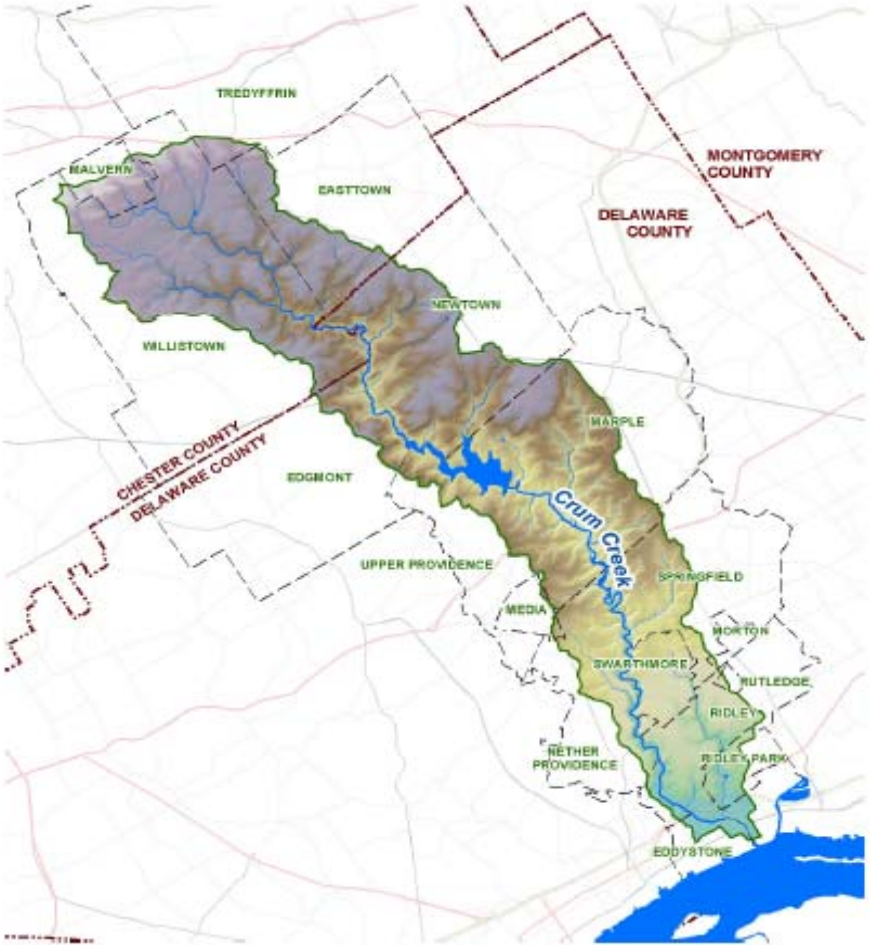
CRUM CREEK WATERSHED ACT 167 STORMWATER MANAGEMENT PLAN

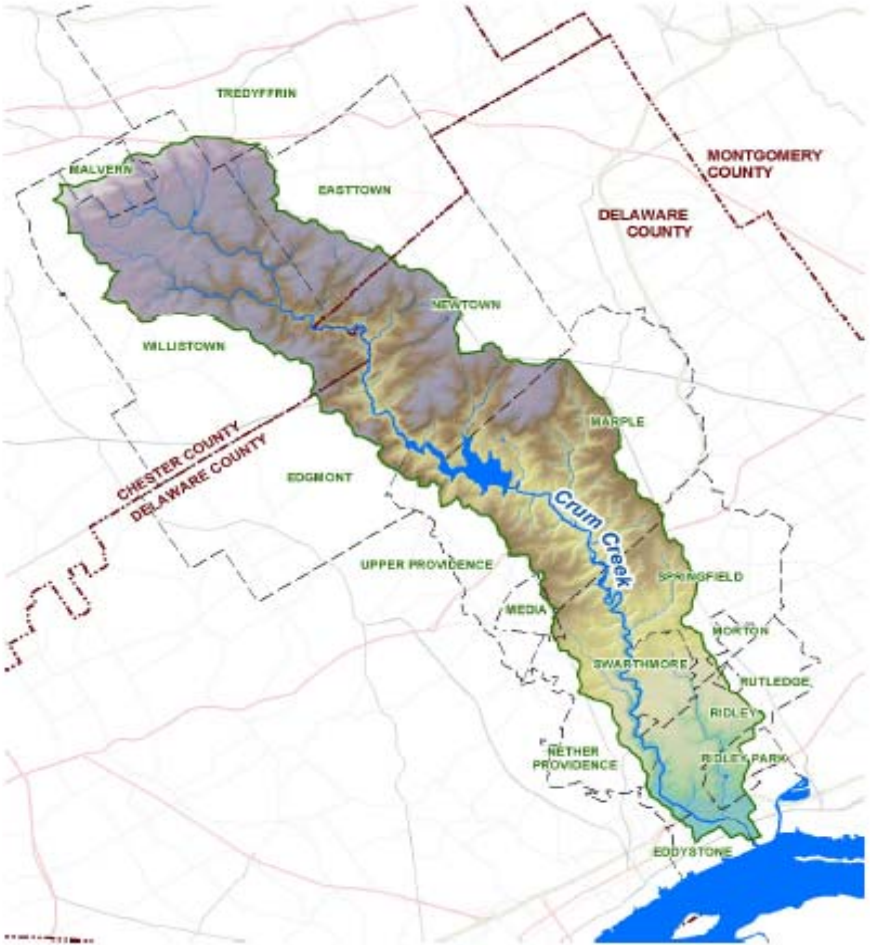


VOLUMES I AND II

CHESTER AND DELAWARE COUNTIES, PENNSYLVANIA

DECEMBER 2011

CRUM CREEK WATERSHED ACT 167 STORMWATER MANAGEMENT PLAN



VOLUME I – EXECUTIVE SUMMARY

CHESTER AND DELAWARE COUNTIES, PENNSYLVANIA

DECEMBER 2011

CRUM CREEK WATERSHED ACT 167
STORMWATER MANAGEMENT PLAN

CHESTER AND DELAWARE COUNTIES, PENNSYLVANIA

VOLUME I - EXECUTIVE SUMMARY

December 2011

DEP DOCUMENT # GRN100021546
FILE NO. SWMP 084-23
BLE PROJECT NO. 2004-1553-00

PREPARED BY:

DELAWARE COUNTY PLANNING DEPARTMENT
Court House and Government Center Building
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and

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ENGINEERING CONSULTANT:

BORTON-LAWSON ENGINEERING, INC.
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PLAN FORMAT

The format of the Crum Creek Watershed Act 167 Stormwater Management Plan consists of Volume I, the Executive Summary; Volume II, the Plan Report; and Volume III, which contains the background technical materials.

Volume I provides an overview of Act 167 and a summary of the standards and criteria developed for the plan. Volume II, the Plan Report, provides an overview of: stormwater management; purpose of the study; data collection; all GIS maps; present conditions; projected land development patterns; calculation methodology; an explanation of criteria contained in the Model Ordinance found in Plan Appendix 1; and an implementation discussion.

Volume III provides the following information: supporting data; watershed modeling parameters and modeling runs; peak flows; release rates; the existing municipal ordinance matrix; and an obstructions inventory. Due to large volumes of data, one copy of Volume III will be on file at the Delaware County Planning Department and one copy of Volumes I-III will be on file at the Chester County Planning Commission.

VOLUME I - EXECUTIVE SUMMARY

TABLE OF CONTENTS

I. INTRODUCTION

This plan has been developed for the Crum Creek watershed in Chester and Delaware Counties, Pennsylvania, to comply with the requirements of the Pennsylvania Stormwater Management Act (Act 167 of 1978). Prior to this plan, the Crum Creek watershed did not have an approved Act 167 plan in place. The impact of stormwater runoff from development was only evaluated and controlled on an individual site-by-site basis. The aggregate effects of development on stormwater runoff throughout the watershed were not considered. The holistic approach to stormwater management emphasized by this Act 167 plan considers the impact of development and stormwater runoff on both a local and watershed-wide scale. This plan essentially sets forth a framework of stormwater management objectives and guidelines for implementation on a site-by-site basis, to control stormwater runoff from new development in order to limit the collective impacts of development upon the Crum Creek and its tributaries.

II. WATERSHED DESCRIPTION

The Crum Creek watershed is located primarily in central Delaware County, with the headwaters of the watershed in eastern Chester County. Crum Creek flows in a southeasterly direction from its headwaters until it reaches its confluence with the Delaware River at the border of Eddystone Borough and Ridley Township.

There are a total of seventeen municipalities within the Crum Creek watershed. Thirteen of these municipalities lie within Delaware County, and four municipalities are within Chester County. The Crum Creek watershed is located in the following municipalities:

Chester County

Easttown Township
Malvern Borough
Tredyffrin Township
Willistown Township

Delaware County

Eddystone Borough
Edgmont Township
Marple Township
Media Borough
Morton Borough
Nether Providence Township
Newtown Township
Ridley Park Borough
Ridley Township
Rutledge Borough
Springfield Township
Swarthmore Borough
Upper Providence Township

Crum Creek drains a watershed area of approximately 38.33 square miles (25.74 square miles in Delaware County and 12.59 square miles in Chester County) and includes the following major tributaries: Preston Run, Hunter Run, Trout Run, Hotland Run, Dicks Run, Whiskey Run, Lewis Run, Reese Run, West Branch Creek, and Little Crum Creek. The largest impoundment within the Crum Creek watershed is the Springton (Geist) Reservoir (upper reservoir) located in Marple, Upper Providence, and Newtown Townships. There is also a smaller reservoir (lower reservoir) with an intake for the Aqua

America Pennsylvania (formerly Philadelphia Suburban Water Company) located on the border of Springfield and Nether Providence Townships. The Crum Creek supplies potable drinking water to over 280,000 residents of Delaware County.

Title 25, Chapter 93 of the Pennsylvania code designates the Crum Creek from its headwaters to the boundary of Newtown, Edgmont, and Willistown Townships as a High Quality Cold Water Fishery (HQ-CWF). The West Branch Crum Creek from its headwaters to its confluence with Crum Creek was recently designated Exceptional Value (EV). The next downstream segment of the creek between the boundary of Newtown, Edgmont, and Willistown Townships to the Springton Reservoir is classified as a Cold Water Fishery (CWF). The furthest downstream segment in the non-tidal portion of the basin is designated a Warm Water Fishery (WWF).

III. METHODOLOGY

The engineer for the project was Borton-Lawson Engineering, Inc. The plan was developed from data collected on the physical features of the watershed, such as soils, wetlands, topography, floodplains, dams and reservoirs, stream dimensions, and obstructions. Information on existing problem areas was solicited from the Watershed Planning Advisory Committee (WPAC) which consisted of representatives from the 17 municipalities, as well as other interested parties including County Conservation Districts, local water suppliers, watershed groups, and others. Although the plan in and by itself cannot fix all existing problems, knowing where and why they exist aided the engineer in developing the subwatersheds and understanding the hydrologic flow of the watershed as a whole. Information on existing land use and zoning was also collected. This helped the engineer to determine where, and to what extent, future development would take place. All of this data was compiled into a geographic information system (GIS) database.

The computer model used for the project was the US Army Corps of Engineers Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS). This model was chosen for the project because it can be easily adapted to an urban and/or rural area, it has the ability to analyze reservoir or detention basin-routing effects, and it is accepted by the Pennsylvania Department of Environmental Protection. To gain a realistic picture of what occurs in the Crum Creek watershed, the model was calibrated against actual stream flow data, regression models, and data from the Federal Emergency Management Agency (FEMA) and the Army Corps of Engineers.

The process of determining how runoff flows through the watershed is a complex one. It involves creating numerous runoff scenarios with the hydrologic model, taking into account the location of obstructions and tributary confluences. In the case of the Crum Creek, this process produced a few large subbasins, which were then further sub-divided into more manageable sub-units. The farthest downstream point of each of these areas is considered a “point of interest” in which increased runoff must be analyzed for its potential impact.

Another aspect of the analysis involves modeling design storms. This term refers to assigning a frequency to a storm based on the amount of rain that falls over a 24-hour period. As the amount of rain falling over a 24-hour period increases, the frequency or chance of that storm occurring decreases. For example, 5.80 inches of rain falling over a 24-hour period is associated with the 25-year design storm; the occurrence of 5.80 inches falling over a 24-hour period happens theoretically only once every 25 years. For this study, the 1-, 2-, 5-, 10-, 25-, 50-, and 100-year storms were modeled.

To make municipal implementation of stormwater peak rate controls viable, a simple, but accurate method was developed for municipal officials, engineers and developers to abide by the Plan. The watershed was divided into two (2) stormwater management districts as shown in Ordinance Appendix A.

IV. MODEL ORDINANCE REQUIREMENTS

The "Stormwater Management Act," Act 167 requires that Municipalities implement the watershed stormwater management plan via a stormwater ordinance developed as part of the plan. Further, the goal of Act 167 and this stormwater management plan is to encourage planning and management of stormwater runoff that is consistent with sound water and land cover practices. In order to try to achieve this goal and to address stream bank erosion, flooding, water quality, infiltration, and stormwater management measures, development and redevelopment sites must consider the following five objectives: maintain infiltration of groundwater; maintain or improve water quality; reduce channel erosion; manage overbank flood events; and manage extreme flood events. An outline of the requirements in the Model Ordinance, found in Volume II, Plan Appendix 3, that addresses each of these objectives is listed below.

1. As outlined in Section 305 of the model ordinance, Infiltration Volume Requirements must be met. Infiltration capacity must be provided for the net 2-year, 24-hour volume, so as to permanently remove this volume from the post-construction stormwater runoff, which meets Control Guideline (CG-1) from the *Pennsylvania Stormwater Best Management Practices Manual* (Document Number 363-0300-002, December 30, 2006). The net volume is the difference between the post-development runoff volume and the predevelopment runoff volume. Therefore, the post-development total runoff volume for all storms equal to or less than the 2-year, 24-hour duration precipitation shall not be increased. If infiltrating the net 2-year, 24-hour volume is not feasible and the design professional has demonstrated that this cannot be physically accomplished, then at least the first one inch (1.0") of runoff from new impervious surfaces shall be permanently removed from the runoff flow, which meets Control Guideline (CG-2) from the *Pennsylvania Stormwater Best Management Practices Manual*. If infiltrating the first one inch (1.0") of runoff from new impervious surfaces cannot be physically accomplished, criteria from CG-2 must be followed, which states that at least the first one-half inch (0.5") of the permanently removed runoff should be infiltrated. The minimum infiltration volume is the maximum infiltration amount that the site can physically accept, or one-half inch (0.5"),

whichever is greater. If site conditions preclude capture of runoff from portions of the impervious area, the infiltration volume for the remaining area should be increased an equivalent amount to offset the loss.

2. If the minimum of one-half inch (0.5") of infiltration requirement cannot be physically accomplished, a waiver from Section 305 of the Model Ordinance (Infiltration Requirements) is required from the Municipality.

3. As described in Section 306 of the Model Ordinance, Water Quality Volume (WQv) Requirements, if the calculated WQv is greater than the volume required to be infiltrated as described in Section 305.A.2, the difference between the two volumes shall be treated for water quality by an acceptable stormwater management practice(s). The required WQv is the storage capacity needed to capture and treat a portion of stormwater runoff from the developed areas of the site.

4. As outlined in Section 306 of the Model Ordinance, the following water quality volume requirements must be met. From Control Guideline (CG-1) in the *Pennsylvania Stormwater Best Management Practices Manual*, the WQv shall be the net 2-year, 24-hour volume. This volume requirement can be managed as the permanent volume of a wet basin or the detained volume from other BMPs. Where appropriate, wet basins shall be utilized for water quality control and shall follow the guidelines of the PA Stormwater BMP manual. Release of water can begin at the start of the storm (i.e., the invert of the water quality orifice is at the invert of the facility). The design of the facility shall provide for protection from clogging and unwanted sedimentation.

