than other BMPs options because extensive clearing and grubbing is not necessary. Cost will depend on height, length and width of berms as well as desired vegetation.

Specifications

The following specifications are provided for information purposes only. These specifications include information on acceptable materials for typical applications, but are by no means exclusive or limiting. The designer is responsible for developing detailed specifications for individual design projects in accordance with the project conditions.

1. **Soil Materials**
   a. Satisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP.
   b. Unsatisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
   c. Topsoil: Topsoil stripped and stockpiled on the site should be used for fine grading. Topsoil is defined as the top layer of earth on the site, which produces heavy growths of crops, grass or other vegetation.

d. Soils excavated from on-site may be used for berm construction provided they are deemed satisfactory as per the above recommendations or by a soil scientist.

2. Placing and Compacting of Berm Area Soil

a. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fill. Plow strip, or break up sloped surfaces steeper than I vertical to 4 horizontal so that fill material will bond with existing surface.

b. When existing ground surface has a density less than that specified under g. (below) for particular area classification, break up ground surface, pulverize, bring the moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

c. Place backfill and fill materials in layers not more than 8 inches in loose depth for material to be compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material to be compacted by hand-operated tampers.

d. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

e. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or same elevation in each lift.

f. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts if soil density tests indicate inadequate compaction.

g. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density, in accordance with ASTM D 1557:

- Under lawn or unpaved areas, compact top 6 inches of subgrade and each layer of backfill or fill material at 85 percent maximum density.
- Under infiltration areas no compaction shall be permitted.

3. Grading

a. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances; compact with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.

b. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10 foot above or below required subgrade elevations.

c. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

4. Temporary Seeding

a. Temporary seeding and mulching shall be required on all freshly graded areas immediately following earth moving procedures. Seed-free straw or salt hay mulch shall be applied at a rate of 75 lbs. per 1,000 square feet over temporary seeded areas. Straw bale barriers shall be placed in swale areas until vegetation is established.

b. Should temporary seeding not be possible or not establish itself properly, mulch as described above, pending fine grading or permanent seeding.

5. Finish Grading

a. Spreading of topsoil and finish grading shall be coordinated with the work of the Landscape Contractor.
b. Verify that the rough grades meet requirements for tolerances, materials, and compaction.
c. Surface of subgrades shall be loosened and made friable by cross-discing or harrowing to a depth of 2 inches. Stones and debris more than 1-1.5 inches in any dimension shall be raked up and grade stakes and rubbish removed.
d. Topsoil shall be uniformly spread to minimum depths after settlement of 6 inches on areas to be seeded and 4 inches on areas to be sodded. Correct any surface irregularities to prevent formation of low spots and pockets that would retain water.
e. Topsoil shall not be placed when the subgrade is frozen, excessively wet, or extremely dry and no topsoil shall be handled when in a frozen or muddy condition. During all operations following topsoil spreading, the surface shall be kept free from stones over 1-1.5 inches in size or any rubbish, debris, or other foreign material.
f. After placing topsoil rake soil to a smooth, even-draining surface and compact lightly with an empty water roller. Leave finish graded areas clean and well raked, ready for lawn work.

References

AMEC Earth and Environmental Center for Watershed Protection et al. *Georgia Stormwater Management Manual*. 2001.

Harris, C. and Dines, N. *Time Saver Standards for Landscape Architecture, 2nd Edition*. New York, NY: McGraw-Hill, 1998.

University of Minnesota. “Building Soil Berms.” *Sustainable Urban Landscape Information Series (SULIS)*. 1998. <http://www.sustland.umn.edu/implement/soil_berms.html>

Chester County Conservation District. *Chester County Stormwater BMP Tour Guide-Infiltration Trenches (Infiltration Berms).* 2002.

Williams, G.P. *Canadian Building Digest - Drainage and Erosion at Construction Sites*. National Research Council Canada. 2004. <http://irc.nrc-cnrc.gc.ca/cbd/cbd183e.html>

BMP 6.7.2: Landscape Restoration

Landscape Restoration is the general term used for actively sustainable landscaping practices that are implemented outside of riparian (or other specially protected) buffer areas. Landscape Restoration includes the restoration of forest (i.e. reforestation) and/or meadow and the conversion of turf to meadow. In a truly sustainable site design process, this BMP should be considered only after the areas of development that require landscaping and/or revegetation are minimized. The remaining areas that do require landscaping and/or revegetation should be driven by the selection and use of vegetation (i.e., native species) that does not require significant chemical maintenance by fertilizers, herbicides, and pesticides..

- Minimize traditional turf lawn area
- Maximize landscape restoration area planted with native vegetation
- Protect landscape restoration area during construction
- Prevent post-construction erosion through adequate stabilization
- Minimize fertilizer and chemical-based pest control programs
- Creates and maintains porous surface and healthy soil.
- Minimize mowing (two times per year)
- Reduced maintenance cost compared to lawn

Commercial: Yes
Ultra Urban: Limited
Industrial: Yes
Retrofit: Yes
Highway/Road: Yes

Stormwater Functions

Volume Reduction: Low/Med.
Recharge: Low/Med.
Peak Rate Control: Low/Med.
Water Quality: Very High

Water Quality Functions

TSS: 85%
TP: 85%
NO3: 50%

Other Considerations

- Soil investigation recommended
- Soil restoration may be necessary

Description

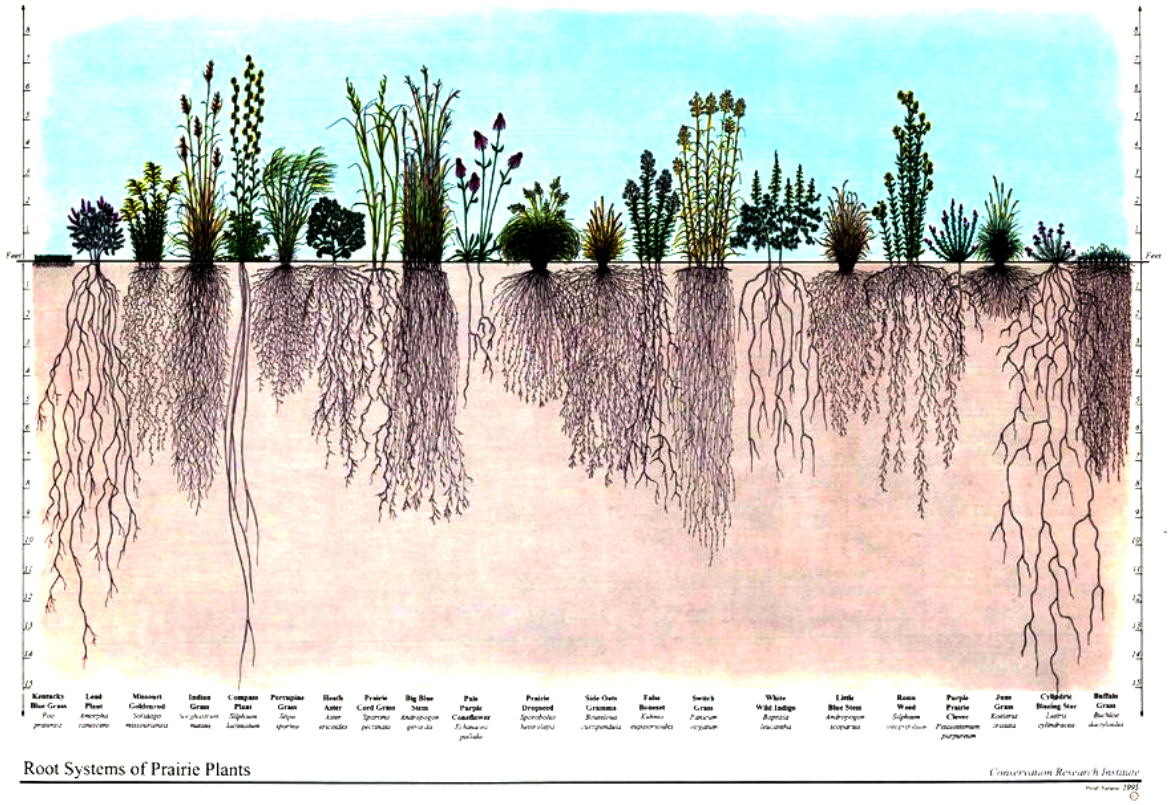
In an integrated stormwater management plan, the landscape is a vital factor, not only in sustaining the aesthetic and functional resources of a site, but also in mitigating the volume and rate of stormwater runoff. Sustainable landscaping, or Landscape Restoration, is an effective method of improving the quality of site runoff. This often overlooked BMP includes the restoration of forest and/or meadow or the conversion of turf to meadow.

Landscape Restoration involves the careful selection and use of vegetation that does not require significant chemical maintenance by fertilizers, herbicides and pesticides. Implicit in this BMP is the assumption that native species have the greatest tolerance and resistance to pests and require less fertilization and chemical application than do nonnative species. Furthermore, since native grasses and other herbaceous materials often require less intensive maintenance efforts (i.e. mowing or trimming), their implementation on a site results in less biomass produced.

Native species are customarily strong growers with stronger and denser root and stem systems, thereby generating less runoff. If the objective is revegetation with woodland species, the longer-term effect is a significant reduction in runoff volumes, with increases in infiltration, evapotranspiration, and recharge, when contrasted with a conventional lawn planting. Peak rate reduction also is achieved. Similarly, meadow reestablishment is also more beneficial than a conventional lawn planting, although not so much as the woodland landscape. Again, these benefits are long term in nature and will not be forthcoming until the species have had an opportunity to grow and mature (one advantage of the meadow is that this maturation process requires considerably less time than a woodland area). Native grasses also tend to have substantially deeper roots and more root mass than turf grasses, which results in:

- A greater volume of water uptake (evapotranspiration)
- Improved soil conditions through organic material and macropore formation
- Provide for greater infiltration

Landscape architects specializing in the local plant community are usually able to identify a variety of species that meet these criteria. Other sources of advice may be county conservation districts, watershed associations and other conservation groups. As the selection of such materials begins at the conceptual design stage, where lawns are eliminated or avoided altogether and landscaping species selected, Landscape Restoration can generally result in a site with reduced runoff volume and rate, as well as significant nonpoint source load reduction/prevention.



Landscape Restoration can improve water quality by minimizing application of fertilizers and pesticides/herbicides. Given the high rates of chemical application which have been documented at newly created lawns for both residential and nonresidential land uses, eliminating the need for chemical application is important for water quality. Of special importance here is the reduction in fertilization and nitrate loadings. For example, Delaware's *Conservation Design for Stormwater Management* lists multiple studies that document high fertilizer application rates, including both nitrogen and phosphorus, in newly created landscapes in residential and nonresidential land developments. Expansive lawn areas in low density single-family residential subdivisions as well as large office parks typically receives intensive chemical application, both fertilization and pest control, which can exceed application rates being applied to agricultural fields. Avoidance of this nonpoint pollutant source is an important water quality objective.

Variations

- Meadow
- No-mow lawn area
- Woodland restoration
- Removal of existing lawn to reduce runoff volume
- Buffers between lawn areas and wetlands or stream corridors
- Replacement of "wet" lawn areas difficult to mow
- Replacement of hard to maintain lawns under mature trees

Applications

- Forested Landscape/Restoration
- Suburban / Developing Landscape
- Urban Landscape
- Meadow Restoration
- Conversion of Turf to Meadow

Design Considerations

1. The recommended guidelines for Landscape Restoration are very closely related to those of Riparian Buffer Restoration (RBR) (BMP 6.7.1). Specifically, Landscape Restoration overlaps with the guidelines for Zones 2 and 3 in typical RBR. As with RBR, it is essential for successful Landscape Restoration that site conditions be well understood, objectives of the landowner considered, and the appropriate plants chosen for the site. These are all tasks that should be completed in the early planning stages of a project. For a summary of the nine steps recommended for the planning stages of a restoration project, see BMP 6.7.1- Riparian Buffer Restoration. Included in this nine-step process are: analysis of site soils/natural vegetative features/habitat significance/topography/etc., determination of restoration suitability, and site preparation.

2. In those sites where soils have been disturbed or determined inadequate for restoration (based on analysis), soil amendments are needed. Soil amendment and restoration is the process of restoring compromised soils by subsoiling and/or adding a soil amendment, such as compost, for the purpose of reestablishing its long-term capacity for infiltration and pollution removal. For more information on restoring soils, see BMP 6.7.3 Soil Amendments and Restoration.