5. Section 306.B of the Model Ordinance states that the temperature of receiving waters shall be protected through the use of BMPs that moderate temperature.

6. To further protect water quality, Section 306.C of the Model Ordinance requires that buffer areas be provided for perennial or intermittent streams passing through the site. The buffer areas are required to be at least fifty (50) feet to either side of the top-of-bank of the channel, lake, or wetland, subject to federal and state buffer policies and regulations. If the applicable rear or side yard setback is less than the required buffer width, or a stream traverses the site, the buffer width may be reduced to twenty-five (25) percent of the setback or twenty-five feet, whichever is greater, or reduced to a minimum of ten (10) feet with a municipal waiver. The buffer area shall be planted and maintained with native vegetation. In addition to water quality protection, the buffer area also reduces channel erosion.

7. As described in Section 307 of the Model Ordinance, Stream Bank Erosion Requirements, the primary requirement to control stream bank erosion is to design a BMP to detain the proposed conditions 2-year, 24-hour design storm to the existing conditions 1-year flow determined using the SCS Type II distribution. Additionally, provisions shall be made to release the proposed conditions 1-year

storm for a minimum of twenty-four (24) hours from a point in time when the maximum volume of water from the 1-year storm is stored in a proposed BMP.

8. Performance standards for overbank flood events and extreme flood events are provided in Section 308 of the Model Ordinance, Stormwater Peak Rate Control, which states that proposed condition rates of runoff from any regulated activity shall not exceed the peak release rates of runoff from existing conditions for the design storms specified in Table 308.1 of the plan (Table EX-1 below) and on the Stormwater Management District Watershed Map found in Appendix A of the Model Ordinance.

TABLE EX-1
Peak Rate Control Standards in the Crum Creek Watershed

District	**Proposed Condition Design Storm**	**(reduce to)**	**Existing Condition Design Storm**
A	2-year		1-year
	5-year		5-year
	10-year		10-year
	25-year		25-year
	50-year		50-year
	100-year		100-year
B	2-year		1-year
	5-year		2-year
	10-year		5-year
	25-year		10-year
	50-year		25-year
	100-year		100-year

9. If none of the above options are feasible due to site constraints, the applicant must provide stormwater detention that meets the management district criteria for the site location or else obtain approval from the municipal Engineer to implement other BMPs that will provide water quality benefits of an equivalent level.

10. Activities that are exempt from certain requirements as defined by the ordinance are still encouraged to implement voluntary stormwater management.

V. EXEMPTIONS

Table EX-2 below, which is a reproduction of Table 106.1 from the Model Ordinance, summarizes the exemptions from the Ordinance. Requirements vary based on size and nature of development, and are meant to be functional without being overly burdensome. An exemption shall not relieve the Applicant from implementing the requirements of the Municipal Ordinance or from implementing such measures as are necessary to protect public health, safety, and property. An exemption shall not relieve the Applicant from complying with the special requirements for watersheds draining to identified high quality (HQ) or exceptional value (EV) waters or any other current or future federal, state or municipal water quality protection requirements. If a drainage problem is documented or known to exist downstream of, or is expected from the proposed activity, then the Municipality may withdraw exemptions listed in the Exemptions Table and require the Applicant to comply with all requirements of the Municipal Ordinance.

Requirements vary based on size and nature of development and are meant to be functional without being overly burdensome. They are as follows:

1. Regulated activities with proposed impervious surfaces between 0 and 499 square feet or earth disturbance between 0 and 4,999 square feet are exempt from fulfilling any requirements of the Model Ordinance, with the exception of existing erosion and sedimentation requirements, and in the case of earth disturbance, Section 306.C of the Ordinance.

2. Regulated activities involving earth disturbance between 5,000 square feet and 1 acre are required to submit a modified Stormwater Management (SWM) plan that only needs to consist of the items in Sections 402.A.2 and 4; 402.B.7, 8, 11, and 22; and 402.D.1 and 3 of the Model Ordinance. Additionally, the SWM site plan also needs to contain any related supportive material needed to determine compliance with Sections 304, 306, and 308 of the Model Ordinance, as applicable. It must satisfy the nonstructural project design, stormwater peak rate control, and management district requirements of the Model Ordinance, but is exempt from all other requirements of the Model Ordinance.

3. All regulated activities with proposed impervious surfaces between 500 and 999 square feet must use the simplified approach found in Appendix B of the Model Ordinance. The simplified approach requires that the first one inch (1.0”) of runoff from all new impervious surfaces be captured. The simplified approach includes a description of several different types of BMPs that can be used to capture the first one inch (1.0”) of runoff and step by step instructions used to determine the size of the BMPs based on the amount of proposed impervious surface. The simplified approach requires the submission of a worksheet showing calculations for BMP sizing, a simple sketch plan, and a signed operations and maintenance agreement all of which are found in Appendix B of the Model Ordinance.

4. All regulated activities that have impervious surfaces greater than 1,000 square feet and/or having greater than 1 acre of earth disturbance must meet all requirements of the Model Ordinance.

TABLE EX-2
Ordinance Exemptions for the Crum Creek Watershed

Ordinance Article or Section	Type of Project	Proposed Impervious Surface			Earth Disturbance		
		0-499 sq. ft.	500-999 sq. ft.	1,000+ sq. ft.	0-4,999 sq. ft. Disturbance	5,000 sq. ft. - < 1 acre	≥ 1 acre
Article IV SWM Site Plan Requirements	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Exempt	Modified[1]	Not Exempt
Section 304 Nonstructural Project Design	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Exempt	Not Exempt	Not Exempt
Section 305 Infiltration Volume Requirements	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Exempt	Exempt	Not Exempt
Section 306 Water Quality Requirements	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Modified[2]	Modified[2]	Not Exempt
Section 307 Stream Bank Erosion Requirements	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Exempt	Exempt	Not Exempt
Section 308 Stormwater Peak Rate Control and Management Districts	Development Redevelopment	Exempt	Exempt	Not Exempt	Exempt	Not Exempt	Not Exempt
Erosion and Sediment Pollution Control Requirements	Must comply with Title 25, Chapter 102 of the PA Code and other applicable state and municipal codes, including the Clean Streams Law.						Not Exempt

Legend:

- **"Proposed Impervious Surface" in Table 106.1 includes new, additional, or replacement impervious surface/cover as part of development or redevelopment.**
- Exempt - Exempt from required section provision only – SWM site plan submission may still be required if other section provisions are applicable.
- Modified[1] - Modified SWM site plan need only consist of items in Sections 402.A.2 and 4; 402B.7, 8, 11, and 22; and 402.D.1 and 3 and related supportive material needed to determine compliance with Sections 304 and 308. Modified SWM site plan is required that includes all elements of Section 304, as applicable.
- Modified[2] - Modified SWM site plan need only consist of items and related material needed to determine compliance with Section 306.C.
- Simplified Approach **– Must comply with provisions of Appendix B of the Ordinance.**
- Redevelopment – See Section 308.I for alternate stormwater peak rate control criteria.

Any regulated activity that is exempt from some provisions of the Ordinance is exempt only from those provisions. If development is to take place in phases, the developer is responsible for implementing the requirements of the Ordinance as the impervious cover/earth disturbance threshold is met. The date of the municipal Ordinance adoption

shall be the starting point from which to consider tracts as “parent tracts” in which future subdivisions and respective impervious area and earth disturbance computations shall be cumulatively considered. Exemption shall not relieve the applicant from implementing such measures as are necessary to protect health, safety, and property.

For example:
If a property owner proposes a 150 square foot shed after adoption of the municipal stormwater management Ordinance, the property owner would be exempt from water quality and quantity requirements of the Ordinance as noted in Table EX-1. If, at a later date, the property owner proposes to construct a 499 square foot room addition, the applicant would be required to comply with the requirements for the Simplified Method for the full 649 square feet of impervious cover created since adoption of the municipal Ordinance. If an additional 700 square foot swimming pool/patio is proposed later, the property owner would be required to implement the full stormwater quantity and quality control submission requirements of the Model Ordinance for the total 1,349 square feet of additional impervious surface added to the original property since adoption of the municipal Ordinance.

Exemptions for Specific Activities:

1. Use of land for gardening or home consumption.

2. Agriculture when operated in accordance with a conservation plan, nutrient management plan, or erosion and sedimentation control plan approved by the County Conservation District. This includes activities such as growing crops, rotating crops, tilling soil, and grazing animals. For agriculture with an approved conservation plan, installation of new or expansion of existing farmsteads, animal housing, waste storage, and production areas having impervious surfaces that result in a net increase in impervious surface of between 500-999 square feet shall apply the simplified approach. Net increases in impervious surface of greater than or equal to 1,000 square feet shall be subject to the provisions of this Ordinance.

3. Forest management operations which are following the Pennsylvania Department of Environmental Protection (PADEP) management practices contained in its publication, “Soil Erosion and Sedimentation Control Guidelines for Forestry,” and are operating under an approved erosion and sedimentation plan and must comply with the stream buffer requirements in Section 306.C.

4. Repaving without reconstruction.

5. Emergency Exemption - Emergency maintenance work performed for the protection of public health, safety, and welfare. A written description of the scope and extent of any emergency work performed shall be submitted to the Municipality within two (2) calendar days of the commencement of the

activity. If the Municipality finds that the work is not an emergency, then the work shall cease immediately and the requirements of this Ordinance shall be addressed as applicable.

6. Maintenance Exemption - Any maintenance to an existing stormwater management system made in accordance with plans and specifications approved by the municipal Engineer or Municipality.

7. Recreational trails, facilities, and appurtenances subject to review provided they comply with all federal, state, and local floodplain policies and regulations.

VI. NPDES REGULATIONS

Federal regulations, approved October 1999, required operators of small municipal separate storm sewer systems (MS4s) to obtain NPDES (National Pollutant Discharge Elimination System) Phase II Stormwater Permits from PADEP by March 2003. This program affects all municipalities in "urbanized areas" of the State and applies to all municipalities within the Crum Creek watershed. Therefore, all municipalities within the Crum Creek watershed are subject to the NPDES Phase II requirements, mandated by the Federal Clean Water Act as administered by PADEP. For more information on NPDES II requirements, contact the PADEP Regional Office.

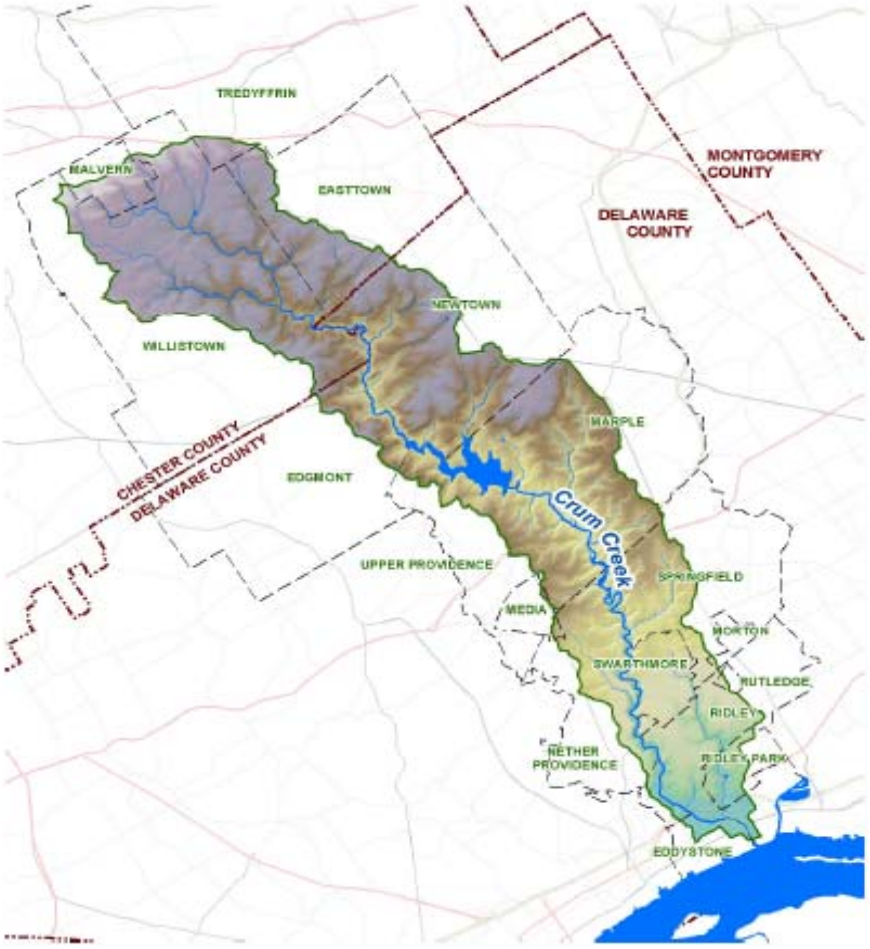
This plan and model ordinance are consistent with PADEP post-construction stormwater management requirement for the NPDES II/MS4 communities in affect at the time of approval of this plan.

VII. IMPLEMENTATION

All municipalities within the watershed are required to adopt the Crum Creek Stormwater Management Plan/Ordinance. The standards and criteria contained in this ordinance will apply only to those portions of the municipality that are located within the boundaries of the Crum Creek watershed. The areas outside of the watershed will still be regulated by the municipality's subdivision/land development ordinance unless otherwise written so as to apply to other areas of the municipality.

County adoption of the plan occurred summer/fall 2011. It was then sent to PADEP for approval. All of the municipalities within the Crum Creek watershed will be required to adopt the Model Ordinance provisions within six (6) months of PADEP approval.

CRUM CREEK WATERSHED ACT 167 STORMWATER MANAGEMENT PLAN



VOLUME II – PLAN CONTENTS

CHESTER AND DELAWARE COUNTIES, PENNSYLVANIA

DECEMBER 2011

CRUM CREEK WATERSHED ACT 167
STORMWATER MANAGEMENT PLAN

CHESTER AND DELAWARE COUNTIES, PENNSYLVANIA

VOLUME II – PLAN CONTENTS

December 2011

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FILE NO. SWMP 084-23
BLE PROJECT NO. 2004-1553-00

PREPARED BY:

DELAWARE COUNTY PLANNING DEPARTMENT
Court House and Government Center Building
201 West Front Street
Media, PA 19063-2751

and

CHESTER COUNTY PLANNING COMMISSION
601 Westtown Road, Suite 270
P.O. Box 2747
West Chester, PA 19380-0990

ENGINEERING CONSULTANT:

Borton-LAWSON ENGINEERING, INC.
3893 Adler Place, Suite 100
Bethlehem, PA 18017

ENGINEER CERTIFICATION STATEMENT

A. Engineer Information

Leonard James Smith II
Engineer Name

Borton -Lawson
Company

3893 Adler Place, Suite 100	Bethlehem		
Street Address	City		
PA	18017	484-821-0470 x232	lsmith@borton-lawson.com
State	Zip Code	Telephone	Email Address

B. Certification

I, Leonard James.Smith II
Name

attest under penalty of law:

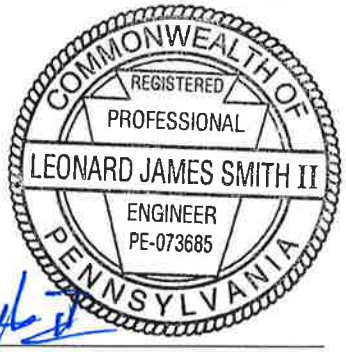
(i) that I am a Registered Professional Engineer in the Commonwealth of Pennsylvania, with expertise in civil or environmental engineering, and am employed by

Borton-Lawson, Inc
Name of Company/Firm

(ii) that this Act 167 Plan for Crum Creek Watershed, Chester County and Delaware County
Watershed and County Names

includes data, information and engineering analysis collected and prepared by Borton-Lawson, Inc. to support the selection of stormwater management standards by the Crum Creek Watershed Plan Advisory Committee; the data, information and engineering analyses contained in this plan were collected and prepared in accordance with sound engineering practices and the technical requirements of the Pennsylvania Stormwater Management Act (Pennsylvania Act 167); and the information submitted by Borton-Lawson, Inc. to the Crum Creek Watershed Plan Advisory Committee to develop this plan is, to the best of my knowledge and belief, true and accurate.