3. “Native species” is a broad term. Different types of native species landscapes may be created, from meadow to woodland areas, obviously requiring different approaches to planting. A native landscape may take several forms in Pennsylvania, ranging from reestablishment of woodlands with understory plantings to reestablishment of meadow. It should be noted that as native landscapes grow and mature, the positive stormwater benefits relating to volume control and peak rate control increase. So, unlike highly maintained turf lawns, these landscapes become much more effective in reducing runoff volumes and nonpoint source pollutants over time.

4. Minimizing the extent of lawn is one of the easiest and most effective ways of improving water quality. Typical (i.e. compacted) lawns on gentle slopes can produce almost as much runoff as pavement. In contrast to turf, “natural forest soils with similar overall slopes can store up to 50 times more precipitation than neatly graded turf.” (Arendt, Growing Greener, pg. 81)
   The first step in sustainable site design is to limit the development footprint as much as possible, preserving natural site features, such as vegetation and topography. If lawn areas are desired in certain areas of a site, they should be confined to those areas with slopes less than 6%.

5. Meadow restoration may be used alone or in combination with a forest restoration. The native meadow landscape provides a land management alternative that benefits stormwater management by reducing runoff volume and nonpoint source pollutant transport. Furthermore, meadow landscapes vastly reduce the need for maintenance, as they do not require frequent mowing during the growing season. Because native grasses and flowers are almost exclusively perennials, properly installed meadows are a self-sustaining plant community that will return year after year.

   Meadows can be constructed as a substitute to turf on the landscape, or they can be created as a buffer between turf and forest. In either situation, the meadow restoration acts to reduce runoff as well as reduce erosion and sedimentation. Meadow buffers along forests also help reduce off-trail pedestrian traffic in order to avoid creating paths which can further concentrate stormwater.

   The challenge in restoring meadow landscapes is a lack of effective establishment and maintenance methods. Native grasses and flowers establish more slowly than weeds and turf grass. Therefore, care must be taken when creating meadow on sites where weed or other vegetative communities are well established. It may take a year or more to prepare the site and to get weeds under control before planting. Erosion prone sites should be planted with a nurse crop (such as annual rye) for quick vegetation establishment to prevent seed and soil loss. Steep slopes and intermittent water courses should be stabilized with erosion blankets, selected to mitigate expected runoff volumes and velocities. Additionally, seed quality is extremely important to successful establishment. There is tremendous variation among seed suppliers, seeds should be chosen with a minimum percent of non-seed plant parts.

6. Conversion of turf grass areas to meadow is relatively simple and has enormous benefits for stormwater management. Though turf is inexpensive to install, the cost of maintenance to promote an attractive healthy lawn is high (requiring mowing, irrigation, fertilizer, lime and

herbicides) and its effects are detrimental to water quality. Turf areas are good candidates for conversion to meadow as they typically have lower density of weed species. The conversion of turf to meadow requires that all turf be eliminated before planting, and care must be taken to control weed establishment prior to planting.

7. Forest restoration includes planting of appropriate tree species (small saplings) with quick establishment of an appropriate ground cover around the trees in order to stabilize the soil and prevent colonization of invasive species. Reforestation can be combined with other volume control BMPs such as retentive berming, vegetated filter strips and swales.

   Plant selection should mimic the surrounding native vegetation and expand on the native species composition already found on the site. A mixture of native trees and shrubs is recommended and should be planted once a ground cover is established.

8. In terms of woodland areas, DCNR's *Conservation Design for Stormwater Management* states, "…a mixture of young trees and shrubs is recommended…. Tree seedlings from 12 to 18 inches in height can be used, with shrubs at 18 to 24 inches. Once a ground cover crop is established (to offset the need for mowing), trees and shrubs should be planted on 8-foot centers, with a total of approximately 430 trees per acre. Trees should be planted with tree shelters to avoid browse damage in areas with high deer populations, and to encourage more rapid growth." (p.3-50). Initial watering and weekly watering during dry periods may be necessary during the first growing season. As tree species grow larger, both shrubs and ground covers recede and yield to the more dominant tree species. The native tree species mix of small inexpensive saplings should be picked for variety and should reflect the local forest communities. Annual mowing to control invasives may be necessary, although the quick establishment of a strong-growing ground cover can be effective in providing invasive control. Native meadow planting mixes also are available. A variety of site design factors may influence the type of vegetative community that is to be planned and implemented. In so many cases, the "natural" vegetation of Pennsylvania's communities is, of course, woodland.

9. Ensure adequate stabilization. Adequate stabilization is extremely important as native grasses, meadow flowers, and woodlands establish more slowly than turf. Stabilization can be achieved for forest restoration by establishing a ground cover before planting of trees and shrubs. When creating meadows, it may be necessary to plant a fast growing nurse crop with meadow seeds for quick stabilization. Annual rye can be planted in the fall or spring with meadow seeds and will establish quickly and usually will not present a competitive problem. Erosion prone sites should be planted with a nurse crop and covered with weed-free straw mulch, while steep slopes and areas subject to runoff should be stabilized with erosion control blankets suitable for the expected volume and velocity of runoff.

Volume Reduction Calculations and Peak Rate Mitigation
Areas designated for landscape restoration should be considered as “Meadow, good condition” in stormwater calculations.

Water Quality Improvement
See Section 8 for Water Quality Improvement methodology, which addresses pollutant removal effectiveness of this BMP.

Construction Sequence

Forest restoration installation follows closely the procedure outlined in BMP 6.7.1- Riparian Buffer Restoration. Refer to BMP 6.7.1 for detailed information, with the understanding that species selection for upland forest restoration will differ from that for riparian restoration.

Meadow installation should proceed as follows:

1. SELECT SITE
- Confirm site is suitable for restoration, should be sunny, open and well-ventilated. Meadow plants require at least a half a day of full sun.
- Obtain landowner permission

2. ANALYZE SITE
- Evaluate site’s physical conditions (soil attributes, geology, terrain)
- Evaluate site’s vegetative features (desirable and undesirable species, native species, sensitive habitats). Good candidates for meadow plantings include areas presently in turf, cornfields, soybean fields, alfalfa fields and bare soils from new construction.
- Areas with a history of heavy weed growth may require a full year or longer to prepare for planting.
- Beware of residual herbicides that may have been applied to agricultural fields. Always check the herbicide history of the past 2-3 years and test the soils if in doubt.

3. PLANT SELECTION
- Select plants that are well adapted to the specific site conditions. Meadow plants must be able to out compete weed species in the first few years as they become established.

4. PREPARE SITE
- All weeds or existing vegetation must be eliminated prior to seeding.
- Perennial weeds may require year long smothering, repeated sprayings with herbicides, or repeated tillage with equipment that can uproot and kill perennial weeds.

5. PLANTING DAY
- Planting can take place from Spring thaw through June 30 or from September 1 through soil freeze-up (“dormant seeding”)
- Planting in July and August is generally not recommend due to the frequency of drought during this time.
- Seeding can be accomplished by a variety of methods: no-till seeder for multi-acre planting; broadcast seeder; hand broadcast for small areas of one acre or less.
- Seed quality is critical and a seed mix should be used with a minimum percentage of non-seed plant parts.

6. SITE MAINTENANCE (additional information below)

- Assign responsibilities for watering, weeding, mowing, and maintenance
- Monitor site regularly for growth and potential problems

Maintenance Issues

Meadows and Forests are low maintenance but not “no maintenance”. They usually require more frequent maintenance in the first few years immediately following installation.

Forest restoration areas planted with a proper cover crop can be expected to require annual mowing in order to control invasives. Application of a carefully selected herbicide (Roundup or similar glyphosate herbicide) around the protective tree shelters/tubes may be necessary, reinforced by selective cutting/manual removal, if necessary. This initial maintenance routine is necessary for the initial 2 to 3 years of growth and may be necessary for up to 5 years until tree growth and tree canopy begins to form, naturally inhibiting weed growth (once shading is adequate, growth of invasives and other weeds will be naturally prevented, and the woodland becomes self-maintaining). Review of the new woodland should be undertaken intermittently to determine if replacement trees should be provided (some modest rate of planting failure is usual).

Meadow management is somewhat more straightforward; a seasonal mowing or burning may be required, although care must be taken to make sure that any management is coordinated with essential reseeding and other important aspects of meadow reestablishment. In the first year weeds must be carefully controlled and consistently mowed back to 4-6 inches tall when they reach 12 inches in height. In the second year, weeds should continue to monitored and mowed and rhizomatous weeds should be hand treated with herbicide. Weeds should not be sprayed with herbicide as the drift from the spray may kill large patches of desirable plants, allowing weeds to move in to these new open areas. In the beginning of the third season, the young meadow should be burned off in mid-spring. If burning is not possible, the meadow should be mowed very closely to the ground instead. The mowed material should be removed from the site to expose the soil to the sun. This helps encourage rapid soil warming which favors the establishment of “warm season” plants over “cool season” weeds.

Cost Issues

Landscape restoration cost implications are minimal during construction. Seeding for installation of a conventional lawn is likely to be less expensive than planting of a “cover” of native species, although when contrasted with a non-lawn landscape, “natives” often are not more costly than other nonnative landscape species. In terms of woodland creation, somewhat dated (1997) costs have been provided by the *Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers*:

$860/acre trees with installation
$1,600/acre tree shelters/tubes and stakes
$300/acre for four waterings on average

In current dollars, these values would be considerably higher, well over $3,000/acre for installation costs. Costs for meadow reestablishment are lower than those for woodland, in part due to the

elimination of the need for shelters/tubes. Again, such costs can be expected to be greater than installation of conventional lawn (seeding and mulching), although the installation cost differences diminish when conventional lawn seeding is redefined in terms of conventional planting beds.

Cost differentials grow greater when longer term operating and maintenance costs are taken into consideration. If lawn mowing can be eliminated, or even reduced significantly to a once per year requirement, substantial maintenance cost savings result, often in excess of $1,500 per acre per year. If chemical application (fertilization, pesticides, etc.) can be eliminated, substantial additional savings result with use of native species. These reductions in annual maintenance costs resulting from a native landscape reestablishment very quickly outweigh any increased installation costs that are required at project initiation. Unfortunately, because developers pay for the installation costs and longer term reduced maintenance costs are enjoyed by future owners, there is reluctance to embrace native landscaping concepts.

Specifications

The following specifications are provided for information purposes only. These specifications include information on acceptable materials for typical applications, but are by no means exclusive or limiting. The designer is responsible for developing detailed specifications for individual design projects in accordance with the project conditions.

Vegetation – See Appendix B

References

Bowman's Hill Wildflower Preserve, Washington Crossing Historic Park, PO Box 685, New Hope, PA 18938-0685, Tel (215) 862-2924, Fax (215) 862-1846, Native plant reserve, plant sales, native seed, educational programs, www.bhwp.org

Morris Arboretum of the University of Pennsylvania; 9414 Meadowbrook Avenue, Philadelphia, PA 19118, Tel (215) 247-5777, www.upenn.edu/morris, PA Flora Project Website: Arboretum and gardens (some natives), educational programs, PA Flora Project, www.upenn.edu/paflora

Pennsylvania Department of Conservation and Natural Resources; Bureau of Forestry; PO Box 8552, Harrisburg, PA 17105-8552, Tel (717)787-3444, Fax (717)783-5109, Invasive plant brochure; list of native plant and seed suppliers in PA; list of rare, endangered, threatened species.

Pennsylvania Native Plant Society, 1001 East College Avenue, State College, PA 16801 www.pawildflower.org

Western Pennsylvania Conservancy; 209 Fourth Avenue, Pittsburgh, PA 15222, Tel (412) 288-2777, Fax (412) 281-1792, www.paconserve.org

Conservation Design for Stormwater Management (DNREC and EMC)

Stream ReLeaf Plan and Toolkits

The Once and Future Forest – Leslie Sauer

Forestry Best Management Practices for Water Quality – Virginia Department of Forestry

Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers (1997)

Arendt, R. *Growing Greener.* Island Press, November 1999.

Diboll, Neil. Five Steps to Successful Prairie Meadow Establishment. Windstar Wildlife Institute.