I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment or both for knowing violations pursuant to 18 Pa. C.S.§§4903-4904.



Signature

PE-073685
Pennsylvania PE Number

Sr. Water Resource Engineer
Title

October 28, 2011
Date

RESOLUTION

WHEREAS, the Stormwater Management Act 167 of 1978 provides for the regulation of land and water use for flood control and stormwater management, requires the Pennsylvania Department of Environmental Protection (Department) to designate watersheds for study, provides for grants to be appropriated and administered by the Department for plan preparation and implementation costs, and requires that each county prepare and adopt a watershed stormwater management plan for each designated watershed; and

WHEREAS, the County of Delaware entered into contract with the Pennsylvania Department of Environmental Protection to develop the watershed stormwater management plan for the Crum Creek designated watershed; and

WHEREAS, the purposes of the Crum Creek Watershed Stormwater Management Plan are to protect public health and safety and to prevent or mitigate the adverse impacts related to the conveyance of excessive rates and volumes of stormwater runoff and associated pollutants by providing for the management of stormwater runoff and control of erosion and sedimentation; and

WHEREAS, the Crum Creek Watershed Stormwater Management Plan fulfills the requirements of the Pennsylvania Stormwater Management Act, Act 167, and sets forth design criteria and standards for stormwater management systems and facilities that shall be utilized within the Crum Creek Watershed;

NOW, THEREFORE, BE IT RESOLVED that Delaware County Council hereby adopts the Crum Creek Watershed Stormwater Management Plan, including all volumes, figures, maps and appendices, in accordance with the provisions of Pennsylvania Stormwater Management Act, Act 167, and, further, hereby forwards and submits this Plan to the Pennsylvania Department of Environmental Protection for approval.

This Resolution is hereby adopted this 20th day of 2011 by:

DELAWARE COUNTY COUNCIL

Chairman

Member

Member

Attest:

County Clerk

RESOLUTION 38- 11

WHEREAS, the policies of the Chester County Comprehensive Plan *Landscapes2*, call for protecting stream channels, baseflows, and water quality; restoring degraded and impaired streams; and encouraging implementation of municipal stormwater management criteria, plans and regulations, among the other policies set out to protect and restore water quality and reduce runoff and flooding, and

WHEREAS, *Watersheds, An Integrated Water Resources Plan for Chester County and Its Watersheds*, the water resources element of *Landscapes2*, recognizes the need to reduce stormwater runoff and flooding in the Crum Creek watershed; and

WHEREAS, the Stormwater Management Act 167 of 1978 provides for the regulation of land and water use for flood control and stormwater management, requires the Pennsylvania Department of Environmental Protection (Department) to designate watersheds for study, provides for grants to be appropriated and administered by the Department for plan preparation and implementation costs, and requires that each county prepare and adopt a watershed stormwater management plan for each designated watershed; and

WHEREAS, the County of Chester entered into a memorandum of understanding with the County of Delaware to develop the watershed stormwater management plan for the Crum Creek designated watershed; and

WHEREAS, the purpose of the Crum Creek Watershed Stormwater Management Plan is to protect public health and safety and to prevent or mitigate the adverse impacts related to the conveyance of excessive rates and volumes of stormwater runoff and associated pollutants by providing for the management of stormwater runoff and control of erosion and sedimentation; and

WHEREAS, the Crum Creek Watershed Stormwater Management Plan fulfills the requirements of the Pennsylvania Stormwater Management Act, Act 167, and sets forth design criteria and standards for stormwater management systems and facilities that shall be utilized within the Crum Creek Watershed;

NOW, THEREFORE, BE IT RESOLVED that on the 29th day of September, 2011, the Chester County Board of Commissioners hereby adopts the Crum Creek Watershed Stormwater Management Plan, including all volumes, figures, maps and appendices, in accordance with the provisions of Pennsylvania Stormwater Management Act, Act 167, and, further, hereby forwards and submits this Plan to the Pennsylvania Department of Environmental Protection for approval.

Attest:

Janelle Swab,
Chief Clerk

9.29.11
Date

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Kathi Cozzone, Commissioner

Ryan Costello, Commissioner

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ENGINEERING CONSULTANT
Borton-Lawson Engineering, Inc.

CRUM CREEK WATERSHED DESIGNATED WPAC MEMBERS
As of October 10, 2007

Delaware County

Delaware County Planning Department	Ms. Karen Holm Manager, Environmental Section
Delaware County Conservation District	Mr. Edward Magargee District Manager
Eddystone Borough	Ms. Francine Howat Manager
Edgmont Township	Ms. Samantha Reiner Manager
Marple Township	Mr. Anthony Hamaday Manager
	Mr. Joseph Flicker Manager (former)
Media Borough	Mr. Jeffrey Smith Manager
Morton Borough	Ms. Delores Giardina Council Member
Nether Providence Township	Mr. Jonathan Sutton EAC Chairman
Newtown Township	Mr. George Clement Assistant Manager
Ridley Township	Mr. Charles J. Catania, Jr. Municipal Engineer
Ridley Park Borough	Ms. Terry Bradley Manager
Rutledge Borough	Mr. Edward O. McGaughey Manager

Springfield Township	Mr. Michael T. LeFevre Manager
Swarthmore Borough	Ms. Nancy Crickman EAC Member Alternate: Ms. Jane Billings
Upper Providence Township	Mr. Anthony Hamaday Manager (former)

Chester County

Chester County Planning Commission	Ms. Carrie Conwell Environmental/Open Space Planner
Chester County Conservation District	Mr. Dan Greig District Manager
Easttown Township	Mr. Dave Burman Assistant Manager
Malvern Borough	Ms. Sandra L. Kelley Manager
Tredyffrin Township	Mr. Stephen Burgo, P.E. Municipal Engineer
Willistown Township	Mr. Hugh J. Murray, Sr. Manager

Others

Chester County Water Resources Authority	Ms. Janet Bowers Director
Chester Ridley Crum Watersheds Association	Mr. Gary Snyder President Alternate: Ms. Anne Murphy
Natural Resources Conservation Service (NRCS)	Mr. Sam High District Conservationist
Aqua Pennsylvania	Mr. Preston Luitweiler Alternate: Craig Marleton

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS
(continued)

APPENDICES

MAPS

FIGURES

TABLES

TABLE OF CONTENTS
(continued)

SECTION I

INTRODUCTION

A. Introduction

This plan was developed for the Crum Creek watershed in Chester and Delaware Counties, Pennsylvania to comply with the requirements of the Pennsylvania Stormwater Management Act (Act 167 of 1978). The Crum Creek watershed is located in both Chester County and Delaware County, Pennsylvania. The headwaters of the watershed are located in eastern Chester County. The downstream sections of the watershed bisect central Delaware County before flowing into the Delaware River, located on the south side of Delaware County. Runoff through the watershed essentially flows from the northwest to the southeast.

This document is developed with the intent to present all the components necessary to implement a stormwater management plan for the Crum Creek watershed. The various components of this plan include legal, engineering, and municipal government topics, which, when combined, form the basis for implementation and enforcement of a final stormwater management ordinance for the Crum Creek watershed. All of the tools necessary to enact the proposed stormwater management ordinance are included in this document. It is the responsibility of the individual municipalities located within the Crum Creek watershed to implement this plan in order to provide a consistent methodology for the management of stormwater throughout the watershed. To assist the municipalities with adoption of this Act 167 plan, a sample ordinance is included in Appendix 3, which the municipalities may use as a template to form their own ordinance.

B. Stormwater Management

Stormwater management entails bringing surface runoff caused by precipitation events under control. Until recently, stormwater control was viewed only on a site-specific basis. Local perspectives and policies regarding stormwater management have changed. Today, it is acknowledged that proper stormwater management can only be accomplished by evaluating the comprehensive effects of stormwater runoff from the entire watershed on its receiving watercourses (i.e., analyzing the impacts of local development in a watershed's headwaters on flooding downstream). Proper stormwater management reduces flooding, soil and streambank erosion and sedimentation, and improves the overall quality of the receiving streams.

Stormwater management requires cooperation between state, county and local officials. It involves proper planning, engineering, construction, operation, and maintenance. This entails educating the public and local officials. It also requires program development, financing, policy revision, the development of workable criteria, and the adoption of ordinances. The Crum Creek Watershed Stormwater Management Plan, which complies with the requirements of the Pennsylvania Stormwater Management Act (Act 167), will

enable continued development to occur within the Crum Creek watershed, utilizing both structural and non-structural measures to properly manage stormwater runoff in the watershed.

SECTION II

ACT 167

A. Stormwater Management Act 167

Recognizing the adverse effects of excessive stormwater runoff resulting from development, the Pennsylvania General Assembly approved the Stormwater Management Act, P.L. 864, No. 167 on October 4, 1978. Act 167 provides for the regulation of land and water use for flood control and stormwater management purposes. It imposes duties, confers powers to the Department of Environmental Protection (DEP), municipalities and counties, and provides for enforcement and appropriations. The Act requires DEP to designate watersheds, develop guidelines for stormwater management, and develop model stormwater ordinances. The designated watersheds were approved by the Environmental Quality Board on July 15, 1980, and the guidelines and model ordinances were approved by the Legislature May 14, 1985. The Act provides for grants to be appropriated by the General Assembly and administered by DEP for 75% of the allowable costs for the preparation of a stormwater management plan. It also provides for 75% of administrative, enforcement, and implementation costs incurred by any municipality or county in accordance with Chapter 111 - Stormwater Management Grants and Reimbursement Regulations (adopted by the Environmental Quality Board August 27, 1985).

All counties must, in consultation with its municipalities, prepare and adopt a stormwater management plan for each of its designated watersheds. The county must review and revise such plans at least every five years. Within six months following adoption and approval of a stormwater management plan, each municipality is required to adopt or amend stormwater ordinances as laid out in the plan. These ordinances must regulate development within the municipality in a manner consistent with the stormwater management plan and the provisions of the Act.

Developers are required to manage the quantity, velocity, and direction of resulting stormwater runoff in a manner that adequately protects health and property from possible injury. They must implement control measures that are consistent with the provisions of the watershed plan and the Act. The Act also provides for civil remedies for those aggrieved by inadequate management of accelerated stormwater runoff.

B. Purpose of the Study

Development in the Crum Creek watershed can contribute to an increase in stormwater runoff and a reduction in groundwater recharge. In addition to the risk of flooding downstream, a number of other negative effects can result from uncontrolled stormwater runoff. These effects include causing erosion and sedimentation problems, reducing stream quality, raising the temperature of the streams, and impairing the aquatic food chain. Increased stormwater runoff can also reduce the base flow of streams, which is

imperative for aquatic life during the drier summer months. Erosion of the streambanks caused by accelerated stream velocities due to increased runoff is already evident in the following municipalities: Chester County - Easttown Township and Malvern Borough; Delaware County - Newtown Township, Ridley Park Borough, Ridley Township, and Upper Providence Township.

With the understanding that managing peak stormwater runoff rates on a site-by-site basis is ineffective at controlling many of the problems occurring within the watershed, there is an increased statewide, as well as local, recognition that sound and effective stormwater management planning requires a diversified, multifaceted approach. Furthermore, it is evident that managing stormwater runoff on a site-specific basis cannot meet the requirements of watershed-based planning. To be effective, a stormwater management plan must account for the full range of hydrologic consequences resulting from development by considering tributary timing, flow volume reduction, base flow augmentation, water quality control and ecological protection. For instance, the timing of flood peaks for each subbasin within a watershed contribute greatly to the flooding potential of a particular storm event, and only by assessing all of the subwatersheds contributing flow to a given tributary can a true understanding of flooding potential be attained. Therefore, each stormwater control site within a subbasin needs to be managed by evaluating the comprehensive picture for the entire watershed.

The Crum Creek Watershed Stormwater Management Plan provides for reasonable regulation of development activities to control accelerated runoff and protect the health, safety, and welfare of the public. The plan includes recognition of the various rules, regulations, and laws at the federal, state, county, and municipal level. Once implemented, the plan will aid in decreasing costly flood damages by reducing the source and cause of local uncontrolled runoff. The plan will make municipalities and developers more aware of comprehensive planning in stormwater control and will help maintain the quality of the Crum Creek and its tributaries.

SECTION III

GENERAL DESCRIPTION OF WATERSHED

The headwaters of Crum Creek are situated in southeastern Chester County. One third of the land area within the Crum Creek watershed is located in the eastern portion of Chester County; the other two thirds of the land area are located in central Delaware County. The watercourse is roughly aligned from north to south and drains runoff from the watershed to the Delaware River located to the south of Delaware County. The Crum Creek watershed encompasses four (4) municipalities in Chester County and thirteen (13) municipalities in Delaware County, which are listed in Table III-1 and illustrated in Map III-1, the Base Map.

TABLE III-1
Crum Creek Watershed Municipalities

Chester County

- Easttown Township
- Malvern Borough
- Tredyffrin Township
- Willistown Township

Delaware County

- Eddystone Borough
- Edgmont Township
- Marple Township
- Media Borough
- Morton Borough
- Nether Providence Township
- Newtown Township
- Ridley Park Borough
- Ridley Township
- Rutledge Borough
- Springfield Township
- Swarthmore Borough
- Upper Providence Township

A. Drainage Area

The Crum Creek watershed has a total drainage area of approximately 38.33 square miles (25.74 square miles in Delaware County and 12.59 square miles in Chester County) and includes the following main tributaries: Preston Run, Hunter Run, Trout Run, Hotland Run (mapped as Holland Run), Dicks Run, Whiskey Run, Lewis Run, Reese Run, West Branch Creek, and Little Crum Creek. Crum Creek originates in Willistown Township and Malvern Borough near Easttown Township in Chester County and flows in a southeast direction through Chester County and the northern portion of the watershed in Delaware County. Approximately halfway through Delaware County, the watercourse turns due south to Eddystone Borough where it again turns to the southeast and flows into the Delaware River.

Title 25, Chapter 93 of the Pennsylvania code designates the Crum Creek from its headwaters to the boundary of Newtown, Edgmont, and Willistown Townships as a High Quality Cold Water Fishery (HQ-CWF). The West Branch Crum Creek from its headwaters to its confluence with Crum Creek was recently designated Exceptional Value

(EV). The next downstream segment of the creek between the boundary of Newtown, Edgmont, and Willistown Townships to Hollow Road, north of the Springton Reservoir is classified as a Cold Water Fishery (CWF). The farthest downstream segment in the non-tidal portion of the basin is designated a Warm Water Fishery (WWF).

The major traffic routes through the Crum Creek watershed include I-476 and I-95, U.S. Routes 1, 30, and 13, and PA Routes 3, 252, 320, and 420. I-476 runs through the lower portion of the watershed for approximately 6 miles, following the main stem of Crum Creek from Marple Township to Ridley Township. I-95 also runs through the southern section of the watershed for approximately 1.3 miles and crosses the Crum Creek near the I-476 interchange in Ridley Township. U.S. Route 30 crosses the upper headwaters of Crum Creek for a short distance in Tredyffrin and Willistown Townships in Chester County. Below U.S. Route 30, U.S. Route 1 is aligned from east to west and traverses the central portion of the watershed for approximately 2.5 miles in Delaware County, from Upper Providence Township to Springfield Township.