Penn State College of Agricultural Sciences, Agricultural Research and Cooperation Extension. " Pennsylvania Wildlife No. 12: Warm-season Grasses and Wildlife" and "Pennsylvania Wildlife No. 5: Meadows and Prairies: Wildlife-friendly Alternatives to Lawn"

Appendix D
Source/ Cause of Impaired Streams

Section 303(d) Listed Impaired Streams

STREAMS	SOURCE/ CAUSE OF IMPAIRMENT
"Dead Woman Hollow"	Atmospheric Deposition - pH
Beaver Creek	Flow Regulation/Modification - Water/Flow Variability
Beaver Creek	Flow Regulation/Modification - Siltation ; Flow Regulation/Modification - Water/Flow Variability
Beaver Creek	Crop Related Agric - Siltation
Trib of Beaver Creek	Flow Regulation/Modification - Siltation ; Flow Regulation/Modification - Water/Flow Variability
Beaverdam Creek	Agriculture - Siltation
Trib of Beaverdam Creek	Agriculture - Siltation
Bermudian Creek	Industrial Point Source - Organic Enrichment/Low D.O.
Trib of Bermudian Creek	Agriculture - Siltation
Brush Run	Agriculture - Organic Enrichment/Low D.O. ; Agriculture - Water/Flow Variability
Trib of Brush Run	Agriculture - Organic Enrichment/Low D.O. ; Agriculture - Water/Flow Variability
Conewago Creek	Agriculture - Siltation
Trib of Conewago Creek	Flow Regulation/Modification - Water/Flow Variability
Trib of Conewago Creek	Agriculture - Siltation
Trib of Conewago Creek	Agriculture - Water/Flow Variability
Trib of Latimore Creek	Grazing Related Agric - Nutrients ; Grazing Related Agric - Siltation
Trib of Little Marsh Creek	Industrial Point Source - Unknown Toxicity ; Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation ; Small Residential Runoff - Nutrients ; Small Residential Runoff - Water/Flow
Trib of Marsh Creek	Land Development - Cause Unknown
Trib of Marsh Creek	Grazing Related Agric - Siltation ; Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation ; Small Residential Runoff - Nutrients ; Small Residential Runoff - Water/Flow Variability
Trib of Marsh Creek	Land Development - Cause Unknown
Trib of Marsh Creek	Small Residential Runoff - Water/Flow Variability ; Road Runoff - Water/Flow Variability
Mountain Creek	Atmospheric Deposition - pH
Trib of Mountain Creek	Atmospheric Deposition - pH
Mud Run	Hydromodification - Excessive Algal Growth
Mud Run	Municipal Point Source - Excessive Algal Growth
Mud Run	Hydromodification - Excessive Algal Growth
Mummasburg Run	Crop Related Agric - Unknown Toxicity ; Crop Related Agric - Nutrients
Mummasburg Run	Agriculture - Nutrients ; Agriculture - Siltation
Mummasburg Run	Agriculture - Nutrients
Trib of Mummasburg Run	Agriculture - Nutrients ; Agriculture - Siltation
Trib of Mummasburg Run	Crop Related Agric - Unknown Toxicity ; Crop Related Agric - Nutrients
Trib of Mummasburg Run	Agriculture - Nutrients
Opossum Creek	Agriculture - Siltation
Trib of Opossum Creek	Agriculture - Siltation

Plum Creek	Agriculture - Siltation ; Urban Runoff/Storm Sewers - Siltation
Trib of Plum Creek	Agriculture - Siltation ; Urban Runoff/Storm Sewers - Siltation
Plum Run	Agriculture - Siltation
Plum Run	Small Residential Runoff - Nutrients ; Upstream Impoundment - Flow Alterations
Trib of Plum Run	Agriculture - Siltation
Quaker Run	Agriculture - Siltation
Trib of Quaker Run	Agriculture - Siltation
Trib of Quaker Run	Channelization - Other Habitat Alterations
Rock Creek	Grazing Related Agric - Nutrients ; Grazing Related Agric - Siltation ; Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation ; Small Residential Runoff - Nutrients ; Small Residental
Rock Creek	Grazing Related Agric - Nutrients ; Grazing Related Agric - Water/Flow Variability ; Grazing Related Agric - Siltation ; Grazing Related Agric - Thermal Modifications
Trib of Rock Creek	Grazing Related Agric - Siltation ; Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation ; Small Residential Runoff - Nutrients ; Small Residential Runoff - Water/Flow Variability
Trib of Rock Creek	Grazing Related Agric - Siltation ; Small Residential Runoff - Water/Flow Variability
South Branch Conewago Creek	Agriculture - Siltation
South Branch Conewago Creek	Surface Mining - Siltation
South Branch Conewago Creek	Agriculture - Siltation ; Urban Runoff/Storm Sewers - Siltation
Trib of South Branch Conewago Creek	Agriculture - Siltation
Trib of South Branch Conewago Creek	Surface Mining - Flow Alterations
Trib of South Branch Conewago Creek	Surface Mining - Other Habitat Alterations ; Channelization - Other Habitat Alterations
Trib of South Branch Conewago Creek	Surface Mining - Water/Flow Variability
Stevens Run	Industrial Point Source - Unknown Toxicity ; Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation ; Small Residential Runoff - Nutrients ; Small Residential Runoff - Water/Flow
Swift Run	Agriculture - Organic Enrichment/Low D.O. ; Agriculture - Water/Flow Variability
Trib of Swift Run	Agriculture - Organic Enrichment/Low D.O. ; Agriculture - Water/Flow Variability
White Run	Small Residential Runoff - Nutrients ; Small Residential Runoff - Siltation ; Upstream Impoundment - Flow Alterations
Willoughby Run	Agriculture - Siltation ; Agriculture - Organic Enrichment/Low D.O. ; Agriculture - Other Habitat Alterations

Appendix E
Municipal Survey Results

Adams County Act 167 - Phase 1
Municipal Survey

Watershed _____

Municipality _____

Person(s) Completing Survey (include title) _____

Date _____

1. a) Does the municipality have a stormwater management ordinance? Yes _____ No _____
   If Yes, are the regulations incorporated in . . .
   - the municipal Subdivision and Land Development Ordinance _____, or
   - a stand-alone ordinance _____?

   b) Does the ordinance contain water quality regulations? Yes _____ No _____

   c) Does the ordinance contain water quantity regulations? Yes _____ No _____

   d) Does the ordinance contain rate controls? Yes _____ No _____

2. Do you have concerns with the stormwater management ordinance? Yes _____ No _____
   What are your specific concerns with the ordinance?

   _____
   _____
   _____
   _____
   _____

3. Can a copy of the ordinance be obtained on line? Yes _____ No _____
   If no, please send a copy of the ordinance or appropriate section of the Subdivision and Land Development Ordinance to the Adams County Planning Department

4. If your residents have frequent stormwater complaints, please list the problem(s) and identify the location.

Complaint (List and Map)	Location

5. Does the municipality have records of flooding throughout the municipality (i.e., dates, height of floodwater)?

a) Yes _____ No _____, or b) for specific areas? Yes _____ No _____

6. Where are the impacts associated with flooding in the municipality, and the nature of the problem (e.g., roadway inundation, structural damage, etc.)?

Location (List and Map)	Problem

7. a) Does the municipality monitor rainfall events? Yes _____ No _____
   b) If Yes, could the information be provided? Yes _____ No _____
   c) If Yes, what procedures are used to monitor rainfall?

_____
_____
_____

8. a) Are there planned infrastructure improvements (e.g., bridge replacement, roadway/culvert repair, etc.) which would alleviate flooding? Yes _____ No _____
   b) If Yes, please note the improvement(s) and the location(s) below:

Location (List and Map)	Improvement	Public or Private Improvement

9. a) Have there been any studies/reports completed related to your watershed? Yes _____ No _____
   b) If Yes, please list the study below and provide a copy to the Adams County Office Planning & Development.

Location(s) (List and Map)	Stream Name(s)

   c) Has there been hydraulic modeling completed in your water shed? Yes _____ No _____
      1. Can a copy of the report(s) be made available? Yes _____ No _____
      2. Can a copy of the model/computer program be made available? Yes _____ No _____
      3. Who was the consultant that prepared the model? _____

10. a) Are there stream gauges within the municipality? Yes _____ No _____
    b) If Yes, who maintains them? _____
    c) If Yes, is data available? Yes _____ No _____
       For what time periods? _____

Location(s) (List and Map)	Stream Name(s)

11. a) Is your municipality involved in any inter-municipal agreements? Yes _____ No _____
    b) If Yes, with what municipality(s), and what does the agreements involve (roadways, land use, etc.)?

_____
_____
_____
_____
_____

12. a) What are the municipality's stormwater review procedures for a land development/subdivision plan (driveways, garage, etc)

_____
_____
_____
_____
_____

b) What are the review policies/procedures when a development/subdivision is not required?

_____
_____
_____
_____
_____

13. a) Does your municipality perform inspections of private or public stormwater improvements during construction? Yes _____ No _____
    b) Does your municipality routinely inspect stormwater management facilities once they are constructed? Yes _____ No _____

14. a) Does your municipality have any other regulations/procedures/ordinances/agreements/planning related to stormwater management in the municipality that you are considering implementing? Yes _____ No _____
    b) If Yes, list such requirements, agreement, plans, etc.

_____
_____
_____
_____
_____

15. Do you perform routine inspections/enforcement actions for stormwater management facilities constructed in your municipality? Yes _____ No _____

16. Are there any large scale development projects (20+ units) that are imminent within the next 5 years?

_____
_____
_____
_____
_____

17. Do you have any other concerns or issues related to stormwater management?

_____
_____
_____
_____
_____
_____
_____
_____
_____

Summary of Municipal Stormwater Ordinances

Stormwater Ordinance Summary						
Municipality	Watershed	Stormwater Ordinance	Location	Water Quality	Water Quantity	Rate Control
Abbottstown Borough	Susquehanna	X	Stand Alone	X	X	X
Arendtsville Borough	Susquehanna		N/A			
Berwick Township	Susquehanna	X	Stand Alone	X	X	X
Biglerville Borough	Susquehanna	X	Stand Alone	X	X	X
Butler Township	Divided	X	Stand Alone	X	X	X
Carroll Valley Borough	Potomac	X	Stand Alone	X	X	X
Conewago Township	Susquehanna	X	Both	X	X	X
Cumberland Township	Potomac	X	Stand Alone	X	X	X
East Berlin Borough	Susquehanna	X	SALDO			
Franklin Township	Divided	X	Stand Alone	X	X	X
Germany Township	Potomac	X	Stand Alone	X	X	X
Hamilton Township	Susquehanna	X	SALDO			
Hamiltonban Township	Potomac	X	Stand Alone	X	X	X
Highland Township	Potomac	X	Stand Alone	X	X	X
Huntington Township	Susquehanna	X	Stand Alone	X	X	X
Latimore Township	Susquehanna	X	S&LDO			X
Littlestown Borough	Potomac	X	Stand Alone	X	X	X
McSherrystown Borough	Susquehanna	X	Both	X	X	X
Menallen Township	Susquehanna	X	SALDO			
Mount Joy Township	Potomac	X	Stand Alone	X	X	X
Mount Pleasant Township	Divided	X	Stand Alone	X	X	X

Municipality	Watershed	Stormwater Ordinance	Location	Water Quality	Water Quantity	Rate Control
New Oxford Borough	Susquehanna		N/A			
Oxford Township	Susquehanna	X	Stand Alone	X	X	X
Reading Township	Susquehanna	X	SALDO	X	X	X
Straban Township	Divided	X	Both	X	X	X
Tyrone Township	Susquehanna	X	SALDO			X
Union Township	Divided	X	Stand Alone	X	X	X

As listed in Table above, the municipalities in the Potomac River Basin also lie within the Monocacy River Watershed. Theses municipalities have adopted a model ordinance that enacts the standards set forth by the Monocacy River Watershed Stormwater Management Plan (MRWSMP).

Twenty-two of the municipalities that responded to the survey perform inspection on the stormwater management facilities, as listed below.

Inspection Procedures			
Municipality	**Construction Inspections**	**Post-Construction Inspections**	**Routine Inspections**
Berwick Township	X		X
Biglerville Borough	X		
Butler Township	X		
Carroll Valley Borough	X	X	X
Conewago Township	X	X	X
Cumberland Township	X	X	X
Franklin Township	X		
Germany Township			X
Hamilton Township	X	X	X
Highland Township	X	X	
Huntington Township	X		
Latimore Township	X		
Littlestown Borough	X		
McSherrystown Borough	X	X	
Menallen Township	X	X	X
Mount Joy Township	X	X	X
Mount Pleasant Township	X	X	X
New Oxford Borough	X		
Oxford Township	X		
Reading Township	X	X	
Straban Township	X	X	X
Tyrone Township	X		

Additional Municipal Survey Responses

Municipality	Monitor Rainfall Events	If yes, Procedures	Planned Infrastructure Improvements	If yes, Location and Type	Watershed Studies/ Reports Completed	If yes, Studies/ Reports	Hydraulic Modeling Completed	Stream Gages in Municipality	If yes, Who Maintains	If yes, Data Available	If yes, Time Period	Inter-municipal Agreements	If yes, Type of Agreement
Abbottstown Borough												X	Police, Planning
Arendtsville Borough	X	Rain gage											
Berwick Township	X	Gage at sewer plant										X	Sewage Services
Biglerville Borough	X	Rain gage										X	Comp Plan
Butler Township												X	Northwest Planning, County Zoning
Carroll Valley Borough	X	Sewer plant monitors										X	
Conewago Township												X	Purchasing
Cumberland Township												X	Roadways, Parks/ Rec
East Berlin Borough												X	Water/ Sewer Projects
Franklin Township												X	Roadways, Tractor, Comp Plan
Germany Township													
Hamilton Township													
Hamiltonban Township												X	Police, Comp Plan, Green Space Grant Prog.
Highland Township													
Huntington Township													

Latimore Township													
Littlestown Borough	X	Gage at sewer plant										X	Comp Plan
McSherrystown Borough					X	Greater Hanover Alliance - Plum Run							
Menallen Township												X	Comp Plan in progress
Mount Joy Township												X	Roadways
Mount Pleasant Township													
New Oxford Borough												X	Comp Plan
Oxford Township												X	Police, Insurance
Reading Township					X	Lake Meade Source Water Protection Plan						X	Comp Plan
Straban Township			X	Pine Tree Rd- replace culverts (public)									
Tyrone Township								X	USGS	X	10/29/04 - present		
Union Township													

Act 167 Phase I
Municipal Survey Responses

Question #2
What are your specific concerns with the stormwater management ordinance?