At the bottom of the watershed, U.S. Route 13 crosses through Ridley Park Borough, Ridley Township, and Eddystone Borough. PA Route 3 runs in an east-west direction through the center portion of the watershed for approximately 2.5 miles and crosses Crum Creek just north of Springton Reservoir. PA Route 252 enters the watershed in Newtown Township and traverses the watershed for approximately 3.5 miles before exiting into Upper Providence Township. PA Route 252 crosses Crum Creek immediately downstream of Springton Reservoir. PA Route 320 runs approximately 4.5 miles through the Crum Creek watershed from Marple Township to Nether Providence Township, crossing Crum Creek near the I-476 underpass. PA Route 420 crosses the watershed for a short distance in Springfield Township.

B. Data Collection

In order to evaluate the hydrologic response of the watershed, data was collected on the physical features of the watershed as follows:

1. **Base Map:** The base map was created using data from a variety of sources. The watershed boundary for this plan was derived from statewide Act 167 watershed boundaries delineated by the PADEP. The PADEP boundary was laid over United State Geological Survey (USGS) 1:24,000 scale topographic maps to assure accuracy and make minor corrections.

   Roads and municipal boundaries for the base map were obtained from Pennsylvania Department of Transportation (PennDOT). Streams data was obtained from the Penn State Environmental Resources Research Institute (ERRI). The ERRI streams data was derived from PADEP streams data as digitized on USGS topographic maps. The ERRI attributes include a Strahler Classification which indicates the order of the stream segments.

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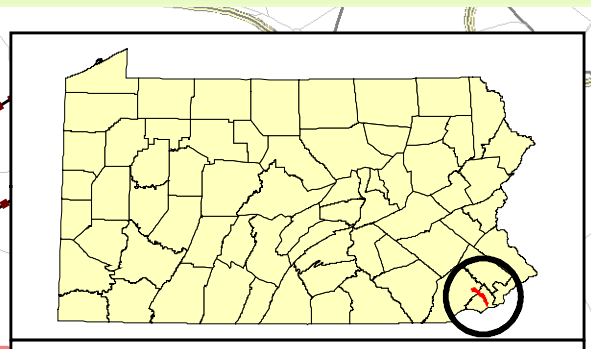

TREDYFFRIN
EASTTOWN
MALVERN
WILLISTOWN
NEWTOWN
EDGMONT
MARPLE
UPPER PROVIDENCE
SPRINGFIELD
MEDIA
MORTON
SWARTHMORE
RUTLEDGE
RIDLEY
NETHER PROVIDENCE
RIDLEY PARK
EDDYSTONE
MONTGOMERY COUNTY
DELAWARE COUNTY
CHESTER COUNTY
DELAWARE COUNTY
PENNSYLVANIA
NEW JERSEY
Crum Creek
West Branch Creek
Lewis Run
Reese Run
Preston Run
Hunter Run
Trout Run
Springton Reservoir
Hotland Run
Whiskey Run
Dicks Run
Little Crum Creek
Delaware River
30
252
3
1
420
320
476
95
291
13

1.25 0.625 0 1.25
1 Inch = 1.25 Miles

MAP III-1: BASE MAP

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Delaware County Planning Department
Courthouse & Government Center
201 West Front Street
Media, PA 19063
610-891-5200

Legend
- WATERSHED BOUNDARY
- COUNTY BOUNDARIES
- MUNICIPAL BOUNDARIES
- BOROUGHS
- SURFACE WATER
- STREAMS

Roads
- INTERSTATE
- US HIGHWAY
- PA HIGHWAY
- OTHER ROADS

NOTE:
Portions of this map were generated from existing data sources as listed below. These data are shown on the map for spatial reference only. These data did not enter into any computations or affect the reliability of the hydrologic analysis. Borton-Lawson Engineering has found inaccuracies in some of these data and has corrected the data in locations where discrepancies were obvious; however, it was not a part of this Act 167 plan to correct all of the mapping data errors.

DATA SOURCES:
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State Roads - PennDOT, 2004
Local Roads - PennDOT, 2001
Counties - PennDOT, 2002
Municipalities - PennDOT, 2001
Streams - PaDEP/ERRI, 2001
Lakes - Aqua America, 2001
Delaware River - USFWS (derived from NWI coverages)

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FILE: \\WB Data\Projects\2004\1553\00\DATA\GIS\FINAL_REPORT_MAPS\ArcMap\Crum_BaseMap.mxd

Lakes and reservoirs were derived from US Fish and Wildlife Service (USFWS) and National Wetlands Inventory (NWI) data. Lacustrine wetland polygons were extracted as a stand-alone data layer. This data layer was laid over USGS digital raster graphics and edited to increase accuracy.

2. **Elevation Data:** USGS digital raster graphic (DRG) formatted topographic maps (1:24,000, 7.5 minute quadrangles) were used to create a watershed-wide DRG. Corresponding 7.5 minute Digital Elevation Models (DEMs) were used to create a watershed-wide digital elevation model.

   Subwatersheds or subareas used in the watershed modeling process were derived from the watershed DEM. Subareas, drainage courses, land slopes and lengths, and drainage element lengths and slopes were determined utilizing the DEMs.

3. **Soils:** All soil data was obtained from the United States Department of Agriculture, Natural Resources Conservation Service (NRCS) in digital format. Generalized soils were obtained from the State Soil Geographic Database (STATSGO). STATSGO maps are statewide soil maps made by generalizing the detailed soil survey data. Soil mapping units with similar characteristics are grouped together.

   Data on hydrologic soil groups (HSGs) was derived from the detailed Soil Survey Geographic Database (SSURGO) data. The spatial component of SSURGO data (the soil map) is provided as a GIS data layer. The attribute data (soil information) is provided as a relational Access database. Together the spatial data and relational database are referred to as National Soil Information System (NASIS) data. The NASIS data was processed to extract HSG classifications for the surface horizon of the soil mapping units within the watershed.

4. **Geology:** The geology for the watershed was extracted from the statewide bedrock geology coverage produced by Pennsylvania Bureau of Topographic and Geologic Survey, Department of Conservation and Natural Resources (DCNR). The dataset obtained from DCNR is not intended for use at any scale finer than 1:250,000. The geology data is displayed for the watershed at a scale larger than 1:250,000. The geology information is provided for illustrative and general information only.

5. **Land Cover:** Existing land cover was determined by utilizing year 2000 Delaware Valley Regional Planning Commission (DVRPC) coverages and year 2000 DVRPC digital aerials for Delaware and Chester Counties. “Heads up” digitizing was completed using the aerial photographs to update the DVRPC land cover data and improve its spatial accuracy. Delaware and Chester Counties reviewed the modified DVRPC data and made revisions which were incorporated into the GIS.

6. **Wetlands:** Wetlands were obtained from the USFWS and NWI in digital format and incorporated into the overall GIS. NWI maps are compiled from photo-interpreted aerial photography from the National Aerial Photography Program (NAPP) 1:40,000 Scale, and the National High Altitude Photography Program (NHAP) 1:58,000 or 1:80,000 Scale. Source dates range from the 1970's to the present. The minimum mapping unit for treeless areas is 1/4 acres, 1 to 3 acres in general.

   The wetlands data is provided for illustrative purposes. Other wetland areas likely exist in the watershed that are not depicted on NWI maps.

7. **Development in Floodplains:** Flood hazard areas for Chester and Delaware Counties were derived from the Federal Emergency Management Agency (FEMA) National Flood Insurance Program Q3 Flood Data CD, September 1996. The floodplain boundaries are considered to be a "best representation," but are not intended for engineering or insurance purposes and do not supplant on-site surveys to determine flood hazard areas.

   The existing developed land covers (residential, commercial, industrial, institutional, etc.) intersected by the flood hazard areas were selected and are displayed to illustrate developed areas that may be impacted by flooding.

8. **Obstructions:** Bridges, culverts, and pipes that convey streams and tributaries under roads, railroads, and other similar infrastructure are referred to as obstructions. The obstruction locations and attribute information (size and shape) for the Crum Creek watershed were obtained by Borton-Lawson through field work. Borton-Lawson personnel toured the watershed taking note of watercourses, then plotting the locations where streams and tributaries transected roads and railroads. The bridges, culverts and pipes were measured and the data was compiled in the GIS for processing and modeling.

9. **Problem Areas:** Stormwater problems include flooding, erosion, sedimentation, landslides, groundwater impacts, pollution, and other potential issues. Data on the location of these problems in the watershed was collected by the municipalities within the watershed and provided to Borton-Lawson for plotting and incorporation into the watershed GIS. The municipalities were provided a topographic map of their township or borough and a set of forms. They identified and plotted the locations of the known problem areas on paper maps or in digital format and completed the forms that describe the problems at each location.

   Borton-Lawson compiled the data from the municipalities and created a data layer to illustrate problem areas throughout the watershed.

10. **Stormwater Management Facilities:** Stormwater management facilities may include detention/retention basins, swales, underground storage, and constructed wetlands. These types of facilities were also identified, plotted, and described on forms by the municipalities.

    As with the problem area data, municipal stormwater management facilities information was compiled by Borton-Lawson and converted into GIS format. Some municipalities submitted storm sewer maps, which enabled Borton-Lawson to illustrate the areas of these townships and boroughs that are served by storm drains.

11. **Stormwater Sewer System Outfalls:** Municipalities in urban areas (as defined by the US Census Bureau) are required to map the location of storm sewer outfalls as part of the PADEP Municipal Separate Storm Sewer System (MS4) program. This information was collected by the municipalities and the County and provided to Borton-Lawson for inclusion in the GIS.

C. Topography and Streambed Profile

Crum Creek begins in the Piedmont Uplands physiographic region in an area characterized by moderate to low hills, narrow steep valleys, and steep to moderate slopes. After passing through the Piedmont region, it crosses through the Coastal Plain province before emptying into the Delaware River, located along the southern border of Delaware County. The velocity gradient of flow within the creek decreases when passing from the Piedmont region to the Coastal Plain. As the lower portion of the creek is located within the coastal plain and discharges directly into the Delaware River, the lower portion of the stream is affected by tidal influences. The developed nature of the watershed has been the cause of recent flooding due to the impervious areas preventing the rainwater from percolating into the ground and causing rapid runoff. The highest point in the watershed is in Willistown Township with an elevation of approximately 604 feet above sea level. The lowest elevations, approximately 10 feet above sea level, are found along Crum and Little Crum Creeks near where the two creeks meet and at the confluence of Crum Creek and the Delaware River. The average channel slope is approximately 23 feet per mile (0.44%). The Digital Elevation Model (DEM) for the watershed is displayed in Map III-2.

D. Soils

The NRCS State Soil Geographic (STATSGO) database is compiled by generalizing more detailed soils survey maps, such as a County Soils Survey. Map unit composition for a STATSGO map is determined by transecting or sampling areas on the more detailed maps and expanding the data statistically to characterize the whole map unit. A generalized soils group can consist of up to 21 different soil components, so the naming convention is typically based upon the three largest components that make up the group. In the Crum Creek watershed, three generalized soil groups were identified. The most common soil association within the watershed, found predominantly in the northern half,

is the *Neshaminy-Lehigh-Glenelg Association*. This group accounts for approximately 17.5 square miles, or close to 46%, of the watershed. The *Chester-Glenelg-Manor Association* is the second most dominant soil type, occupying about 15 square miles or roughly 40% of the watershed. Below are listings of the three generalized soils groups within the watershed and a description of the three largest components. The distribution of the generalized soil groups in the Crum Creek watershed is shown in Map III-3.

1. **Chester-Glenelg-Manor (PA061)**

CHESTER	-	The Chester series consists of very deep, well drained, moderately permeable soils on uplands. They formed in materials weathered from micaceous schist. Slopes range from 0 to 65 percent.
GLENELG	-	The Glenelg series consists of very deep, well drained, moderately permeable soils on uplands formed in residuum weathered from micaceous schist. Slopes range from 0 to 55 percent.
MANOR	-	The Manor series consists of very deep, well drained to somewhat excessively drained, moderately permeable soils on uplands. They formed in materials weathered from micaceous schist. Slopes range from 0 to 65 percent.

2. **Neshaminy-Lehigh-Glenelg (PA062)**

NESHAMINY	-	The Neshaminy series consists of deep and very deep, well drained soils formed in materials weathered from diabase and other dark colored basic rocks. Permeability is moderately slow.
LEHIGH	-	The Lehigh series consists of deep, moderately well and somewhat poorly drained soils formed in residuum from metamorphosed sandstone and shale. Slopes range from 9 to 25 percent.
GLENELG	-	The Glenelg series consists of very deep, well drained, moderately permeable soils on uplands formed in residuum weathered from micaceous schist. Slopes range from 0 to 55 percent.

3. **Urban Land-Westbrook-Pits (PA072)**

URBAN LAND	-	Urban land is a nearly level to moderately steep mixture of soils, rock, and miscellaneous manmade material. It is in industrial, commercial, and some residential areas where urban structures and works so obscure the land surface that identification of the soils is not practical. Most areas are on

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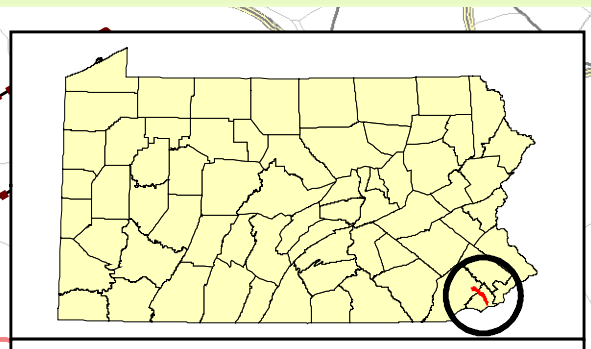

TREDYFFRIN
MALVERN
EASTTOWN
MONTGOMERY COUNTY
DELAWARE COUNTY
Crum Creek
West Branch Crum Creek
WILLISTOWN
NEWTOWN
Lewis Run
Reese Run
Preston Run
Hunter Run
Trout Run
MARPLE
CHESTER COUNTY
DELAWARE COUNTY
EDGMONT
Springton Reservoir
UPPER PROVIDENCE
Hotland Run
SPRINGFIELD
MEDIA
MORTON
Dicks Run
SWARTHMORE
RUTLEDGE
Little Crum Creek
NETHER PROVIDENCE
RIDLEY
RIDLEY PARK
EDDYSTONE
Delaware River
PENNSYLVANIA
NEW JERSEY
30
252
3
1
420
320
476
95
291
13

ELEVATION (Feet)

High : 604 ft

Low : 10 ft

1.25 0.625 0 1.25

1 Inch = 1.25 Miles

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MAP III-2: DIGITAL ELEVATION MODEL (DEM)

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Legend

- WATERSHED BOUNDARY
- COUNTY BOUNDARIES
- MUNICIPAL BOUNDARIES
- SURFACE WATER
- WATERWAYS

Roads

- INTERSTATE
- US HIGHWAY
- PA HIGHWAY
- OTHER STATE ROADS

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Municipalities - PennDOT, 2001
Streams - PaDEP/ERRI, 2001
Lakes - Aqua America, 2001
Delaware River - USFWS (derived from NWI coverages)
Digital Elevation Model - USGS