Gail Sweezey, Butler Township

- Butler Township adopted the Monocacy Stormwater Management Plan. It is a complicated document that focuses on large development. It provides cost prohibitive stormwater requirements for property additions and other small development projects. Engineered plans are too expensive for the average citizen. There should be cost effective solutions available.

Flo Ford, Cumberland Township

- Regulations were not written to address our soil types

Robert Strausbaugh, Conewago Township

- Adequacy

Joseph Brennan, Highland Township

- I am concerned with the potential cost of implementation, the need for appropriate enforcement without undue restriction upon the citizens, and a general lack of knowledge by the public at large about the need for and advantages of appropriate stormwater management.

Tim Topper, Littlestown Borough

- Planning board with regulation required by the MPC

Kelly Duty, Reading Township

- That it can only be enforced when someone is subdividing or doing land development. Occasionally, when you have a small lot with a large building proposed it would be nice to be able to require seepage beds. This change could be incorporated into zoning ordinance for all structures over a certain size.

David Richards, East Berlin Borough

- Not specific as to construction, size of culverts or pipes, disposition of collected water

Erik Vranich, Straban Township

- The specific concerns with the stormwater ordinance deal with the ordinance having different requirements than that of the NPDES permit, which leads to confusion and difficulty for designers and landowners. A second concern is for landowners owning large tracts of land (>5 acres) and proposing little impervious area (in proportion to lot size), they immediately fall out of the exemption criteria based upon lot size, resulting in additional design and construction costs. A comprehensive stormwater ordinance, both water quality/peak rate control requirements as well as technical design requirements/standards would streamline the review and design process.

Glenn Zepp, Straban Township

- My concern is that an inequitable distribution of costs and benefits, caused by the separation between those who benefit from the ordinance and those who incur the costs, causes municipalities to enact overly rigid and inflexible regulations. Everyone shares more or less equally in the benefits but only those few persons who want to develop land bear the costs. Not only does this separation create an unfair distribution of cost, but it likely results in greater expenditure on control measures than the value of benefits associated with those measures.

Act 167 Phase I
Municipal Survey Responses

Question #2
What are your specific concerns with the stormwater management ordinance?

- A more equitable ordinance would treat stormwater management as a utility, taxing both old and new development for its contribution to stormwater runoff and water quality deterioration, giving credits to those who have installed stormwater controls, and cost sharing or partially reimbursing the costs for further measures.

Act 167 Phase I
Municipal Survey Responses

Question #12 a)
What are the municipality's stormwater review procedures for a subdivision/ land development plan (driveways, garage, etc)

#12 b)
What are the review policies/ procedures when a subdivision/ land development plan is not required?

Gail Sweezey, Butler Township

12 a) We comply with the Monocacy River Stormwater Management Plan. Engineered plans are required for most projects. Residents can ask for plan waivers on appropriate projects.

Flo Ford, Cumberland Township

12 a) Listed in SALDO; completed by township engineer

12 b) Grading plans reviewed by township engineer

Dean Shultz, Union Township

12 a) Review to verify the plans meet the requirements of Monocacy River Stormwater Management Ordinance

12 b) Must meet requirements of Monocacy Ordinance if additional impervious area is created

Brenda Constable/ Jerry Altoff, Mt. Joy Township

12 a) Require a plot plan showing stormwater management as required per ordinance

12 b) Require a plot plan (sketch) showing stormwater management and must accompany the land use permit application

Robert Strausbaugh, Conewago Township

12 a) Adams County Soil Conservation and Township Engineer

12 b) Individual lot grading plan review for creation of impervious surfaces

Barry Stone/ Cory Vos, Mt. Pleasant Township

12 a) See ordinance for requirements of plan submission.
Over 3 lots – stormwater management plan is submitted with review by township engineer and possibly other agencies, then reviewed by township planning commission, supervisors, and planning staff: approval or revisions. Stormwater maintenance agreement with township, security (financial) received.

12 b) Site is evaluated based on ordinance Tables 1 & 1A (peak rate controls). Detailed maps are submitted by landowner. If applicable research is completed, based on history of property, Township staff and occasional township engineer input with recommendations: approval

Joseph Brennan, Highland Township

12 a) Planning Commission and Township Engineer review applications

Act 167 Phase I
Municipal Survey Responses

Question #12 a)
What are the municipality's stormwater review procedures for a subdivision/ land development plan (driveways, garage, etc)

#12 b)
What are the review policies/ procedures when a subdivision/ land development plan is not required?

12 b) same as above

William McMaster, Oxford Township

12 a) Plans for buildings of 5,000 sqft or less are done by the permit applicant. Development review by Township engineer

12 b) The township has a procedure in place for buildings

Richard Mountfort/ Sandi Vasquez, Biglerville Borough

12 a) Stormwater management ordinance – Article IV stormwater management plan requirement: borough engineer review and adms county conservation district, subdivision plan reviewed by the AC Planning Office

12 b) Ordinance applies to any activity that creates additional impervious surface greater than 1,000 sqft. Smaller projects are not subject to ordinance and not reviewed by borough agents or officials

John Shambaugh/ Gus Fridenvalds, Huntington Township

12 a) Plan must be drawn by a registered professional and reviewed by the Township Engineer

12 b) Any structure over 1,000 sqft requires a stormwater plan unless it is covered by the original subdivision or is agricultural

Robert Gordon, Hamiltonban Township

12 a) stormwater review is concurrent with subdivision/ land development plan review

12 b) stormwater plan is submitted to the township and reviewed by township engineer

Dave Hazlett, Carroll Valley

12 a) See ordinance

12 b) See ordinance

Kelly Duty, Reading Township

12 a) Stormwater review is based on the township stormwater article of the SALDO. It looks at pre and post-development. Post runoff conditions cannot be greater than that of the pre-development condition. The Zoning Ordinance limits the amount of impervious surface

12 b) We regulate the amount of impervious surface permitted per the Zoning Ordinance

David Richards, East Berlin Borough

12 a) Would be presented to Zoning and Planning, referenced to SALDO

Act 167 Phase I
Municipal Survey Responses

Question #12 a)
What are the municipality's stormwater review procedures for a subdivision/ land development plan (driveways, garage, etc)

#12 b)
What are the review policies/ procedures when a subdivision/ land development plan is not required?

12 b) Observance of specific zoning and building codes. All are reviewed on an ad hoc basis. Adherence to construction codes are performed by outside inspector

Donna Dixon, Tyrone Township

12 a) Submitted in conjunction with land development plans to the Adams County Office of Planning & Development and Tyrone Township; the stormwater management plan is reviewed by the Township Engineer and then approved by the Township Board of Supervisors once all ordinance requirements have been met.

12 b) If disturbance is more than one acre, plans must be reviewed by the AC Conservation District

Robert Lauriello, New Oxford Borough

12 a) New impervious must be reviewed and controlled (non-residential)

12 b) Technical review by engineer

Erik Vranich/ Glenn Zepp, Straban Township

12 a) Stormwater review would commence upon submission of the subdivision/land development plan and would be conducted by the Township Engineer. Review would be in conjunction with the land development plan review and all ordinance requirements must be met prior to approval of the land development or subdivision plan. The plans must meet the requirements set forth in Chapter 109 and SALDO 117-43.

12 b) For smaller grading plans or stormwater management plans, the plan is first submitted to Straban Township, then passed on to the Township Engineer for review and approval. All comments are worked out between the Township Engineer and the design engineer. Once all stormwater ordinance requirements are met, a recommendation to issue a land use permit is passed on to the Township. The plans must meet the requirements set forth in Chapter 109 and SALDO 117-43.

John Shambaugh, Latimore Township

12 a) Reviewed by Township Engineer

12 b) None

Lori Killinger/ Sandra Spence, Franklin Township

12 a) The township engineer reviews and advises

12 b) The township engineer still reviews the stormwater management plans

Scott Cook, McSherrystown Borough

12 a) See Chapter 184-2, review and approval

Act 167 Phase I
Municipal Survey Responses

Question #12 a)
What are the municipality's stormwater review procedures for a subdivision/ land development plan (driveways, garage, etc)

#12 b)
What are the review policies/ procedures when a subdivision/ land development plan is not required?

12 b) Zoning – maximum lot coverage, buildings and other impervious surfaces

Tim Beard, Hamilton Township

12 a) Planning commission reviews requests/ plans. Township engineer reviews plans and makes suggestions to meet 120-32. When met, supervisors approve. Disapprove plans

12 b) Same as above

Jerry Lillich, Abbottstown Borough

12 a) See Ordinance Article IV, paragraphs 180-20 – 180-25 and Article V paragraphs 180-26 & 27.

12 b) Building permits above a certain size or kind would activate the above mentioned requirements.

Leah Heine, Berwick Township

12 a) Applicant submits plans, Township Engineer reviews and comments, Planning Commission reviews and makes recommendations, Board of Supervisors approves, and Township Engineer issues permit and inspects installation.

12 b) Grading and Stormwater Management Plans (when required by ordinance) must be approved prior to building permit issuance.

Gail Sweezey, Butler Township

- We are supportive of this county-wide initiative. We are interested in creating a reasonable Stormwater Management plan that is financially feasible for the average citizen. An ordinance that is succinct, easy to implement and shows examples of reasonably priced and constructed stormwater management plans by project type would be useful to township residents. There should be different standards for different situations.

Flo Ford, Cumberland Township

- Make sure soil types are considered during preparation of new plan
- Cost to homeowner with smaller projects
- Administration is a burden to the township

Barry Stone/ Cory Vos, Mt. Pleasant Twp

- Mt. Pleasant Twp soil are poorly draining soil types. Therefore, some of the BMP facilities cannot be utilized. Our current ordinance was revised in order to have some common sense approaches on various sites. Considering that the township is split between two watersheds, we are trying to make sure the ordinance language and the intent of the ordinance is carried through without being too burdensome for the homeowner placing an outbuilding or the farmer placing a farm implement shed.

Joseph Brennan, Highland Township

- There is a great deal of uncertainty about the most cost effective way to proceed on individual projects and a very major gap in public understanding of the need for stormwater management programs.

Craig Rocky, Highland Township

- State prescribed standards/ procedures regarding homeowner monitoring of stormwater systems/ facilities and the recordation/ verification of same have not been promulgated.

Gus Fridenvaldes, Huntington Township

- I would like to see infiltration pits on downspouts of existing properties.

David Richards, East Berlin Borough

- Development in neighboring townships will impact water flow through the borough in some cases. Most runoff will flow to creek partially surrounding borough.

Erik Vranich, Straban Township

- Concerns have been raised within the Township to create a stormwater management ordinance that has provisions for individual, small lot construction (houses, garage, barns, etc.) that is reduced in scope and more reasonable for homeowners and landowners. At this time, the cost of a stormwater management plan and implementation of the plan (construction costs) can be significant and overwhelming for potential homeowners. It should also be made very clear within the ordinance how existing impervious area within a site are to be addressed from a 'pre-development' condition

Rusty Ryan, AC Conservation District (3/23/09)

- Keep in mind what BMPs are best for the soils in Adams County
- Give homeowners more non-structural options for minor projects

Glenn Zepp, Straban Township (3/23/09)

- Inequality in current program. Who pays versus who benefits, older homes don't have to pay. Look at a method of financing – tie cost to beneficiary.

Dean Shultz, Union Township (3/23/09)

- Stormwater is like the sewage systems in the '60s, there will be resistence at first until issues are worked out and people are used to it.
- Not every lot may be able to be developed.
- Look at the BMPs that can be used in poorly drained and rocky soils

Craig Rockey, Highland Township (3/23/09)

- Give as much direction to the municipality as possible

Bob Gordon, Hamiltonban Township (3/23/09)

- Identify floodplain locations and potential areas for stream restoration projects

Kevin Kozain, PennDOT (3/23/09)

- PennDOT would like to see standards specifically for transportation projects

Stan Wannop, New Oxford Borough (3/29/09)

- The borough has problems because most of the amount of impervious surfaces. Most of the runoff goes to the floodplain, but the ordinance should specifically address boroughs.

Emma Seibert, Tyrone Township (3/24/09)

- Need an ordinance with teeth
- Concerned with administration and the cost of enforcement

Jerry Lillich, Abbottstown Borough (3/24/09)

- Municipalities are adopting an ordinance that the state has written

Scott Cook, McSherrystown (3/24/09)

- Boroughs are developed, SWM ordinance is rarely used
- Surrounding township activity affects the Boroughs

William McMaster, Oxford Township (3/24/09)

- Has gotten rid of the requirement of an engineered drawing for homeowners and pays the engineer to do inspections

Gail Sweezy, Butler Township (3/24/09)

- Unsure of how much to waive for individuals
- Would like a strong training component

Erik Vranich, Straban Township (3/24/09)

- Explain the intent of the ordinance with training and what the design standards should be

Leah Heine, Berwick Township (5/5/09)

- The Township has known sinkholes and problems occasionally. Infiltration should only be used where it is justified and in a vicinity where geology permits.

Appendix F
SPAC Attendance

STORMWATER PLANNING ADVISORY COMMITTEE (SPAC) MEETING

July 29, 2010

NAME	ORGANIZATION	EMAIL
Emma Seibert	Tyrone Twp Planning Comm.	
Bill Stacy	Tyrone Twp.	
Gale Smith	Tyrone Twp	
ERIC MAINS	KPI TECH.	
Sarah Weigle	ACCPD	
Ricky REDMAN	Franklin Township	
Joe Brenna	Highland Township	
Alicia Birckhead	Highland Township	
John L. Shambaugh	Logan Hunting Twp.	
Coleen Reamer	Hamiltonban Twp	
Doreen Premo	" "	
Barry D. Stone	Mt Pleasant Twp	
ROB CZYZEWSKI	BOROUGH COUNCIL	
BOB SHARRAH	MCSHERRYSTOWN BORO	
Erik Vronick	Tyrone + Straban Twp.	
Charles Eisenhaut	East Berlin Boro	
Chad Clabaugh	C.S. Davidson Inc.	
Larry Markick	Adams CD	
Bill McMorter	Orford Twp.	
David Waybright	Cumberland Twp	
Glenn Zepp	Straban Twp	ZEPPGA@Embarqmail.com
	Free Dam	
Pete Martin	C.S. Davidson.	
ADAM ANDERSON	GORDON L. BROWN & ASSOCIATES	aanderson@glba-engineering.com

SPAC Meeting – 9/30/2010

NAME	ORGANIZATION	EMAIL
Bicky Rocburn	Franklin Township	
Sarah Weigle	ACOPD	
Gus Frickenwalts	Huntington Twp	huntington@pa.net
Coleen Reamer	Hamiltonban	
Glenn Zepp	Straban Twp	
Charles W. Eisenhart	East Berlin Boro.	mervino@comcast.net
ERIC MAINS	BUCHART-HORN	
BOB SHARRAH	SDGI	
Allen B[illegible]	FreeDom Tsh.	
~~Daniel Leskinen~~		
Dean Shorb	Gettysburg Eng. Co. INC	
~~Paul [illegible]~~		
Doreen C. Premo	Hamiltonban Twp	
Debra Musselman	ACCD	
David Updyke	Mt Joy Twp	
Bill McMaster	Oxford Twp	
BRANDON GUIHER	KPI TECNOLOGY	BRANDONG@KPITECH.NET
Pete Martin	C.S. Davidson	pjm@csdavidson.com
Larry Martick	Adams CD	"
Tim Topper	Littlestown Borough.	
Carrie Gerr	New Oxford Borough	MayorNewOxford@yahoo.com
STAN WANNOP	NEW OXFORD BORO	
Joe Brennan	Highland Twsp.	
Craig Rockey	" "	
Kelly Baty	Reading Twp	readingzoning@comcast.net
MATT STADE	GLBA	MSTADE@GLBA-ENGINEERING.COM
John Shambaugh	FPE	

SPAC Meeting – 11/30/2010

NAME	ORGANIZATION	EMAIL
R. L. RYAN	ACCD	
~~D. MUSSELMAN~~	~~ACCD~~	
~~L. MARTICK~~	~~ACCD~~	
Chad Clabaugh	C.S. Davidson Inc	Cmc@csdavidson.com
Bob Sharrah	SHARRAH DESIGN GROUP	RSHARRAH@SHARRAHDESIGN.COM
Bill McMaster	Oxford Township	
Debra Musselman	ACCD	
Ricky Rodman	Franklin Township	
Pete Martin	C.S. Davidson	pjm@csdavidson.com
Craig Rockey	Highland Township	dcrockey@comcast.net
Joe Brenneman	" "	Brennemanbuilt@comcast.com
Ken Lundberg	Carroll Valley	nklundb@earthlink.net
Sarah Weigle	ACOPO	
Larry Martick	Adams CD	lmartick@adamscounty.us
Tim Knoebel	KPI	timk@kpitech.net
Adam Anderson	GLB+A	aanderson@glba-engineering.com
Erik Vranich	Wm. F. Hill & Assoc.	evranich@wmfhill.com
Stan Wannop, JR.	New Oxford Borough	stanley-steamer@comcast.net
Francis Cool	Fairfield Borough	
Kelly Duty	Reading Twp.	readingzoning@comcast.net
Gus Frederick Nobles	Huntington Twp	huntingtontwp.net
John Shambaugh	FPE Consulting	Fpeconsulting@AOL.com.
Glenn Zepp	Straban Twp	Zeppga@Embarqmail.com

SPAC
SIGN-UP 1/31/2011

NAME	EMAIL/PHONE	MUNICIPALITY
ERIC MAINS	emains@bh-ba.com	—
Glenn Zepp	zeppgg@embargmail.com	Straban
KEN LUNDBERG	nklundb@earthlink.net	CARROLL VALLEY
FRANCIS COOL	642-6244	FAIRFIELD
Sarah Weigle	sweigle@adamscounty.us	
Jennifer Kehler	jekehler@state.pa.us	DEP
Emma Seibert	[illegible]@earthlink.net	Tyrone Twsp
Charles Eisenhart	mervino@comcast.net	East Berlin
John L. Shambaugh	FPE Consulting @ aol.com	Latimore, Huntington, Menallen
Dean Shultz	Gettyeng@embargmail.com	Union -
STAN WANNOP	stanley-steamer@comcast.net	NEW OXFORD BORO
Pete Martin	pjm@csdavidson.com	C.S. Davidson
Chad Clabaugh	cmc@csdavidson.com	C.S. Davidson
Doreen Premo	premodme@hotmail.com	Hamiltonban
Erik Vranich	evranich@wmfhillinc.com	Wm. F. Hill & Assoc.
MARK BERG	MARK.D.BERG@gmail.com	[illegible]
Frank Buhrman	f.buhrman@[illegible]	CARROLL VALLEY
BOB SHARRAH	RSHARRAH@SHARRAHDESIGN.com	McSH. BORO
Leah Heine	leahh@kpitech.net	———
BRANDON GUIHER	BRANDONG@KPITECH.NET	
RICKY REDMAN		Franklin Township
Larry Martick		Adams CD
Craig Rockey	dcrockey@comcast.net	Highland
Joe Brennan		Highland
Bill McMaster	MCMASTERB@Comcast.net	Oxford
Kelly Duty	readingzoning@comcast.net	Reading
ADAM ANDERSON	aanderson@glbengineering.com	Butler
Debra Musselman		ACCD
Rusty Ryan		ACCD

MARCH 31, 2011

SPAC MTG.

Sign-up

Name	Organization
Ken Lundberg	Carroll Valley
John L. Stanbaugh	FPE Consulting
Bill [illegible]	FPE Consulting
Jennifer Kehler	PADEP
Deb Musselman	ACCD
Glenn Zepp	Straban Twp
Doreen Premo	Hamiltonban Twp.
Dean A Shaltz	Union Twp
Carl Cookerly	Germany Twp
Francis Cool	Fairfield Borough
Barry D. Stone	Mt. Pleasant Twp
Erik Vranich	Wm. F. Hill & Assoc.
Sarah Weigle	ACOPD
BRANDON GUTHER	KPI TECHNOLOGY
Craig Rockey	Highland Township
STANLEY WANAMOP, JR.	New Oxford Boro
Carrie Carr	New Oxford - Mayor
Gus Fridenmeds	Huntington
Charles Eisenhart	East Berlin Boro
Leah Heine	KPI Technology
Larry Martick	Adams CD
Bill McMartel	Oxford Twp

5-31-11
SPAC

Sign in

	Name	Organization
1)	Sarah Weigle	ACOPD
	Jennifer Kehler	PADEP
	Francis Cool	Fairfield
	Glenn Zepp	Straban Twp
	Dean A. Shultz	Union
	Barry D. Stone	Mt Pleasant Twp
	Emma Seibert	Tyrone Twsp
	Don Perva	FPE Consulting
	Charles Eisenhart	East Berlin Boro.
	Adam Anderson	Gordon Brown
	Erik Vronch	Wm. Hill & Assoc.
	BRANDON GUTHER	KPI
	STAN WANNOP	New Oxford Boro.
	Larry Martick	ACCD
	Coleen Reamer	Hamiltonban Twp
	ERIC MAINS	CONEWAGO / READING TWP.

SPAC Meeting Signup Sheet 9/29/2011

STORMWATER PLANNING ADVISORY COMMITTEE

LAST NAME	FIRST NAME	REPRESENTING	MISC INFO
MAINS	ERIC	READING / CONEWAGO TWP.	EMAINS @ BH-BA.COM
HANNE	BILL	ARENDTSVILLE	mbmeh@earthlink.net
REAMER	Coleen	Hamiltonban	
Uranick	Eric	Straban/Tyrone/Mt. Joy	euranick@earthlink.com
Arndt	David	Conewago Township	ct-code@earthlink.ne
WARNOP	STAN	NEW OXFORD BOROUGH	STANLEY-STEARMER@COM.NC
Duty	Kelly	Reading	readingzoning@comcast.ne
HEINE	LEAH	KPI Technology	leahh@kpitech.net
GUIHER	BRANDON	KPI	BRANDONG@KPITECH.NE
Perva	Dan	FPE	
Stone	Barry	Mt Pleasant Twp	mptcodcert@comcast.n
Colonna	[illegible]	Manheim	
Thacker	Rob	Planning	-
Wiggle	Sarah	u v	
Lundberg	Ken	CARROLL VALLEY	nklundb@earthlink.net
Larry Martick	Larry	Adams CD	
~~Tom~~ Anderson	ADAM	GLBTA Battlefield.	
RYAN	RUSTY	ACCD	

SPAC Meeting Signup Sheet 9/29/2011

STORMWATER PLANNING ADVISORY COMMITTEE

LAST NAME	FIRST NAME	REPRESENTING	MISC INFO
ZEPP	Glenn	Straban Twp	
Premo	Doreen	Hamiltonba Twp.	
Seibert	Emma	Tyrone Twp	
Wiggle	Sarah	Planning	
Rockey	Craig	Highland Twp	
Martick	Larry	ACCD	
COLONA	NICK	ACOPD	
RYAN	Rusty	ACCD	

Appendix G
Impact of Conflicting Codes on Stormwater Management

The Impact of Conflicting Codes on Stormwater Management

By Janie French, PA Environmental Council

Pennsylvania's Uniform Building Code, known as the Uniform Construction Code (UCC) is administered by the PA Department of Labor and Industry and was enacted into law in 1999. The basic premise of the Act is to provide for the protection of life, health, property and the environment and for the safety and welfare of the consumer, general public and the owners and occupants of buildings and structures. Findings by the General Assembly indicated that "in some regions of this Commonwealth a multiplicity of construction codes currently exist and some of these codes may contain cumulatively needless requirements which limit the use of certain materials, techniques or products and lack benefits to the public." The Department of Labor and Industry adopts the International Code Council's family of codes as approved by the Independent Regulatory Review Commission (IRRC) which performs a triennial review to revise the codes.