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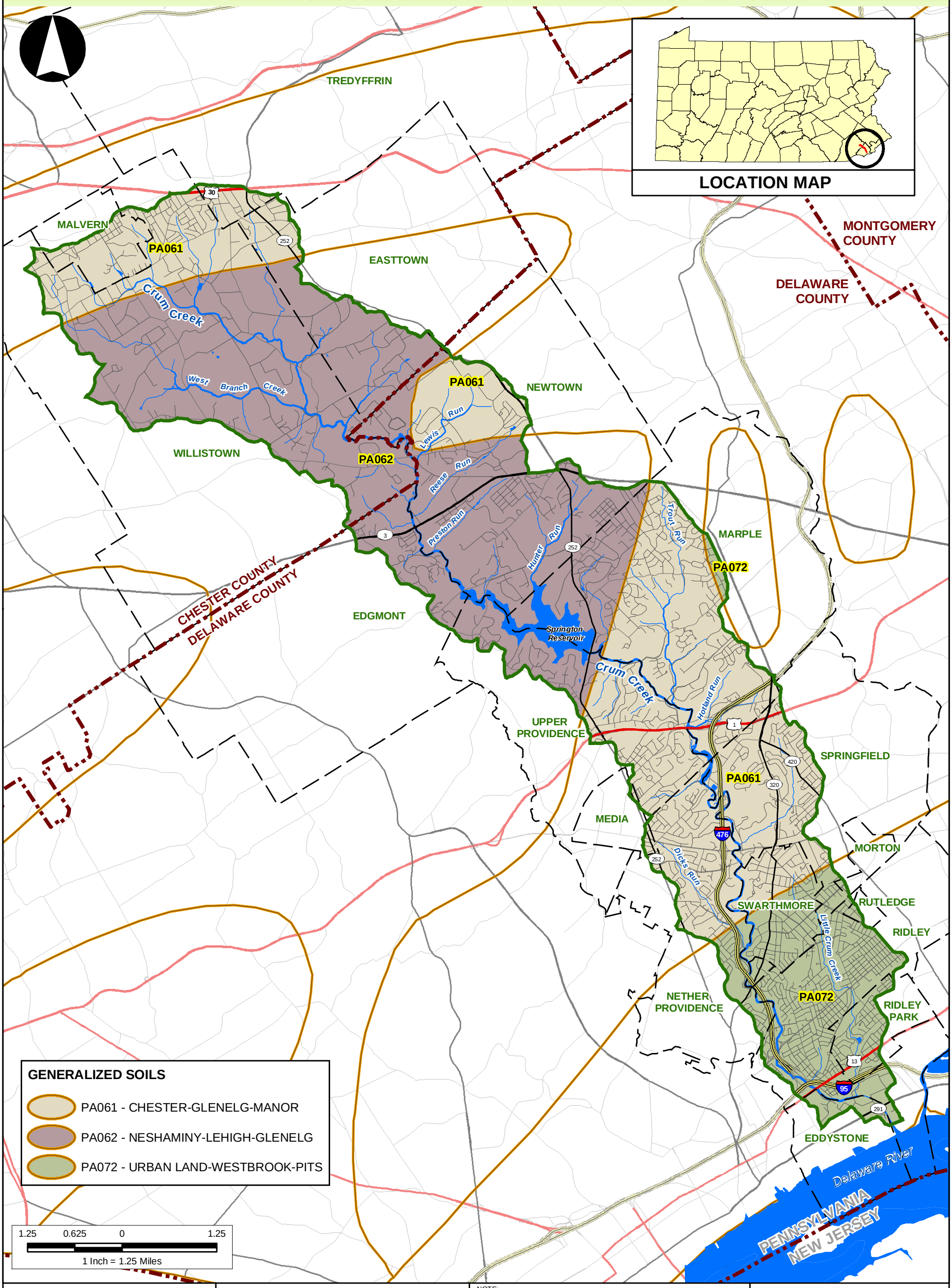

MAP III-3: GENERALIZED SOILS

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Courthouse & Government Center
201 West Front Street
Media, PA 19063
610-891-5200

Legend

- WATERSHED BOUNDARY
- COUNTY BOUNDARIES
- MUNICIPAL BOUNDARIES
- SURFACE WATER
- STREAMS
- REGIONAL GENERALIZED SOILS

Roads

- INTERSTATE
- US HIGHWAY
- PA HIGHWAY
- OTHER ROADS

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Streams - PaDEP/ERRI, 2001
Lakes - Aqua America, 2001
Delaware River - USFWS (derived from NWI coverages)
Generalized Soils - United States Department of Agriculture
State Soil Geographic (STATSGO) Database

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uplands or terraces, but some are on floodplains. In many places the original soil profile has been completely modified.

WESTBROOK - The Westbrook series consists of very deep, very poorly drained soils formed in organic deposits over loamy mineral material. They are in tidal marshes subject to inundation by water twice daily. Saturated hydraulic conductivity is moderately high to very high in the organic layers and low to high in the underlying mineral sediments. Mean annual temperature is about 50 degrees F, and mean annual precipitation is about 45 inches.

PITS - The Pits series consists of very deep, poorly drained soils that formed in fine-textured alluvium weathered from extrusive and basic igneous rocks. Pit soils are on floodplains and in basins. Slopes range from 0 to 5 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 47 degrees F.

Soil properties influence the runoff generation process. The NRCS has established a criterion for determining how soils will affect runoff by placing all surface horizon soils into four Hydrologic Soil Groups (HSGs) A through D, based on infiltration rate and depth. Hydrologic soil group A characteristics, which have a high infiltration rate and therefore low runoff potential, are minimal in the watershed and mostly found along Crum Creek and its tributaries. The majority of the surface horizon soils in the Crum Creek watershed are classified as group B. Group B is characterized as having moderate infiltration rates. It consists primarily of moderately deep to deep, moderately well to well drained soils that exhibit a moderate rate of water transmission. Group C soils are found throughout the watershed, though mostly in the very southern portion. Group C soils have slow infiltration rates when thoroughly wetted and contain fragipans, a layer that impedes downward movement of water and produces a slow rate of water transmission. Found predominantly along Crum Creek and its tributaries, group D soils are tight, low permeable soils with high runoff potential and typically clay soils. This information was incorporated into GIS and, from this, the watershed HSG map was developed as shown in Map III-4.

E. Geology

Geology plays a direct role in surface runoff to the Crum Creek watershed because it affects its soil types within the watershed through parent material breakdown. The three major geologic formations in the Crum Creek watershed are the Wissahickon Formation (approximately 31%), Felsic gneiss (almost 18%) and Felsic and intermediate gneiss (almost 15%). The Wissahickon Formation is found predominantly in the southern half of the watershed while the Felsic gneiss and Felsic and intermediate gneiss are located in the northern portion. These three metamorphic geologic formations have undergone severe deformation, which causes extensive fracturing and chemical weathering of the rock into saprolite overburden.

The saprolite regolith, containing various metal oxidative states, has much clay and silt, which can form impermeable layers. The impermeable layers coupled with extensive fracturing in many different directions forms an anisotropic system that can cause variable waterflow. Seasonally high water tables can be mounded at different points in the aquifer as a result of the anisotropic system, which can affect stormwater BMP performance. There is no carbonate (limestone and dolomite) surface geology in the Crum Creek watershed, and there are no sinkholes listed in the DCNR Sinkhole Inventory for this area. The geologic map of the watershed can be found in Map III-5. The following descriptions of geologic formations in the watershed are modified from Berg, T. M., Geyer, A. R., Edmunds, W. E., and others, compilers of the 1980 *Geologic Map of Pennsylvania*, Pennsylvania Geological Survey, 4th ser., Map 1. Criteria and standards should reflect implications of geology.

1. **"Glenarm Wissahickon" formation (Xgw) -** Lithologically similar to oligoclase-mica schist of the Wissahickon Formation (Xw) described below, but also includes lenticular amphibolite bodies having ocean-floor basalt chemistry.

2. **Bryn Mawr Formation (Tbm)** - High-level terrace deposits; reddish-brown gravelly sand and some silt. Age uncertain.

3. **Diabase (Jd) -** Medium to coarse grained, quartz-normative tholeiite; composed of labradorite and various pyroxenes; occurs as dikes, sheets, and a few small flows. Includes the dark-gray York Haven Diabase (high titanium oxide) and the slightly younger Rossville Diabase (low titanium oxide). In chilled margins, the Rossville is distinguished from the York Haven by its lighter gray color and distinctive, sparse, centimeter-sized calcic-plagioclase phenocrysts.

4. **Felsic and intermediate gneiss (fgh) -** Light, medium grained; includes rocks of probable sedimentary origin.

5. **Felsic gneiss (fgp) -** Light, medium grained; includes rocks of probable sedimentary origin.

6. **Granitic gneiss and granite (Xgr)** - Includes Springfield Granodiorite (granitized Wissahickon) in Philadelphia area.

7. **Mafic gneiss (mgp) -** Dark, medium grained; includes rocks of probable sedimentary origin; may be equivalent to "Xmgp" in places.

8. **Mafic gneiss- metagabbro (Xmgh)** - Dark, medium grained; includes rocks of probable sedimentary origin; may be equivalent to "mgh" in places.

9. **Octoraro Formation (Xo) -** Includes albite-chlorite schist, phyllite, some hornblende gneiss, and granitized members.

CRUM CREEK
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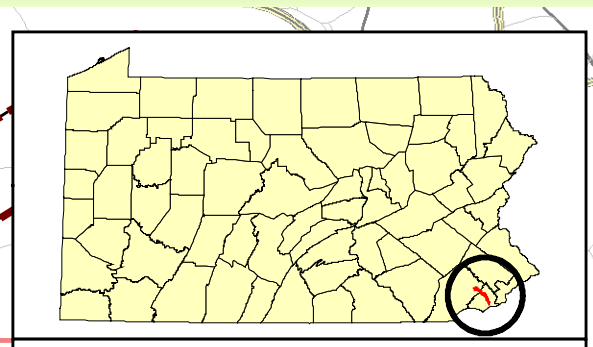

TREDYFFRIN
MALVERN
EASTTOWN
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DELAWARE COUNTY
NEWTOWN
WILLISTOWN
CHESTER COUNTY
DELAWARE COUNTY
EDGMONT
MARPLE
UPPER PROVIDENCE
SPRINGFIELD
MEDIA
MORTON
SWARTHMORE
RUTLEDGE
RIDLEY
NETHER PROVIDENCE
RIDLEY PARK
EDDYSTONE
Crum Creek
West Branch Creek
Lewis Run
Reese Run
Preston Run
Hunter Run
Trout Run
Springton Reservoir
Crum Creek
Hotlandi Run
Dicks Run
Little Crum Creek
Delaware River
PENNSYLVANIA
NEW JERSEY
30
252
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95
291

HYDROLOGIC SOIL GROUPS

- A -High Infiltration Rate (Low Runoff Potential)
- B - Moderate Infiltration Rate
- C - Low Infiltration Rate
- D - Very Low Infiltration Rate (High Runoff Potential)
- W - Water

1.25 0.625 0 1.25

1 Inch = 1.25 Miles

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MAP III-4: HYDROLOGIC SOIL GROUPS

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Legend

- WATERSHED BOUNDARY
- COUNTY BOUNDARIES
- MUNICIPAL BOUNDARIES
- SURFACE WATER
- STREAMS

Roads

- INTERSTATE
- US HIGHWAY
- PA HIGHWAY
- OTHER ROADS

NOTE:
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State Roads - PennDOT, 2004
Local Roads - PennDOT, 2001
Counties - PennDOT, 2002
Municipalities - PennDOT, 2001
Streams - PaDEP/ERRI, 2001
Lakes - Aqua America, 2001
Delaware River - USFWS (derived from NWI coverages)
Soils - United States Department of Agriculture/Natural Resources Conservation Service - HSG values derived from NASIS databases

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CRUM CREEK
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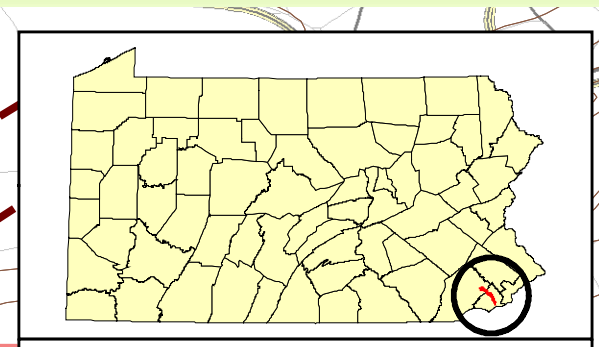

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NEWTOWN
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RIDLEY
RIDLEY PARK
NETHER PROVIDENCE
EDDYSTONE
MONTGOMERY COUNTY
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Trout Run
Springton Reservoir
Hotland Run
Dicks Run
Little Crum Creek
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Geologic Formations

- Formation Boundaries
- Xgw - "Glenarm Wissahickon" formation (oligoclase-mica schist)
- Tbm - Bryn Mawr Formation
- Jd - Diabase
- fgh - Felsic and intermediate gneiss
- fgp - Felsic gneiss
- Xgr - Granitic gneiss and granite
- mgp/ mgh - Mafic gneiss
- Xmgh - Mafic gneiss (metagabbro)
- Xo - Octoraro Formation (albite chlorite schist)
- Tpb - Pensauken and Bridgeton Formations, undifferentiated
- Qt - Trenton Gravel
- Xu - Ultramafic rocks (serpentinite)
- Xw - Wissahickon Formation

1.25 0.625 0 1.25
1 Inch = 1.25 Miles

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MAP III-5: GEOLOGY

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Legend

- WATERSHED BOUNDARY
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- STREAMS
- SURFACE WATER

Roads

- INTERSTATE
- US HIGHWAY
- PA HIGHWAY
- OTHER ROADS

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Lakes - Aqua America, 2001
Delaware River - USFWS (derived from NWI coverages)
Geology - PA Dept of Conservation and Natural Resources:
PA Geologic Survey, 2001

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10. **Pensauken and Bridgeton Formations, undifferentiated (Tpb)** - Dark-reddish-brown, cross-stratified, feldspathic quartz sand and some thin beds of fine gravel and rare layers of clay or silt. These poorly sorted sediments cause flow variation in space. Sediment destabilization from increased stormwater peak rates and volume could occur at variable locations within the formation as a result of this heterogeneous system.

11. **Trenton Gravel (Qt)** - Gray or pale-reddish-brown, very gravelly sand interstratified with crossbedded sand and clay-silt beds; includes areas of Holocene alluvium and swamp deposits. These poorly sorted sediments cause flow variation in space. Sediment destabilization from increased stormwater peak rates and volume could occur at variable locations within the formation as a result of this heterogeneous system.

12. **Ultramafic rocks (Xu) -** Includes serpentine, steatite, and other products of alteration of peridotites and pyroxenites.

13. **Wissahickon Formation (Xw) -** Includes oligoclase-mica schist, some hornblende gneiss, some augen gneiss, and some quartz-rich and feldspar-rich members due to various degrees of granitization.

F. Climate

The Crum Creek watershed has a temperate and somewhat humid climate in which the temperature is moderated by the presence of the Atlantic Ocean to the east. This means that the temperature is slightly warmer during the winter months in comparison to other parts of the state. The watershed experiences an average annual temperature of about 52 degrees Fahrenheit and an average annual precipitation of approximately 48 inches. Winds from the west are usually prevailing and typically bring storm fronts through the area.

During the winter months (December through February), the average temperature is around 32 degrees F and the average precipitation is about 11.15 inches. Fluctuations during dry and wet years are not noticeably extreme. Spring months (March through May) bring moderate average temperatures of 50.1 degrees and precipitation levels of 11.95 inches. The average precipitation during the spring months for a very wet year (1889) is 16.68 inches and 6.20 inches for a considerably dry year (1941). Average summer (June through August) temperatures are 72.1 degrees F and average precipitation values are about 13.76 inches. Somewhat more extreme fluctuations seem to exist during the summer months, in which the wettest year precipitation average is over 22 inches and the driest year precipitation level is just over 10 inches. As the year enters the fall season (September through November), moderate temperatures and precipitation levels are prevalent. The average temperature is 54.7 degrees F and the average precipitation is 11 inches.

The watershed experiences an average frost-free period of 190 days. The first and last frost days are usually October 23 and April 16, respectively. Although abundant moisture levels occur throughout the year, local periods of drought have been recorded, which can devastate crops and put pressure on the municipalities' water supply.

G. Land Cover

The landscapes of the Crum Creek watershed vary from agricultural to highly suburbanized. While much of the northern portion (headwaters) of the Crum Creek watershed lies within Chester County, the majority of the watershed lies within Delaware County. Generally speaking, the central to lower portions of the watershed can be characterized as densely developed with a high degree of suburbanization. Most of the upper portions of the watershed can be characterized as mildly suburbanized.