Of interest to those of us working on green stormwater solutions, the UCC can present an interesting dilemma. Section 1101.2 of the State plumbing code specifically reads "**Where required.** - All roofs, paved areas, yards, courts and courtyards shall drain into a separate storm *sewer* system, or a combined *sewer* system, or to an *approved* place of disposal. For one- and two-family dwellings, and where *approved*, storm water is permitted to discharge onto flat areas, such as streets or lawns, provided that the storm water flows away from the building."

Problems occur with the interpretation of phrases like "where required" and "approved place" and "where approved." Also, whose approval is needed? In certain areas of Pennsylvania, this interpretation has caused problems. For example, in Allegheny County, 19 municipalities in the Pine Creek Watershed have adopted an ordinance for their Act 167 Stormwater Management Plan that includes Best Management Practices for directing downspouts to rain gardens, dry wells and porous paved areas. Ordinances were modified to read, "Existing roof drain, underdrain and sump pump discharge should be directed to lawn area or other pervious areas. If required by the Township, the discharge shall be directed to a stone sump or infiltration BMP. If approved by the Township the discharge may also be directly connected to the storm sewer system." Until Allegheny County, which adopted the UCC, modified their plumbing code to include provisions for meeting the intent of Act 167, the County plumbing code was in direct competition with the intent of the municipal stormwater management ordinance.

According to the PA Department of Labor and Industry, more than 90% of Pennsylvania's municipalities follow the UCC regulations. Language in the code needs to be clarified or modified to eliminate confusion and coincide with the intent of ACT 167. The impacts of stormwater have been identified as one of the top three causes of water quality impairment through the 303(d) Clean Water Act process (PA DEP Comprehensive Stormwater Management Policy; 392-0300-002). Ongoing education about the value of disconnecting downspouts needs to continue at all levels of municipal government so that residents can explore the opportunity of implementing green infrastructure without the worry of violating codes.

Appendix H
Comment - Response Documents

ADAMS COUNTY

STORMWATER MANAGEMENT PLAN

October 31, 2011

Pre-Hearing Response Document

The following responses were prepared to address concerns and observations received during the comment period for the draft Adams County Stormwater Management Plan. Responses to received comments are categorized into five (5) sections: General, Draft Stormwater Management Plan, Draft Model Stormwater Management Ordinance, Simplified Approach/ Municipal Stormwater Management Worksheets, and Stormwater Plan Review and Municipal Approval Process. Italicized text relates to specific questions raised. The name or municipality in parentheses at the end of bulleted text indicates who asked the question or made the observation related to the response. All comments were appreciated.

The draft Plan will not be revised to reflect applicable comments until after the public hearing, which will be held November 2, 2011 at 2:00 p.m. at the Agricultural and Natural Resources Center. This document will be available at the hearing.

I. General

- Spelling, punctuation, grammatical mistakes and other clarifications will be corrected, inserted, and/ or deleted in the final Plan document.

- Additional flood-prone locations will be added to the Flood Prone Locations Map. (Fairfield Borough)

- There are no plans to set up a GIS database until the County has a standard process to accept Subdivision/ Land Development plans electronically. (B.Redman)

- The current state model ordinance does not address stormwater management of existing impervious areas, whether or not facilities had been designed to handle flows from those existing areas. The Plan will more clearly state that the Ordinance only addresses proposed impervious areas. Some municipal ordinances may address percentage of impervious area when new development is proposed on lots with existing impervious areas through lot coverage requirements. The Plan also allows

the municipality the ability to deny the use of the Simplified Approach if there are existing stormwater problems on a proposed site. (Shultz)

- The date of adoption of the Adams County Stormwater Management Plan is the starting point from which future development and the respective exemption criteria shall be cumulatively considered and regulated (Ordinance Section 302). The Municipal Stormwater Management Worksheets are recommended to assist the Municipality in tracking impervious areas developed after the Plan has been adopted. (D. Shultz, W. Davis)

- Adams County had all intentions of evaluating BMPs to determine which ones work efficiently within the County and was part of the Scope of Study for the Adams County Stormwater Management Plan. However, due to funding cuts, the Scope of the Stormwater Management Plan was scaled back and an Engineer was not used. The County still feels that this is a valid aspect and would like to pursue if funds become available. (D. Shultz, Mount Pleasant Township) NOTE: The Pennsylvania Stormwater Technical Group (PaSTW) was formed to integrate state of the art science and sound engineering practices into Pennsylvania's stormwater management designs. www.stormwaterpa.org

- The definition of impervious surface (impervious area) has been clarified to include decks and pools and also to state "Any areas designed to be covered by loose surfacing materials such as gravel, stone and/or crushed stone, and intended for storage of and/or travel by vehicles, or pedestrians shall be considered impervious. Surfaces or areas designed, constructed and maintained to permit infiltration may be considered pervious.". Both terms will be used in the document. (E. Vranich, W. Davis, D. Shultz, L. Heine, S. Smith)

- Regulated Activit(ies)y will both be used and capitalized throughout the document. (S. Smith, W. Davis)

- A chart or sliding scale establishing criteria for exemptions based on the size of a lot is not part of this Plan. The current approach deals with the creation of new impervious area on an individual lot basis. Each lot using the Simplified Approach, will have to demonstrate that that they can manage the stormwater created, based on the amount of new impervious area. Exemptions are not necessarily automatic in all situations. (D. Shultz, B. Stone)

- *We are aware that future studies will most likely be completed for the Susquehanna River Basin and a proposed Plan will again be on the table for review. Our comment here would be to consider the proposed Model Ordinance as being utilized and be common for both watershed applications. Our township is split among the two watersheds. Would the proposed Plan mingle with a future Plan?* (B. Stone)

    - Act 167 requires that stormwater management plans are reviewed and revised at least every 5 years. The draft Plan and model Ordinance will

cover all of Adams County, including both the Susquehanna and Potomac River Basins. So while this is the 5 year review of the Monocacy, it is being revised to include, and provide consistency throughout, all watersheds within Adams County.

II. Draft Stormwater Management Plan

- Section I – Introduction: Reference to the Conochocheague Creek Watershed Stormwater Management Plan will be added. (C. Reamer)

- Section III – County Characteristics: "Two quarries…" will be revised to "Three mineral extraction operations…". (C. Reamer)

- Section VI – Problem Areas & Impairments: Reference to the map and Table in the Stream Obstructions section has been clarified to indicate that they are both taken directly from the Monocacy SWM Plan. Since the map is the Measured Stream Obstructions from the Monocacy Plan, it will not have a title or legend consistent with other Plan maps. (A. Lowas, E. Mains)

- Section X – References: The model stormwater management ordinance is part of the Plan as an Appendix; it is not a reference. (B. Redman)

III. Draft Stormwater Management Ordinance (Appendix A)

- Definitions that are not used in the Ordinance will be removed.

- Municipalities should ensure that definitions are consistent with other Ordinances.

- Technical or design criteria may be added to the municipal ordinance as long as it is not in conflict with the model. We recommend that the municipality have DEP review the municipal stormwater management ordinance before adoption. Many municipalities may already have technical criteria in their SALDOs, which may remain. (L. Heine, D. Shultz)

- Section 105.B will be reworded and the last sentence of this section will become 105.C (S. Smith, J. Fox, D. Shultz). This section will read:

    B. Any submission that does not require a stormwater management plan at the time of subdivision or land development will still be required to address stormwater management at the time the individual lots are developed or construction commences, unless said subdivision proposes infrastructure features, such as a cul-de-sac street, for which stormwater management controls are ordinarily required.

C. Development of the individual lots is subject to stormwater management as defined within the ordinance.

- Section 106 – *I suggest that the repealer of other ordinances inconsistent with the model ordinance be stated to be applicable to "Regulated Activities" from on and after the date of the model ordinance.* (W. Davis)

    - The repealer is for ordinance standards only. We are unsure how "Regulated Activities" fit into this section?

- Section 108 Compatibility – *I suggest that there also be a statement that in the event of a conflict between the model ordinance ("this ordinance") and any other ordinance, the more restrictive ordinance shall apply.* (W. Davis)

    - We do not object to the addition of a statement of this type in Section 108. Municipalities should consult with their solicitors for appropriate language.

- Section 110 – *The first sentence may not be lawful as it provides no opportunity to be heard as to whether or not the grounds for revocation are valid* (S. Smith)

    - Section 706 provides steps to appeal any action associated with the administration of the Ordinance.

- Section 110 – *I advise against adopting the model ordinance with the last sentence of this section being in it. There can be errors in permits that wind up being non-consequential or easily correctable without forcing the applicant to go through the entire process again.* (W. Davis)

    - The Ordinance is a model. Municipalities may make adjustments to this section once it is determined how they would like to handle mistakes.

- Upon consultation with the municipal solicitor, Ordinances could include Section **112. Municipal Liability Disclaimer** with the suggested wording (as recommended by J. Fox):

    A. Neither the granting of any approval under this Ordinance, nor the compliance with the provisions of this Ordinance, or with any condition imposed by a municipal official hereunder, shall relieve any person from any responsibility or damage to persons or property resulting there from, or as otherwise imposed by law nor impose any liability upon the Municipality for damages to persons or property.

    B. The granting of a permit which includes any stormwater management facilities shall not constitute a representation, guarantee, or warranty of any kind by the Municipality, or by an official or employee thereof, of the practicability or safety of any structure, use or other plan proposed, and

shall create no liability upon or cause of action against such public body, official or employee for any damage that may result pursuant thereto.

- Definition of "Applicant" - *Definition does not conform to MPC definition of "applicant"* (S. Smith)

    - We acknowledge that the definition reads somewhat differently from the MPC, but feel that the definition is compatible enough. The municipality should consult with their solicitor.

- Definition of "Land Development", Subsection C – *Courts has opined that certain uses that arguably fall within the MPC definition of "land development" are not land development, ex. Billboards. Where an individual municipality has in its SALDO established exclusions under this enabling authority, such terms should be stated here for consistency between Ordinances.* (S. Smith) *Sub-paragraph C is not appropriate. Section 503(1.1) of the MPC provides the ability of local government to exclude certain developments (such as amusement parks) from the definition of "land development" It should not be in this ordinance.* (W. Davis)

    - This definition is from DEP's model ordinance. Municipalities, upon consultation with their solicitor, should confirm consistency between definitions.

- Section 301. F – *This subsection addresses plan requirements for Special Management Areas. It does not require any information on why the area being planned is a Special Management Area. Should Characteristics of why it is a Special Management Area be required to be put on the plan?* (W. Davis)

    - The types of Special Management Areas are listed in the Definitions and further described in the BMP Manual.

- *Section 301.K - Provide a list of consultants in an addendum. (D. Shultz)*

    - Section 301.K is referring to consultations with DEP and maintaining a record of those consultations, not consultants.

- Section 302.B.3-5 – *All of the items described in these sections appear to be exempt in the first place since the ordinance seems to only address new impervious areas and not existing impervious areas.* (W. Davis)

    - The ordinance only addresses new impervious areas. These sections will be removed from the model.

- Section 302.C.2 – This section suggests a procedure to request Exemptions. The individual Municipality will need to decide how they would like to formally handle requests for Exemptions.

- Sections 304.A.2.b & 305.A – *This section establishes that 20% of existing impervious area, when present, shall be considered meadow in existing conditions. In accordance with Section 303.A.3, can it be clarified that this only applies to existing impervious areas 'proposed to be altered by the regulated activity'?* (E. Vranich)

    - We will consult with DEP on the requested clarification.

- Section 304.B.2 – *This section states that the first inch of runoff must be permanently removed through infiltration or reuse if possible. There is no mention as to what should be done with the remaining 1" of runoff leftover from the two inches captured as established in §304.B.1. Is the remaining 1" to be treated for water quality?* (E. Vranich)

    - As this is the State's criteria, we will request clarification from DEP. At a minimum, we believe the "remaining 1"' will be subject to the peak flow requirements of the Ordinance and controlled accordingly (see Section 305).

- Section 307. B – *The words "qualified person" ought to be replaced with "a delegate appointed by the (Name of the Municipality)" for the inspection of BMPs.* (W. Davis)

    - Qualified person is defined in the Ordinance as someone licensed or otherwise qualified by law, which should make them qualified to inspect BMPs during construction. We also note that DEP staff have indicated that "qualified person" is the term they wish to see utilized in the Ordinance in this and related sections.

- Section 307.B.7 – *Shows the minimum infiltration rate of 0.05 inches per hour. This doesn't seem right. This is 1/20 inch per hour and is not even measurable.* (D. Shultz)

    - This requirement is from DEP. We will request clarification.

- *Section 402 - §403 indicates the municipality must approve or deny the SWM Plan. If this is the required, then there should be approval blocks on the Plan for the Municipality to sign. (D. Shultz)*

    - Section 402.A.29 requires a signature block certifying that the plan has been reviewed and meets the criteria of the Ordinance.

- *Section 402 – Last sentence beginning with "Where the submission…" may not be lawful as written; law requires subdivision/ land development applicant to comply only with standards as found in the SALDO.* (S. Smith)

    - We acknowledge the concern, municipalities should consult their solicitor. We recommend that municipal Stormwater Management Ordinances be

adopted as stand-alone ordinances and cross referenced in the municipal SALDO. If SWM Ordinances are referenced in SALDOs, it should make it easier in the future to amend SWM Ordinances. Technical criteria could still be located within SALDOs.

- Section 402.18 – Will be clarified to require both existing and final grading contours. (D. Shultz)

- Section 403.B.1 – *I strongly object to voluntarily putting any of my clients under a "deemed approval" procedure. It is bad enough that the Legislature did it in the MPC; we need not do it to our selves. If anything, I suggest a deemed denial if there is no action within a specified time, giving the developer/ landowner the right of appeal pursuant to law.* (W. Davis)

    - This logic could work the other way as well. The municipality is required to enforce Ordinances fairly.

- Section 401.B.3 – *Does the ACCD want SWM Site Plans for all SW Plans, even those not covered under NPDES? Does the ACCD want all revised copies of the SWM Site Plans or just the final approved versions for those sites not falling under NPDES requirements? Will the ACCD comment on any SWM Site Plans not requiring NPDES approval? (E. Vranich)*

    - The Conservation District does not need to receive SWM Site Plans for those projects not requiring an NPDES permit. The municipality however, may choose to require that the applicant provide the Conservation District with a courtesy copy.

- Section 403.B.3 (NPDES permit Coordination) – *It appears that this section states that if a site is an NPDES permitted site, the ACCD will not conduct the administrative review until after the municipality notifies the district of technical compliance. This seems like it will lead to longer overall review period since now the NPDES permit review can not be done concurrently with the SWM Site Plan review.* (E. Vranich)

    - The District is in communication with Central Office of DEP. The logistics must be worked out to make this work. The last sentence could be changed to read: "Upon receipt of this notification, the Adams County Conservation District will acknowledge a General NPDES permit. In the case of an Individual NPDES permit, the District will coordinate municipal reviews with the DEP Regional office for eventual permit issuance by DEP."

- Section 403.C.3 - *This subsection references §301.K with regard to final decisions to deny exemption requests. But 301.K involves consultation with DEP. I don't think we want to pull in DEP every time a municipality feels an exemption denial is appropriate, so I suggest this section be deleted entirely.* (W. Davis)

- Sections 403.C.3 & 301 K deal with waivers and consultation with DEP to approve measures for meeting state water quality requirements other than those in the Ordinance, not exemptions.

- Section 406.A – *Without more guidance, this section raises concern with unlawful exercise of discretion.* (S. Smith)

    - We acknowledge the concern, this section will remain in the model ordinance as written, as it was derived from DEP's model. We assume that DEP's model was reviewed for legal completeness. As previously stated, Municipalities should consult with their solicitor.

- Section 406.B – *If a SWM Plan is part of a land development and/ or subdivision plan, let the MPC control its validity. I suggest this subsection be deleted in its entirety and let existing statutory law control the situation.* (W. Davis)

    - This section is subject to the term of validity as established by the municipal SALDO. Section 403.B will be abridged in the final version, but will still be included to provide guidance and an appropriate ordinance cross-reference for those SWM Site Plans submitted as a component of a subdivision or land development plan.

- Section 407 – *I fully understand that this section deals with a SWM system that has been completed. I worry, however, that many landowners will take this to mean that only one inspection is required, and that no inspections will be requested until after the bulk of any underground facilities are buried. While I have no specific recommendations, I think the committee should consider some way of referencing the need for inspections throughout the construction process so systems don't have to be dug up. (See §307.B.3)* (W. Davis)

    - NPDES permitted sites require inspections during construction. The municipality may also wish to consider including language regarding inspection during construction of non-infiltration BMPs on those sites that do not require an NPDES permit.

- Section 501.A – *This section ought to include a statement that the municipality may require that the SWM Plan and/or the subdivision/ land development plan NOT contain a dedication.* (W. Davis) *This provision is not lawful if actions of municipality demonstrate prior expressed intent to accept the dedication.* (S. Smith)

    - "The *(Name of Municipal Elected Body)* may…" will be changed to "The *(Name of Municipal Elected Body)* shall…".

    - This section does not require acceptance of facilities.

- The language in this section does not contribute to potential problems which may arise in the instance that a municipality changes its mind, in regard to accepting dedications.

- Section 501.D – *The terms deed restrictions, protective covenants, and conservation easements have discrete legal meanings, authority and process under common and statutory law.* (S. Smith) *How do we expect municipalities to enforce the requirement that new deeds be prepared and recorded when a property has a SWM Plan approved and constructed? Would the recording of the SWM Agreement be sufficient to accomplish what this subsection desires to accomplish?* (W. Davis)

    - The reference to deed restrictions/ protective covenants or conservation easements in this subsection will be removed. It will be revised to state that the SWM Agreement and the O&M Plan shall be recorded in the Adams County Recorder of Deeds Office.

- Section 502.A.2 – Suggested revision *The property owner shall provide to (Name of Municipality) such licenses and/ or easements to ensure access for periodic inspection and any necessary but unperformed maintenance.*(W. Davis)

    - The section requires the property owner provide easements to the municipality to ensure access in the event that municipal inspection is necessary. Since this requirement deals solely with potential municipal inspections, there is no need for the property owner to provide licenses.

- Section 502.A.4 – Will be revised to read "The Operation and Maintenance (O&M) Plan shall be recorded with the Adams County Recorder of Deeds" per Mr. Davis' comments.

- Section 502.B, last sentence – Will be revised to read "Nonpayment of fees, costs and other expenses incurred in the performance of services required may result in a municipal lien against the property". (W. Davis)

- Section 601.B – Will be revised to read "The applicant shall be responsible for the payment of all fees, costs, and other expenses incurred in the submission, review, and decision on plans and other submissions pursuant to this ordinance". (W. Davis)

- Section 702.A.3 – *I think it is unrealistic for us to assume that any property owner will know when a 10 year storm has occurred. I don't see how this could possibly be enforced.* (W. Davis)

    - We agree that most property owners will not know when a 10-year storm has occurred, or how one would possibly know that this frequency storm is occurring ("During…the cessation of a ten (10)-year or greater storm…").

However, this language is from DEP. We would support use of a more intuitively measured standard with DEP concurrence.

- Section 702.B – *What would the municipality do with all of that paper if anyone actually adhered to the requirement to file a report after each inspection?* (W. Davis)

    - We would like to revise this section to require the land owner to keep records of all inspections. The municipality should determine how, when, and in what form, they would like inspection records. We believe that some form of record-keeping is necessary to ensure that the owner inspection requirements of this section are followed.

- *Section 703.A.2 What does "any other applicable law…" refer to? §703.A.3 As drafted, the "creation of any condition…which constitutes or creates a … nuisance" would include any and all possible sources of nuisance (noise, smoke, dust, etc.) regardless of relationship to stormwater management.* (S. Smith)

    - The language used in this section is taken directly from DEP's model.

- Section 705 – *Should the fine for a violation be uniform throughout the County. It seems unreasonable for the penalty to accumulate daily when it takes time to design and construct a corrective action.* (A. Lowas) *Delete subsection B in its entirety as it is unrelated to "penalties".* (S. Smith)

    - The Ordinance states "Municipalities should confer with their solicitors to provide appropriate wording and a judgment amount for this section". Because this is a municipal ordinance, the amount will most likely not be uniform throughout the County. The County cannot determine the amount of the fine.

- Article VIII Enactment – *Not appropriate. As an ordinance, the document needs to be reframed to begin with a proper title, opening statement and appropriate whereas clauses, and to end with repealer and other standard provisions, a final statement and signatory lines appropriate to the type of municipality.* (S. Smith)

    - This article will be left blank in the final version of the model. The Municipality will need to include the appropriate language and signature format when preparing its ordinance for adoption.

- O & M Agreement – Paragraph 1. will be supplemented with "Landowner shall construct or **cause the construction of**…**"** to ensure that the agreement will remain in place if a development is flipped after approvals are received. (W. Davis)

- O & M Agreement – Paragraph 8. *This paragraph should be deleted.* (W. Davis)

- The language is from DEP's model ordinance. If there is a concern with this paragraph, the municipality should consult with DEP.

- Ordinance Appendices (S. Smith, D. Shultz, A. Lowas)

    - Appendix B, Disconnected Impervious Area - Will be removed. It is already located in the Plan.

    - Appendix C, Noxious and Invasive Plant Control - Will become Appendix B and only include the Noxious Weed Control List and reference to DCNR's Invasive Plants.

    - Appendix D, Technical Review Checklist (Optional) – Will become Appendix C.

    - Appendix E, Erosion and Sediment Pollution Control Guidelines – Will be removed; it doesn't relate to stormwater management.

IV. Simplified Approach/ Municipal Stormwater Management Worksheets (Appendix C)

- The Simplified Approach was designed so that the average homeowner and/ or Municipality could understand and prepare needed documentation for smaller projects. It is recommended that all municipalities use the same format to provide consistency throughout the County; however it is not required. (D. Shultz, Mount Pleasant Township)

- There was some concern whether a property owner would be able to draw a minor stormwater management plan to scale. The Simplified Approach states that the Adams County GIS Office may assist property owners by providing them with a map of existing features. Drawings, to scale, accompany many building or zoning permit applications. We do not think that this will be a major issue. (W. Davis, D. Shultz)

- *Percolation test data should not be used from septic system testing unless it is near the approved septic area. Often septic systems are installed on the higher portion of the lot where there are better soils and stormwater facilities on the downhill, low portion of the lot which have failed soil testing sites.* (D. Shultz)

    - The use of perc tests was suggested to provide additional soil data and more accurate soil types for minor stormwater management plans. Perc tests resulting in an on-lot septic system or replacement area should be avoided.

- The 1,000 – 10,000 sqft exemption for new development is not automatically allowed in all situations. The simplified approach is recommended for projects of

this size that cannot manage stormwater through disconnection. It was observed that *many lots are 20,000 sqft or less. If you allow an additional 10,000 sqft of impervious area, over 50% of the lot will be impervious.* (D. Shultz)

  - In this case, the property would need at least a 75 foot flow path (and meet other disconnection requirements). For a lot of this size, it doesn't seem possible that there would be enough area within the lot for the 75' flow path. Most municipal ordinances also regulate the amount of impervious area/ lot coverage and in many instances; many residential districts do not allow this much coverage.

- *Most new subdivisions now have Stormwater Management Plans, which includes in their stormwater calculations for SWM, a square footage of impervious area for each new lot. If the impervious area of the lots exceed this square footage, then they need to do SWM for the additional square footage of impervious area. Will this Ordinance now allow them to be exempt from this requirement? How will new subdivisions be addressed?* (D. Shultz)

  - Like previous Ordinances, new developments will be subject to the requirement of preparing a SWM Plan at the time of subdivision/ land development plan submission, where stormwater management is calculated and managed for the entire site. After the dwelling is constructed, if a property owner wanted to add a deck, then they would (in most cases) be allowed to use the Simplified Approach to determine if the deck could be considered exempt.

- *As an example, if you now own 50 acres, under this ordinance you could seek a 10,000 sq ft exemption for construction of new impervious area on this 50 acre tract. If you subdivided this 50 acre tract into 40 lots, as now written, each lot could seek a 10,000 sqft exemption.* (D. Shultz)

  - Yes, a land owner of 50 acres could seek an exemption for the construction of a new impervious area of 10,000 sqft., if they can demonstrate that the associated stormwater can be disconnected and managed onsite. However, if the lot were subdivided into 40 lots, unless all 40 lots were located along an existing road (no new infrastructure), each lot had the area to manage the stormwater runoff created by each new impervious area of 10,000 sqft, and municipal ordinances did not require submission of a SWM Plan at the time of subdivision, could this scenario be possible.

- *The Partial Rooftop Disconnection chart on page 8 and page 2 of the application does not appear to match the chart provided within Appendix B of the Model SWM Ordinance.* (E. Vranich)

  - The Partial Rooftop Disconnection in the Simplified Approach includes a separate column for Length of Pervious Flow Path for lots under 10,000 square feet (upon DEPs suggestion). It is only used for those projects

qualified to use the Simplified Approach. Appendix B will be removed from the Ordinance.

- *Where the length of impervious area only meets the credit factor for only a portion of the rooftop disconnection calculation, how the remaining portion of the stormwater discharge is to be handled needs to be addressed.* (D. Shultz)

    - The applicant will have to choose BMPs to address the remaining portion of stormwater discharge.