The predominant land cover in the Crum Creek watershed is classified as residential (48.2%). Approximately 31.2% of the watershed is undeveloped land (agriculture, forest, meadow, etc.) and 6% is classified as open space (parks, cemeteries, golf courses, etc.). The remaining land is mostly classified as commercial, industrial, and institutional. A total of 3.5% of the watershed's land area is classified as "paved," including portions of I-95 and I-476 and a few large parking areas. This percentage does not include other smaller roads or driveways. Map III-6 displays the existing land cover of the watershed while Table III-2 details land cover by category within the Crum Creek watershed.

TABLE III-2
Land Cover by Category

Land Cover	Square Miles	Percent
Agricultural	2.45	6.4
Commercial	1.25	3.3
Farmstead	.10	.3
Forest	8.99	23.5
Industrial	.33	.9
Institutional	1.00	2.6
Meadow	.48	1.3
Mining	.01	.0
Open Space/ Recreation	2.31	6.0
Open Water	.81	2.1
Orchard	.04	.1
Pasture	.71	1.8
Paved/ Concrete/ Compacted Soil	1.39	3.5
(Residential-R1) (1 to 4 acres)	7.11	18.5
(Residential-R2) (1/3 to 1 acre)	5.31	13.9
(Residential-R3) (1/8 to 1/3 acre)	5.25	13.7
(Residential-R4) (1/8 acre or less)	.79	2.1
Total:	**38.33**	**100.0**

Source: Borton-Lawson, 2008

CRUM CREEK
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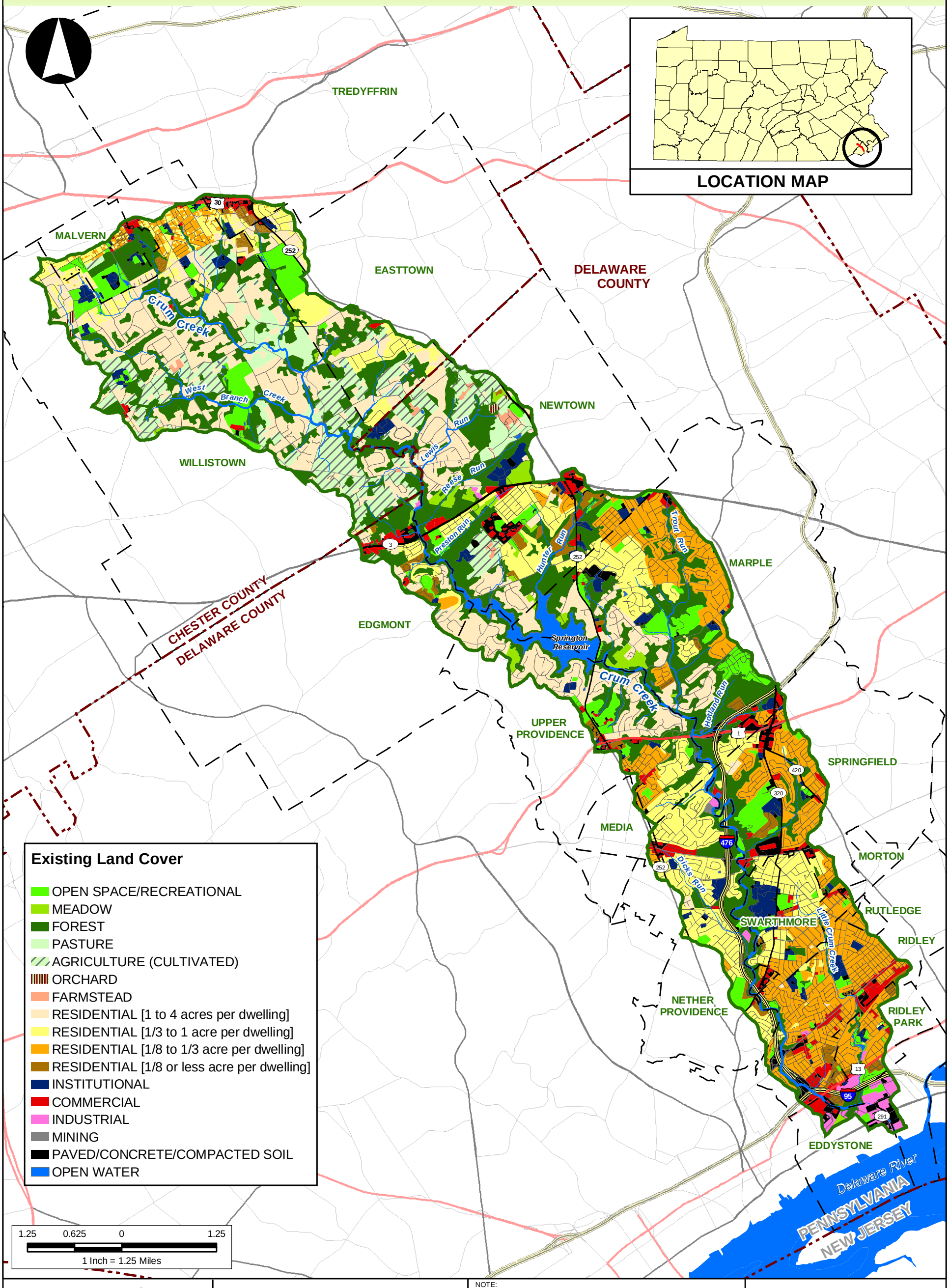

MAP III-6
EXISTING LAND COVER

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Legend

- WATERSHED BOUNDARY
- MUNICIPAL BOUNDARIES
- COUNTY BOUNDARIES
- STREAMS

Roads

- INTERSTATE
- US HIGHWAYS
- PA HIGHWAYS
- OTHER ROADS

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Local Roads - PennDOT, 2001
Counties - PennDOT, 2002
Municipalities - PennDOT, 2001
Streams - PaDEP/ERRI, 2001
Delaware River - USFWS (derived from NWI coverages)
Existing Land Cover- Derived from 2000 DVRPC Land Cover
Edited by Chester County and Delaware County, 2005

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In summary, the watershed is primarily developed, especially in the southern portion. The portion of the watershed within Chester County is only about half developed, while the large majority of the watershed that lies within Delaware County is developed. The undeveloped areas in the Chester County portion are scattered throughout; in contrast, most of the undeveloped land in the Delaware County portion is found along Crum Creek and its tributaries.

H. Land Development Patterns

There is currently little developable land remaining in the watershed. Zoning maps and input from the Delaware County Planning Department and Chester County Planning Commission were used to describe the future land development/growth pattern for the watershed. The majority (approximately 69%) of new development is anticipated to be single-family dwellings with lot sizes greater than one acre. This type of development is expected to occur throughout the watershed, primarily in the upper portion. The second largest impact (approximately 15%) comes from institutional development and is expected to occur in Malvern Borough, Willistown Township, and Newtown Township. Residential areas with dwellings between 1/3 of an acre to one-acre account for about 8.9 % of future predicted development within the watershed.

Table III-3 provides an overview of projected development based on a future land cover scenario developed through the use of zoning maps, local comprehensive plans, and by developing land cover growth trends. The future land cover map is shown in Map III-7. These increased impervious areas were included in the HEC-HMS to develop future condition flows for the 100-year storm. A comparison of peak flows for the 100-year storm for future and existing conditions can be found in Table III-4.

The future 100-year storm hydrograph peak was found to be an average of ***100.2%*** of the present 100-year storm hydrograph on Crum Creek. Table III-4 summarizes the flows for each subwatershed for existing conditions and future land cover projections, assuming proper stormwater management facilities are not installed. Increased development in a watershed increases runoff peaks, volumes, and velocities; this decreases the time to peak, increasing the frequency of flooding.

I. Present (Existing) and Projected Development in the Flood Hazard Areas

The U.S. Department of Housing and Urban Development, Federal Insurance Administration, Federal Emergency Management Agency (FEMA) prepares Flood Insurance Studies (FISs) and floodplain mapping for the municipalities in the Crum Creek watershed. This activity is now a responsibility of the U.S. Department of Homeland Security. Municipalities and the Pennsylvania Department of Community and Economic Development (PADCED) should be contacted as to the latest FIS studies before use.

TABLE III-3
Development Potential by Municipality
Based Upon Existing Patterns in the Crum Creek Watershed

Municipality	AG	CO	FM	FO	IN	IS	MI	MW	OR	OS	PA	PS	R1	R2	R3	R4	WA
Easttown Township	r	-	-	r	-	-	-	-	-	r	-	r	X	-	-	-	-
Eddystone Borough	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Edgmont Township	-	-	-	r	-	-	-	r	-	-	-	-	X	-	-	-	-
Malvern Borough	-	-	-	r	-	X	-	-	-	r	-	-	-	O	-	-	-
Marple Township	-	-	-	r	-	X	-	-	-	r	-	-	X	X	-	-	-
Media Borough	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Morton Borough	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nether Providence Twp	-	-	-	-	-	-	-	-	-	r	-	-	X	-	-	-	-
Newtown Township	r	X	-	r	X	X	-	r	r	r	-	r	X	X	O	X	-
Ridley Park Borough	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ridley Township	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rutledge Borough	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Springfield Township	-	-	-	r	-	-	-	-	-	r	-	-	X	-	-	-	-
Swarthmore Borough	-	-	-	r	-	-	-	-	-	r	-	-	X	-	-	-	-
Tredyffrin Township	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Upper Providence Twp	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-
Willistown Township	r	-	-	r	-	X	-	r	r	r	O	r	-	-	O	X	-

Land Use
AG - Agriculture
CO - Commercial
FM - Farmstead
FO - Forest
IN - Industrial
IS - Institutional
MI - Mining
MW - Meadow
OR - Orchard
OS - Open Space
PA - Paved
PS - Pasture
R1 - Residential (1 - 4 acres per dwelling)
R2 - Residential (1/3 - 1 acre per dwelling
R3 - Residential (1/8 - 1/3 acre per dwelling)
R4 - Residential (1/8 or less acre per dwelling)
WA - Water

Impact Level
- No Impact: No change in area between future land cover and existing land cover
O Minor Impact: Total area increased between 0–15 percent between future and existing land cover.
X Major Impact: Total area increased for future land cover > 15 percent from existing land cover.
r Reduction in land cover: Total area reduced in between future and existing land cover.

Source: Borton-Lawson, 2008

CRUM CREEK
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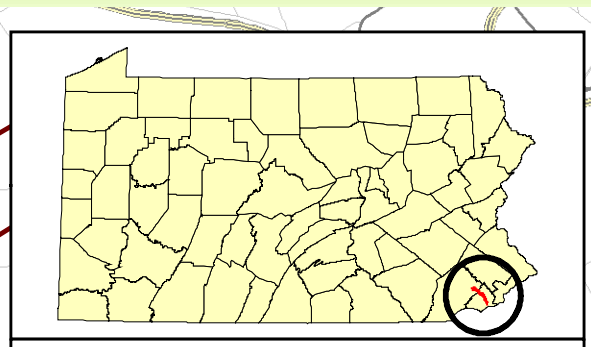

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Trout Run
Springton Reservoir
Holland Run
Dicks Run
Little Crum Creek
Delaware River
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Future Land Cover

- OPEN SPACE/ RECREATION
- MEADOW
- FOREST
- PASTURE
- AGRICULTURE (CULTIVATED)
- ORCHARD
- FARMSTEAD
- RESIDENTIAL [1 to 4 acres per dwelling]
- RESIDENTIAL [1/3 to 1 acre per dwelling]
- RESIDENTIAL [1/8 to 1/3 acre per dwelling]
- RESIDENTIAL [1/8 or less acre per dwelling]
- INSTITUTIONAL
- COMMERCIAL
- INDUSTRIAL
- MINING
- PAVED/CONCRETE/COMPACTED SOIL
- OPEN WATER

1.25 0.625 0 1.25

1 Inch = 1.25 Miles

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MAP III-7
FUTURE
LAND COVER

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Legend

- WATERSHED BOUNDARY
- MUNICIPAL BOUNDARIES
- COUNTY BOUNDARIES
- STREAMS

Roads

- INTERSTATE
- US HIGHWAY
- PA HIGHWAY
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DATE: 4/23/2007 PROJECT #: 2004-1553-00

TABLE III-4
Present (Existing) Versus Future Combined Peak Flows –
100-Year 24-Hour Storm
(Please refer to Appendix A of the Model Ordinance (found in Plan Appendix 3) for Subarea Locations)

Subarea No.	Subarea Area (sq. mi.)	Existing Peak Q (cfs)	Future Peak Q (cfs)
50	1.1	1010	1019
51	2.0	1357	1468
52	1.6	1017	1020
53	0.7	499	499
54	1.4	884	884
55	1.1	710	713
56	0.5	598	600
57	1.5	877	883
58	1.3	1205	1215
59	0.7	584	584
60	2.0	1708	1708
61	1.9	2525	2759
62	1.2	1004	1067
63	1.6	1340	1377
64	0.8	579	603
65	3.0	5356	5369
66	2.8	1506	1514
67	1.1	755	755
68	2.3	2222	2254
69	1.3	1193	1196
70	1.4	1752	1756
71	0.9	1115	1117
72	0.9	625	625
73	0.8	738	739
74	0.3	311	311
75	1.3	1143	1144
76	0.4	823	823
77	1.2	875	876
78	1.1	1194	1194
79	0.2	339	339

Note: The computed flow values were derived for watershed planning purposes and should not be considered regulatory values for permitting purposes. While they may be used for comparison or checking purposes, additional hydrologic computations may be needed for the design of bridges, culverts and dams.

Source: Borton-Lawson, 2008

There are two types of studies conducted in the FIS program: detailed and approximate. Detailed methods included hydrologic computations and detailed HEC-2 or HEC-RAS backwater computations. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction. Areas studied by the approximate methods were areas having low development potential or minimal flood hazards.

Map III-8 shows the 100-year floodplains classified as detailed and approximate as taken from the 1993 FEMA mapping for the Crum Creek watershed. Encroachments of residential, industrial, and commercial land covers are shown by overlaying these areas on the floodplain maps in the GIS. Approximately 1,999 acres (8.2% of the watershed) are within floodplains. Of these 1,999 acres, 486 are developed. The remainder is agriculture, forest, meadow, open space, or water. Table III-5 provides a summary of the total amount of developed floodplain area. (Note: New FEMA maps were released in 2009; they should be used for all future stormwater calculations and plans.)

The overall evaluation of the municipal questionnaires received shows several occurrences of stream flooding throughout the watershed during major storm events, resulting in both private and public property damages, as discussed in Section III-K.

Stormwater management planning is critical in the areas both affected and currently unaffected by stormwater problems in the Crum Creek watershed. For areas that are currently being affected, the frequency of flooding is mainly during larger storm events. The Act 167 plan can significantly address future, more frequent flooding problems in these areas by managing runoff from newly developing areas. This plan provides watershed communities with information essential in evaluating and upgrading current undersized stormwater systems as indicated in Section III-K.

TABLE III -5
Summary of the Total Amount of Developed Floodplain Area

Existing Land Cover	Acres in Floodplain	Square Miles in Floodplain
Commercial	38.4	0.06
Industrial	32.0	0.05
Institutional	6.4	0.01
Paved	70.4	0.11
R1	179.2	0.28
R2	102.4	0.16
R3	38.4	0.06
R4	19.2	0.03
TOTAL	**486.4**	**0.76**

Source: Borton-Lawson, 2008

For areas currently unaffected by stormwater problems, the Act 167 plan provides controls on future development to aid in preventing future stormwater runoff problems.

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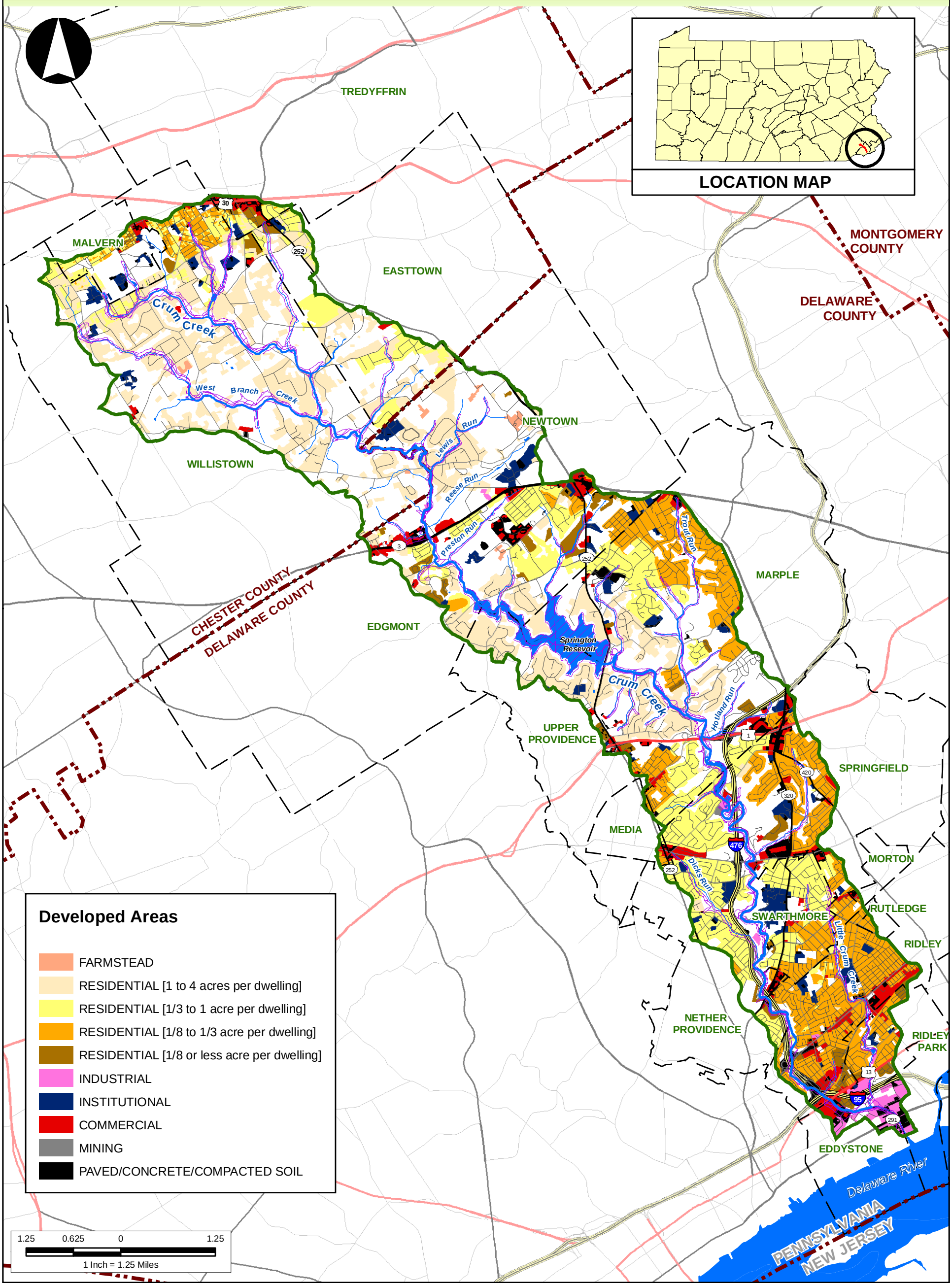

Developed Areas

- FARMSTEAD
- RESIDENTIAL [1 to 4 acres per dwelling]
- RESIDENTIAL [1/3 to 1 acre per dwelling]
- RESIDENTIAL [1/8 to 1/3 acre per dwelling]
- RESIDENTIAL [1/8 or less acre per dwelling]
- INDUSTRIAL
- INSTITUTIONAL
- COMMERCIAL
- MINING
- PAVED/CONCRETE/COMPACTED SOIL

1.25 0.625 0 1.25

1 Inch = 1.25 Miles

MAP III-8
FLOODPLAINS & DEVELOPMENT

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610-891-5200

Legend

- WATERSHED BOUNDARY
- COUNTY BOUNDARIES
- MUNICIPAL BOUNDARIES
- SURFACE WATER
- STREAMS
- FLOODPLAINS

Roads

- INTERSTATE
- US HIGHWAY
- PA HIGHWAY
- OTHER ROADS

NOTE:
Portions of this map were generated from existing data sources as listed below. These data are shown on the map for spatial reference only. These data did not enter into any computations or affect the reliability of the hydrologic analysis. Borton-Lawson Engineering has found inaccuracies in some of these data and has corrected the data in locations where discrepancies were obvious; however, it was not a part of this Act 167 plan to correct all of the mapping data errors.

DATA SOURCES:
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Municipalities - PennDOT, 2001
Streams - PaDEP/ERRI, 2001
Lakes - Aqua America, 2001
Delaware River - USFWS (derived from NWI coverages)
Floodplains - FEMA National Flood Insurance Program Q3 Flood Data CD, 1996
Existing Landuse - Derived from 2000 DVRPC Landuse
Edited by Chester County and Delaware County, 2005

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One of the biggest problems in floodplain management is the increase in peak flow caused by development in the watershed. Recognizing this, the National Flood Insurance Program (NFIP) has developed a Community Rating System (CRS) to give communities credit for floodplain management activities that exceed the minimum requirements. As part of this rating system, credit points can be awarded to communities if they voluntarily implement the following:

- regulatory language (ordinance) requiring peak rate of runoff from development to be no greater than the predevelopment runoff
- a stormwater master plan (such as this Act 167 Plan)
- state review of the stormwater management plan
- requirement for a building's lowest floor to be elevated above flood levels
- erosion and sediment control regulations (such as Chapter 102)
- water quality regulations

The more credits a community can accumulate, the less its residents will have to pay for flood insurance. For further information on the community rating system, the publication "NFIP CRS: A Local Guide to Saving Lives, Preventing Property Damage, Reducing the Cost of Flood Insurance," April 2006, published by FEMA, is available on line from FEMA.

J. Obstructions

Locations of significant waterway obstructions (i.e., culverts, bridges, etc.) were obtained by inspection of the United States Geologic Survey (USGS) topographic base map. Data on these obstructions was obtained from the Pennsylvania Department of Transportation (PennDOT), FEMA FISs, and field surveys.

The obstruction flow capacities were compared to the peak flow at that point derived through the modeling process for each design storm frequency. The obstructions were classified into seven categories as follows:

- Those obstructions which are able to pass the 100-year, 24-hour storm without obstructing the flow.

- Those obstructions which are able to pass the 50-year, 24-hour storm and greater without obstructing the flow.

- Those obstructions which are able to pass the 25-year, 24-hour storm and greater without obstructing the flow.

- Those obstructions which are able to pass the 10-year, 24-hour storm and greater without obstructing the flow.

- Those obstructions which are able to pass the 5-year, 24-hour storm and greater without obstructing the flow.

- Those obstructions which are able to pass the 2-year, 24-hour storm and greater without obstructing the flow.

- Those obstructions which are NOT able to pass the 2-year, 24-hour storm and greater without obstructing the flow.

The locations of all obstructions, including those that fall into the seven categories above, can be found in Map III-9. The obtained data and the obstruction flow capacities can be found in the Technical Appendix.

During the fieldwork phase of this project, project team members noted that there were large numbers of pipes and culverts either in disrepair or clogged to a point that the flow capacity of the pipe was reduced or completely blocked. It is recommended that municipalities take advantage of the data collected and shown in Map III-9 to rank which culverts may need repair. Municipalities should establish a program to maintain unobstructed flow on all culverts and bridges.

K. Existing Drainage Problems and Proposed Solutions

Information on drainage problems and proposed solutions was solicited from each municipality within the watershed by providing forms to each Watershed Plan Advisory Committee (WPAC) member early in the Watershed Plan study. Map III-10 shows the problem areas collected.

Table III-6 summarizes the problems discussed. These are shown graphically in Map III-10 (Problem Areas). Solutions have been proposed both formally and informally as a result of WPAC discussions.

Forty-one (41) problem areas, 7 of which are water quality problem areas, were identified in this study. The type, cause, and occurrence of these problems are indicated on Table III-6. The types of problems shown in Table III-6 typically have similar causes and solutions that are discussed below.

Erosion and Sedimentation (E&S)

The Chester and Delaware County Conservation Districts are responsible for administering PA Title 25, Chapter 102 (Erosion Control Regulation). These regulations address accelerated erosion and the resulting sedimentation from earthmoving activities. Permanent stabilization of exposed areas and proper stabilization of channels of conveyance will reduce erosion problems.

Storm Sewers, Culverts, and Outlets

Some of the problems identified in Table III-6 are the result of inadequately sized storm culverts, and/or unstable outlets that traverse state, municipal, or private roads. The

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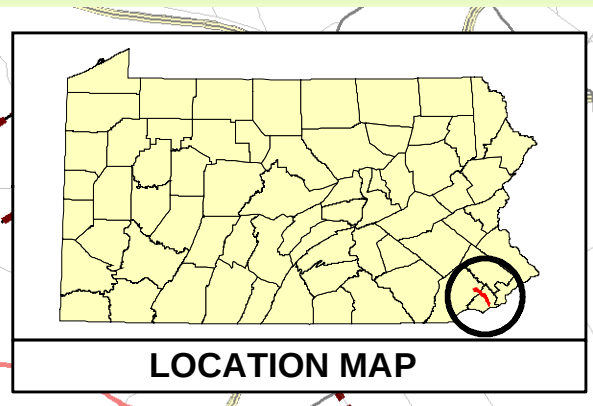

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RUTLEDGE
SWARTHMORE
RIDLEY
RIDLEY PARK
NETHER PROVIDENCE
EDDYSTONE
MONTGOMERY COUNTY
DELAWARE COUNTY
CHESTER COUNTY
PENNSYLVANIA
NEW JERSEY
Delaware River
Crum Creek
Springton Reservoir
Lewis Run
Reese Run
Preston Run
Hunter Run
Trout Run
Hotland Run
Dicks Run
Little Crum Creek

Obstructions

- Able to Pass 100-Year Storm
- Able to Pass 50-Year Storm and Greater
- Able to Pass 25-Year Storm and Greater
- Able to Pass 10-Year Storm and Greater
- Able to Pass 5-Year Storm and Greater
- Able to Pass 2-Year Storm and Greater
- Not Able to Pass 2-Year Storm and Greater
- No Data

1.25 0.625 0 1.25
1 Inch = 1.25 Miles

MAP III-9
OBSTRUCTIONS

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Legend

- WATERSHED BOUNDARY
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- MUNICIPAL BOUNDARIES
- SURFACE WATER
- BOROUGHS
- STREAMS

Roads

- INTERSTATE
- US HIGHWAY
- PA HIGHWAY
- OTHER ROADS

NOTE:
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Municipalities - PennDOT, 2001
Streams - PaDEP/ERRI, 2001
Lakes - Aqua America, 2001
Delaware River - USFWS (derived from NWI coverages)
Obstructions - Municipalities within watershed, 2004-2006

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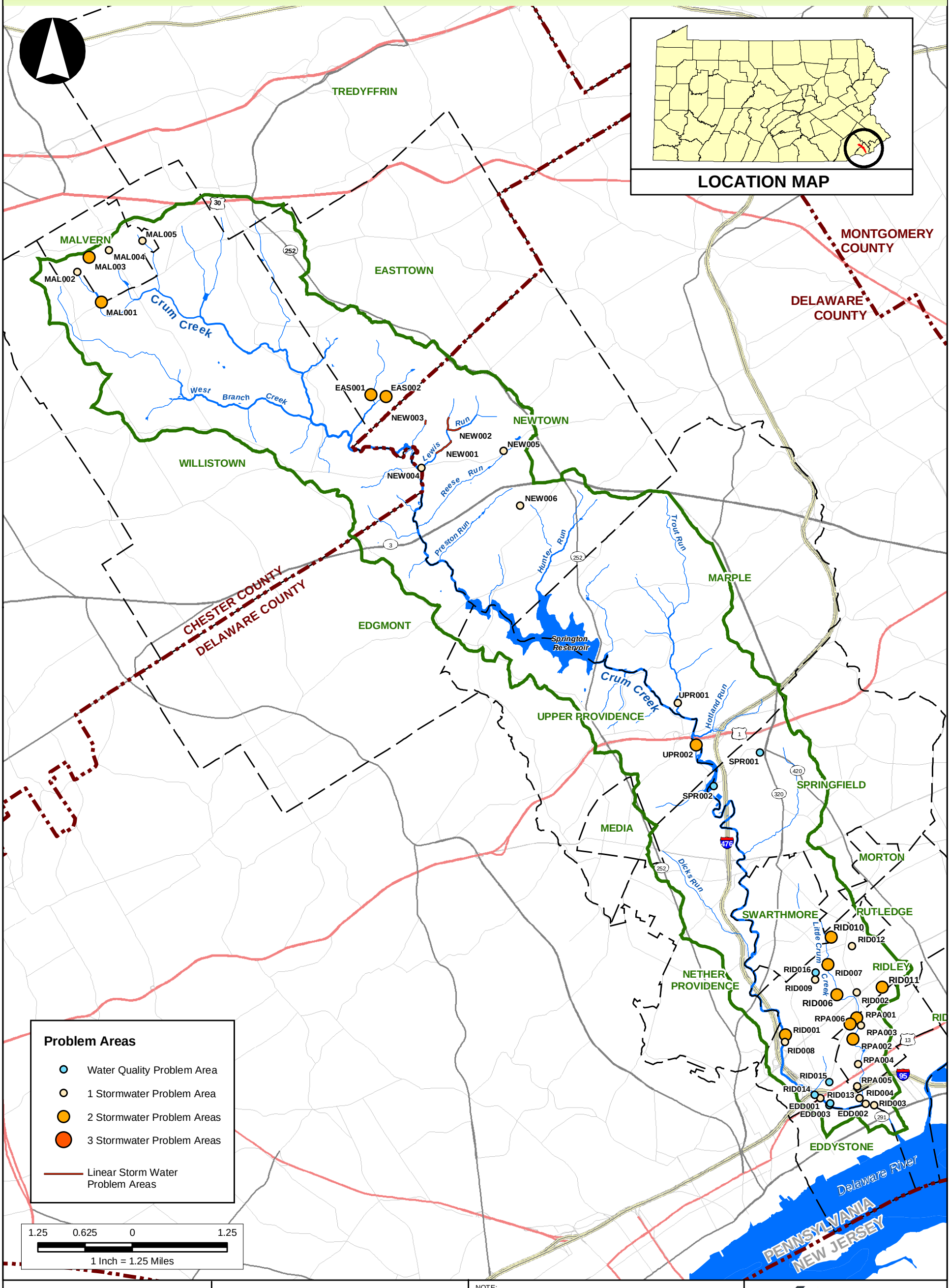

Map III-10
PROBLEM AREAS

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Legend

- WATERSHED BOUNDARY
- COUNTY BOUNDARIES
- MUNICIPAL BOUNDARIES
- SURFACE WATER
- WATERWAYS

Roads

- INTERSTATE
- US HIGHWAY
- PA HIGHWAY
- OTHER ROAD

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Municipalities - PennDOT, 2001
Streams - PaDEP/ERRI, 2001
Lakes - Aqua America, 2001
Delaware River - USFWS (derived from NWI coverages)
Problem Areas - Municipalities within watershed, 2004-2006

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typical solution involves performing a hydrologic study to determine pipe size and replacing the pipe with a properly sized unit. Costs are typically borne by the owner of the road.