- The area of the Worksheets discussing the tree planting credit will be clarified to include spacing. (D. Shultz)

- Stormwater Management/ BMP Facilities & Maintenance Agreement – Paragraph 4. was supplemented with the text "…to enter upon the property *without prior notification* at reasonable times…" to insure inspections that may need to be done quickly would have the property owner's permission in advance. (W. Davis)

- A space for the Tax Parcel ID Number will be added to the Municipal Stormwater Management Worksheets. (E. Vranich)

- Stormwater Management/ BMP Facilities & Maintenance Agreement – Paragraph 6. was supplemented with the phrase "The municipality has the right to file a municipal lien for unpaid costs and expenses that have not been reimbursed thirty (30) days after receipt of invoice." to make it easier for the municipality to recover costs incurred while performing work on BMPs. (W. Davis)

- Municipal Stormwater Management Worksheets will be reviewed and any clarification necessary to make them as easy to use as possible will be added.

- The Stormwater Design Assistance Manual consists of sheets from several sources describing different BMPs that are typically used. Many of these sheets do list specifications (i.e. for stone, geo-textile, pipe, etc) that have been provided for information purposes. A municipality can require specific technical requirements if they would like. (D. Shultz)

V. Stormwater Plan Review and Municipal Approval Processes

- The Conservation District intends to provide at least 2 training sessions in regard to the use of the Simplified Approach and the Municipal Stormwater Management Worksheets, which will provide real world examples and the County's suggested method of applying the Simplified Approach. Additional outreach/training may be provided upon request by the municipality. (Franklin Township, Reading Township, Mount Pleasant Township, B. Stone, D. Shultz)

- Municipalities may modify exemption criteria to be more stringent than the suggested criteria in the Plan. (L. Heine)

- The specific process of submitting and reviewing stormwater management plans is at the discretion of the municipality. Section VII – Model Ordinance Provisions includes “Recommended Municipal SWM Plan Review and Approval Process”, which municipalities may use as a guide or adjust based on their preferred method of receiving and reviewing formal stormwater management plans.

Adams County Conservation District
Adams County Office of Planning & Development

Public Hearing, Wednesday, November 2, 2011 – Adams County Stormwater Management Plan

The Public Hearing was called to order at 2:00 p.m. by Board Chairman George A. Weikert. The following were in attendance: Commissioners R. Glenn Snyder and Lisa Moreno-Woodward; Solicitor John M. Hartzell; Albert Penksa, County Manager; Barry Newman, Department of Environmental Protection (DEP); Larry Martick, Conservation District Manager; Rusty Ryan, Resource Conservationist/Supervisor; Sarah Weigle, Senior Planner; Nick Colonna, Director of Planning & Development; Robert Thaeler, Principal Planner; Bicky Redman, Director Environmental Services; Barry D. Stone, Mt. Pleasant Township; Jim Palmer, ICPRB, Dean Shultz; Gettysburg Engineering; Jim Martin, Menallen Township; Chad Clabaugh, C.S. Davidson, Inc.; Jonathan Reisinger, Mt. Pleasant Township; Brandon Guiher and Leah Heine, KPI Technology; Jess Haines, *The Gettysburg Times* and Chief Clerk Paula V. Neiman. Chairman Weikert noted, per the requirements, that this is the date, place and time duly advertised to hold the Act 167 Stormwater Management Plan Public Hearing. Chairman Weikert introduced Barry Newman who provided the following comments:

Barry Newman, DEP – Mr. Newman provided an overview of the Act 167 requirements and the importance of having such plans. He has been involved with Adams County since 2004 and about a year and a half ago the County began the updating process. Unfortunately all funding was cut off by the State for Act 167 reimbursements and therefore the County had to work and prepare the Plan internally. He thanked the County and everyone involved for moving forward with this project.

Public Comments:

Chairman Weikert at this time asked for Public Comment/Questions. The following were received:

- Jim Palmer, Interstate Commission on the Potomac River Basin – They downloaded the Plan for review from the website and apologized that they did not submit comments during the comment period. There is some overlap between this Plan and the stormwater recommendations of Marsh/Rock Creek Critical Area Resource Plan (CARP), and even though it is not complete, it will be done in a year or so.

Section 6 – Marsh and Rock Creek are not problem areas (as related to Section 6 of the SWM Plan); however we need to become more

efficient and increase sufficiency of stormwater management to help alleviate water shortage problems in the future. There is the option of including mention of the CARP in Section 5 of the Plan.

- Bicky Redman– agreed with Mr. Palmer and that this would apply to the entire county, through integrated water resources management, and not just the CARP.

- Dean Shultz – Mr. Shultz provides engineering services to several municipalities. He has received the Stormwater Management Plan Pre-Hearing Response Document but did not have a chance to review the contents. His concerns are: a) are we going to allow the exemptions to be used for development. The response he received was No. He has a concern that this ordinance does allow new developments to use these exemptions (provided an example). It should be spelled out that this is not for new subdivisions; b) this Plan does not specify peak discharge. He applauds the fact there are some means for volume control. There is provided a calculation that allows for 2.3 inches of stormwater back into the ground during a 2 year period; c) the homeowner can come up with their own designs. An average homeowner is not knowledgeable enough to do this. They should still be reviewed; and d) he distributed a report that contained other comments.

- Barry Newman – provided the process for developing these plans. The County works with a plan advisory committee consisting of representatives from municipalities, Conservation District and Planning Office and anyone else the Commissioners chooses. The draft is distributed to all members and planning organizations that are associated with the county plan for review. A public hearing is then held, which is where we are today. A question for today is should the county adopt the Plan and submit it to DEP for approval? DEP will review and approve the Plan, which will then go into effect. At this time everyone (municipalities) will need to comply by adopting or amending ordinances consistent with the Plan. Barring any momentous event, the Commissioners need to know if they should adopt and submit for approval. If the Commissioners do not adopt the Plan he is not sure what would happen next.

Mr. Shultz asked Mr. Newman if he had a chance to look through the ordinance as presented today. Response - yes I did and I am satisfied with the plan. I did not find any fatal flaws in the ordinance. I may have done some things differently but he feels this is what the county would like to see. The plan, including the ordinance, as

presented today would be approved. Mr. Shultz asked him to justify the new subdivisions. Mr. Newman responded that municipalities have the option to disallow, deny or require additional steps to the proposed developer. Rusty Ryan asked Mr. Shultz to review the comments provided by Sarah Weigle. They will address his concerns.

- Chad Clabaugh – will you be announcing when you plan to adopt the Plan. Response - Yes. His concerns: a) Section 304 Volume Control - impervious coverage is not the right word to be used. Suggested disturbance; b) the Response Document from the county has a statement "The draft Plan will not be revised to reflect applicable comments until after the public hearing, which will be held November 2, 2011 at 2:00 p.m. at the Agricultural and Natural Resources Center". The parties will not have time to review the answers to the comments that were received. Chairman Weikert noted we will address these at the meeting.

Summary of the Hearing: a) training will be provided to municipalities; b) plan is a guideline, ordinance is a model, municipalities can make their Ordinance more stringent; c) lesson the burden and expense on homeowners; d) address inconsistencies with the Monocacy stormwater plan; e) protect water resources and f) look at uniformity throughout the County

Chairman Weikert noted it is the county's responsibility to have this Plan in place. Our Conservation District and Planning Office worked together on this and kept everyone involved well informed of the process. We all appreciated the comments that were received and they will be reviewed.

Questions & Answer Period:

Chairman Weikert asked if there were any additional questions, comments, concerns to be addressed.

- Chad Clabaugh – with the comments received, will there be a new revised ordinance. Will the Commissioners wait to approve the ordinance until all the parties have a chance to see the revised document? He would like to see all the comments that are addressed.

Solicitor Hartzell noted the statute requires public input but does not require additional back and forth reviews. This public hearing that we are holding today meets the statutory requirements.

- Bicky Redman – with this plan we will be able to achieve the looming problem of recharging our groundwater supplies.

Final Adoption:

Chairman Weikert announced the comments will be reviewed and the ones with merit will be implemented in the plan. The Commissioners are looking to adopt this plan during their Wednesday, November 23, 2011 Commissioners Meeting. Commissioner Snyder added that he is concerned when you have to pay more for the stormwater management plan than what it costs to build on your property. This gets way to costly for the homeowner and we should be consumer friendly.

Chad Clabaugh asked about the timeline for the plan after it is submitted to DEP. Mr. Newman noted it should be reviewed within a day or two, and when it is sent to DCED it takes about a week or so. Total – from the time he receives the plan 2-3 weeks to approve. DEP has 180 days to approve. Municipalities then have six, (6) months from the date of DEP approval to adopt or amend ordinances consistent with the Plan, as stipulated by the statute (Act 167).

Chairman Weikert asked if a municipality has an ordinance that is more restrictive than this plan, do they have to adopt our model. If they are comfortable with their ordinance and it works in their township, not asking them to adopt this one. They should however, justify their additional restrictions or why it offers more protection, so that they are on record. A municipality should keep a record of this to defend themselves if challenged. Chairman Weikert asked if the Monocacy Ordinance was consistent. Mr. Newman stated that those standards are not consistent with the proposed model ordinance.

Adjournment:

Commissioner Snyder moved, seconded by Commissioner Moreno-Woodward to adjourn the public hearing at 3:28 p.m. this date.

Motion carried.

Respectfully submitted,

Paula V. Neiman
Chief Clerk

ADAMS COUNTY

STORMWATER MANAGEMENT PLAN

November 16, 2011

Post-Hearing Response Document

The following responses were prepared to address concerns and observations received during the public hearing for the draft Adams County Stormwater Management Plan, which was held November 2, 2011 at 2:00 p.m. at the Agricultural and Natural Resources Center. Responses to several comments given at the Hearing were already provided in the Pre-Hearing Response Document.

- Dean Shultz, Municipal Engineer – Felt that Exemptions should not be given to new development. He gave an example of the subdivision of a 50 acre farm, which he provided in writing during the comment period.
    - The intent of the Ordinance is not to allow new, multiple-lot subdivisions the option of using the Simplified Approach. If infrastructure is proposed, a formal stormwater management plan will have to be prepared. If a stormwater management plan is not prepared at the time of subdivision, in those instances that the subdivision plan states that stormwater management will be addressed during the issuance of building permits (depending on the municipal process), the individual property owner would still have to demonstrate that the stormwater runoff could be managed within the property. The 10,000 square foot exemption is not an automatic exemption for all new development. Impervious areas of 5,000 – 10,000 sqft are only exempted if the size of the property allows for the entire volume of stormwater runoff created to be directed to pervious areas (disconnected) without using BMPs.
    - Please see the Pre-Hearing Response Document for our reply to the specific examples.
- Jim Palmer, ICPRB – Requested that the Rock-Marsh Creek Critical Areas Resource Plan, which is currently underway, is mentioned in Section V – Existing

Plans & Regulations, because more effective management of stormwater runoff could help alleviate some of projected water shortages in the study area.

- A reference to the Marsh/ Rock Creek Critical Areas Resource Plan will be added to Section V. The text states:

  Marsh/ Rock Creek Critical Areas Resource Plan (CARP) (In Progress)
  A Critical Areas Resource Plan is underway for the Rock Creek and Marsh Creek Watersheds. Pennsylvania deemed this area as having the potential for water demand to exceed supply. This plan is taking a closer look into this issue, as well as water quality, which is also a concern within the watersheds. Recommendations related stormwater management could be implemented, if applicable to the involved municipalities.

- Chad Clabaugh, C.S. Davidson, Inc. – Suggested replacing the words "impervious coverage" in Ordinance Section 304. Volume Controls with "disturbance".

  - Replacing "impervious coverage" with "disturbance" reduces the threshold for which volume control method can be used. The 1 acre of impervious coverage standard is established as the threshold point at which an applicant can no longer consider using CG-2. It changes the meaning of a consistently used state standard that is referenced and described in the BMP Manual. The Plan bases this standard of controlling the stormwater from impervious surfaces.

    This change could also add the possibility of an applicant having to do stormwater management permitting for a disturbance associated with a quote "Regulated Activity" that does not really result in a stormwater impact. The definition of "Regulated Activity" is so broad that you could have a disturbance with no new impervious area that would still have to go through a stormwater management review for a project with "disturbance" but results in essentially no stormwater runoff.

    We feel that this could also result in a fair amount of applicants being forced out of the ability to use the Simplified Method (CG-2) and being forced to use the more expensive and detailed CG-1 approach. One of the goals of the Plan was to keep costs down for applicants proposing lower impact projects.