TABLE III-6
Crum Creek Watershed Problems

Municipality	Type Of Problems	Causes Of Problems	Occurrences Of Problems	Types Of Damage
	(A)	(B)	(C)	(D)
Easttown Township	1, 2	4	2	-
Eddystone Borough	1	4	1	-
Edgmont Township	N/A	-	-	-
Malvern Borough	1, 2, 5	1, 2, 3, 4	2	3
Marple Township*	-	-	-	-
Media Borough	N/A	-	-	-
Morton Borough	N/A	-	-	-
Nether Providence Twp.	N/A	-	-	-
Newtown Township	1, 2	1, 2, 3, 4	2	2, 3
Ridley Park Borough	1, 2, 3, 6	1, 2, 4	2	3
Ridley Township	1, 2, 3	1, 2, 3, 4	1, 2	2, 3
Rutledge Borough	N/A	-	-	-
Springfield Township	N/A	-	-	-
Swarthmore Borough	N/A	-	-	-
Tredyffrin Township	N/A	-	-	-
Upper Providence Twp.	1, 2	1, 4	2	3
Willistown Township	N/A	-	-	-

N/A No problem areas reported
* Form received without map

Types of Problems
(A)
1. Flooding
2. Accelerated Erosion
3. Sedimentation
4. Landslide
5. Groundwater
6. Water Pollution
7. Other

Causes of Problems
(B)
1. Stormwater Volume
2. Stormwater Velocity
3. Stormwater Direction
4. Water Obstruction
5. Other

Occurrences of Problems
(C)
1. > 1 time per year
2. < 1 time per year
3. Only major flood events

Types of Damages
(D)
1. Loss of life
2. Loss of vital services
3. Property damage

Source: Borton-Lawson, 2008

Bridges

Because of the high bed loads of streams within the watershed, gravel deposits reduce the waterway opening, that in turn threatens bridge conveyance capacity. The proposed solution typically involves performing a hydrologic study and increasing the hydraulic capacity underneath the roadway. Costs are typically borne by the owner of the bridge.

Flooding

As discussed in Section III-I, Crum Creek and its tributaries experience flooding conditions. The areas within the watershed immediately adjacent to Crum Creek and various low lying wetland areas are generally subject to minor flooding after rain or thaw conditions. Flooding in the watershed can be classified into two categories: 1) local flooding caused by inadequately sized storm culverts; and 2) flooding caused by the location of structures within the floodplain of the major tributaries.

L. Existing and Proposed Stormwater Collection Systems

Based on the information in the data collection forms, supplied by the municipalities through the survey, stormwater collection systems are located throughout the Crum Creek watershed. The following municipalities have proposed stormwater collection systems: Ridley Park Borough, Ridley Township, and Springfield Township. Map III-11 shows the storm sewer areas in the watershed.

M. Existing and Proposed State, Federal, and Local Flood Control Projects

According to the information gathered from collection forms submitted by the municipalities, there are several types of existing flood control projects in the watershed. Examples include two culverts found within Newtown Township, and a culvert and channel wall are found along Crum Creek in Eddystone Borough. Riprap and a rock deflector have been installed along Little Crum Creek in Ridley Township; riprap is also found within Malvern Borough. Newtown Township has proposed a system that will discharge into wetland areas, and a floodwall is proposed in Eddystone Borough.

N. Existing and Proposed Stormwater Control Facilities

There are many known stormwater control facilities as shown in Map III-12. Based on the forms collected, there are 20 control facilities located in Malvern Borough and Easttown, Tredyffrin, and Willistown Townships in Chester County; and Edgmont, Marple, Nether Providence, Newtown, Springfield, and Upper Providence Townships in Delaware County.

There are four proposed stormwater control facilities – one in Malvern Borough, Chester County and three in Springfield Township, Delaware County.

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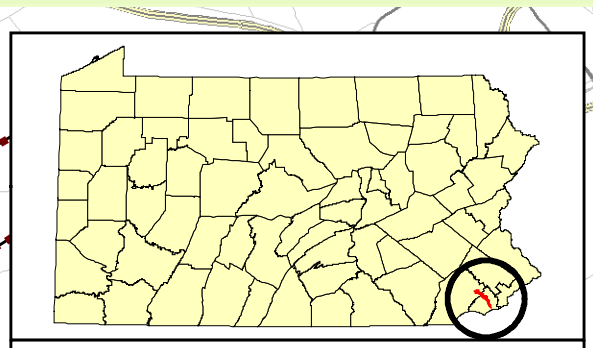

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EDGMONT
MARPLE
UPPER PROVIDENCE
SPRINGFIELD
MEDIA
MORTON
SWARTHMORE
RUTLEDGE
NETHER PROVIDENCE
RIDLEY
RIDLEY PARK
EDDYSTONE
MONTGOMERY COUNTY
DELAWARE COUNTY
CHESTER COUNTY
Crum Creek
Lewis Run
Reese Run
Preston Run
Hunter Run
Trout Run
Springton Reservoir
Hotland Run
Dicks Run
Little Crum Creek
Delaware River
PENNSYLVANIA
NEW JERSEY
30
252
3
1
420
320
476
95
13
291

1.25 0.625 0 1.25

1 Inch = 1.25 Miles

Map III-11
STORM SEWER AREAS

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Legend

- WATERSHED BOUNDARY
- COUNTY BOUNDARIES
- MUNICIPAL BOUNDARIES
- SURFACE WATER
- WATERWAYS
- AREAS SERVED BY STORM SEWERS

Roads

- INTERSTATE
- US HIGHWAY
- PA HIGHWAY
- OTHER ROADS

NOTE:
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Lakes - Aqua America, 2001
Delaware River - USFWS (derived from NWI coverages)
Storm Sewers - Municipalities within watershed

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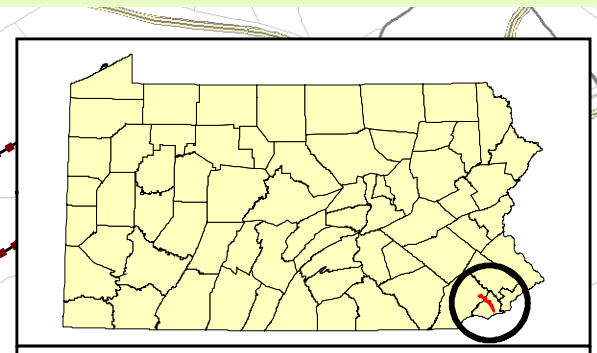

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MONTGOMERY COUNTY
DELAWARE COUNTY
CHESTER COUNTY
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Lewis Run
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Preston Run
Hunter Run
Trout Run
Hoyland Run
Dicks Run
Little Crum Creek

TRE001
MAL001
MAL002
MAL003
MAL004
MAL005
WIL002
EAS001
EAS002
EAS003
EAS004
EAS005
NEW001
NEW002
NEW003
NEW004
NEW005
NEW006
NEW007
NEW008
EDG001
UPR001
UPR002
MAR001
MAR002
SPR001
SPR002
SPR003
SPR004
SPR005
SPR006
SPR007
NPR001
RID001
RID002
RID003
EDD001
EDD002
EDD003

Flood and Stormwater Facilities

- Existing Flood Control Projects
- Proposed Flood Control Projects
- Existing Stormwater Control Facility
- Proposed Stormwater Control Facility

1.25 0.625 0 1.25

1 Inch = 1.25 Miles

Map III-12
FLOOD CONTROL AND STORMWATER FACILITIES

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Legend

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- SURFACE WATER
- STREAMS

Roads

- INTERSTATE
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- PA HIGHWAY
- OTHER STATE ROADS

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Delaware River - USFWS (derived from NWI coverages)
Stormwater Facilities - Municipalities within the watershed, 2004-2006

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There are eleven known dams in the Crum Creek watershed, according to PADEP records. The majority (9) of these dams are classified as small impoundments, which have little impact on watershed hydrology. The other two dams found in the watershed, Springton Reservoir and Crum Creek Dam, were included in the hydrologic model.

O. Wetlands

Wetlands were obtained from the National Wetlands Inventory Maps in digital format and incorporated into the overall GIS. Map III-13 shows the wetlands for the watershed.

Wetlands play an important part in flood flow attenuation and pollutant filtering. Wetlands within the watershed are primarily found along Crum Creek and its tributaries. Wetland flood flow attenuation was accounted for in the computer modeling by adjusting the stream routing time, or stream velocities, for overbank events. Wetlands should be preserved through the joint permit application process.

P. Outfalls

Mapping and documenting stormwater outfalls is a requirement of one of the six Municipal Control Measures (MCMs) itemized in the PADEP MS4 Stormwater Management Program Protocol to meet the requirements of the NPDES Phase II Program. The objective is to detect and eliminate illicit discharges from municipal storm sewers.

The municipalities within the watershed were tasked with locating the outfall locations and completing an Outfall Information Form (Form O). Information to be entered on the form included a unique identifier for the outfall, the receiving water, the municipality, basic structural information, and observations that may indicate illicit discharges (colors, odors, etc.).

Maps showing the outfall locations and the forms with the outfall information were provided to Borton-Lawson in both hard copy and digital formats. Not all municipalities submitted data. Borton-Lawson created a point shape file for each municipality showing the location of the outfalls within the watershed and compiled all the outfall information into a single database. The individual municipal shape files were merged into a single watershed-wide shape file.

The master database and watershed-wide outfall shape file were then linked to create a single GIS layer representing outfall information in the watershed. Over 300 outfalls were identified, mapped, and labeled. Maps III-14A, III-14B and III-14C show the outfall locations and IDs at a readable scale.

CRUM CREEK
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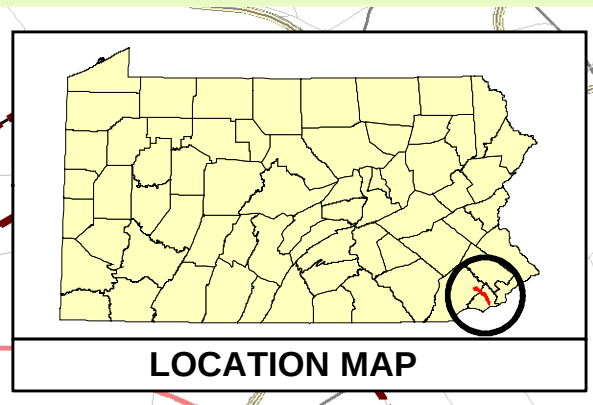

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DELAWARE COUNTY
CHESTER COUNTY
DELAWARE COUNTY
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West Branch Creek
Lewis Run
Reese Run
Preston Run
Hunter Run
Trout Run
Hotland Run
Dicks Run
Little Crum Creek
30
252
3
1
420
320
476
95
291
13

1.25 0.625 0 1.25
1 Inch = 1.25 Miles

MAP III-13: WETLANDS

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Legend

- WATERSHED BOUNDARY
- COUNTY BOUNDARIES
- MUNICIPAL BOUNDARIES
- WETLANDS
- SURFACE WATER
- STREAMS

Roads

- INTERSTATE
- US HIGHWAY
- PA HIGHWAY
- OTHER ROADS

NOTE:
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Municipalities - PennDOT, 2001
Streams - PaDEP/ERRI, 2001
Lakes - Aqua America, 2001
Delaware River - USFWS (derived from NWI coverages)
Wetlands - U.S. Fish and Wildlife Service National Wetlands Inventory

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DATE: 10/24/2006 PROJECT #: 2004-1553-00

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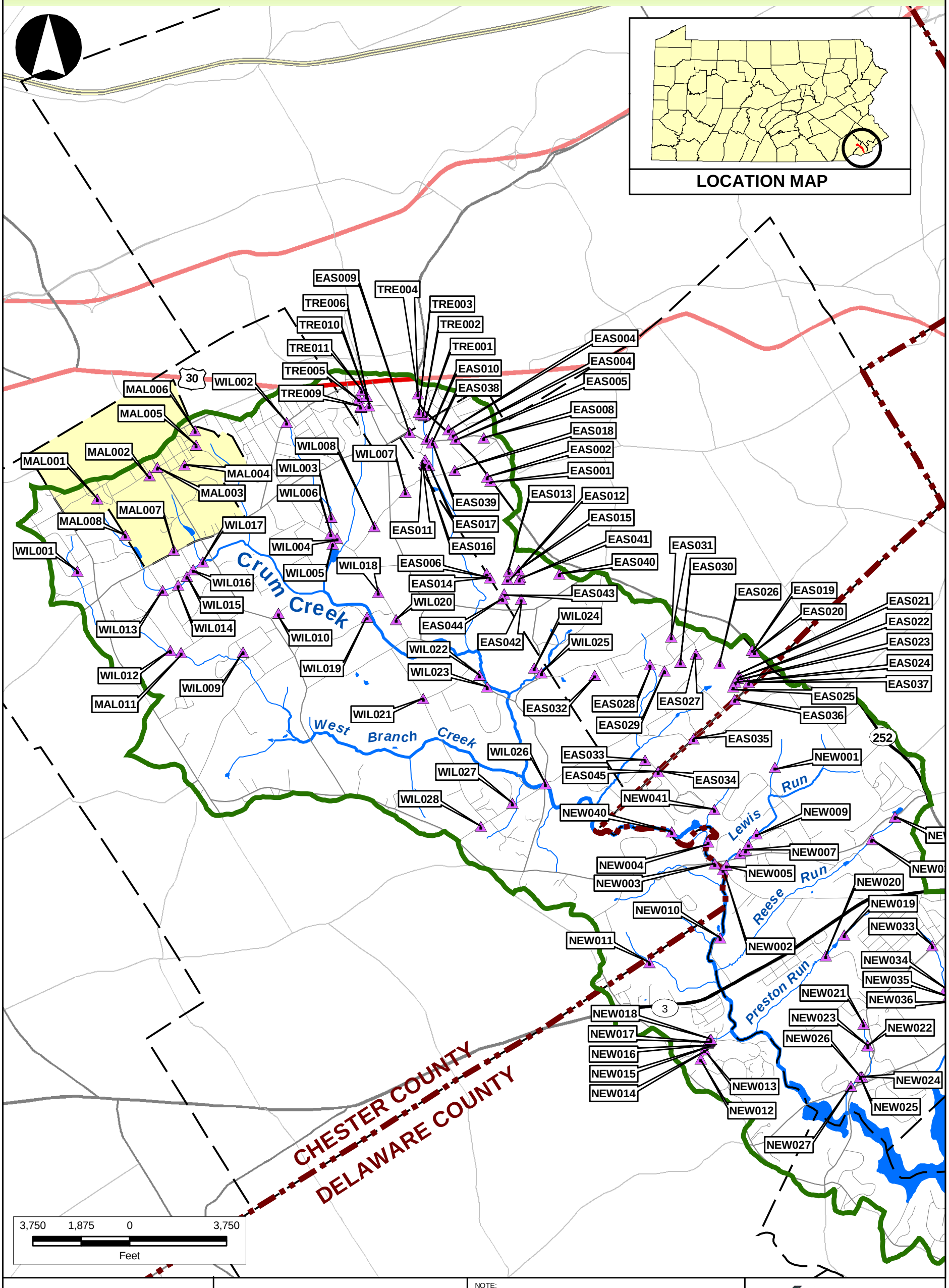
CRUM CREEK
PHASE II - ACT 167 STORMWATER MANAGEMENT PLAN



Map III-14A
OUTFALLS

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610-891-5200

Legend

- OUTFALLS
- WATERSHED BOUNDARY
- COUNTY BOUNDARIES
- MUNICIPAL BOUNDARIES
- BOROUGH
- SURFACE WATER
- WATERWAYS

Roads

- INTERSTATE
- US HIGHWAY
- PA HIGHWAY
- OTHER ROAD

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Lakes - Aqua America, 2001
Delaware River - USFWS (derived from NWI coverages)
Outfalls - Municipalities, 2004-2006

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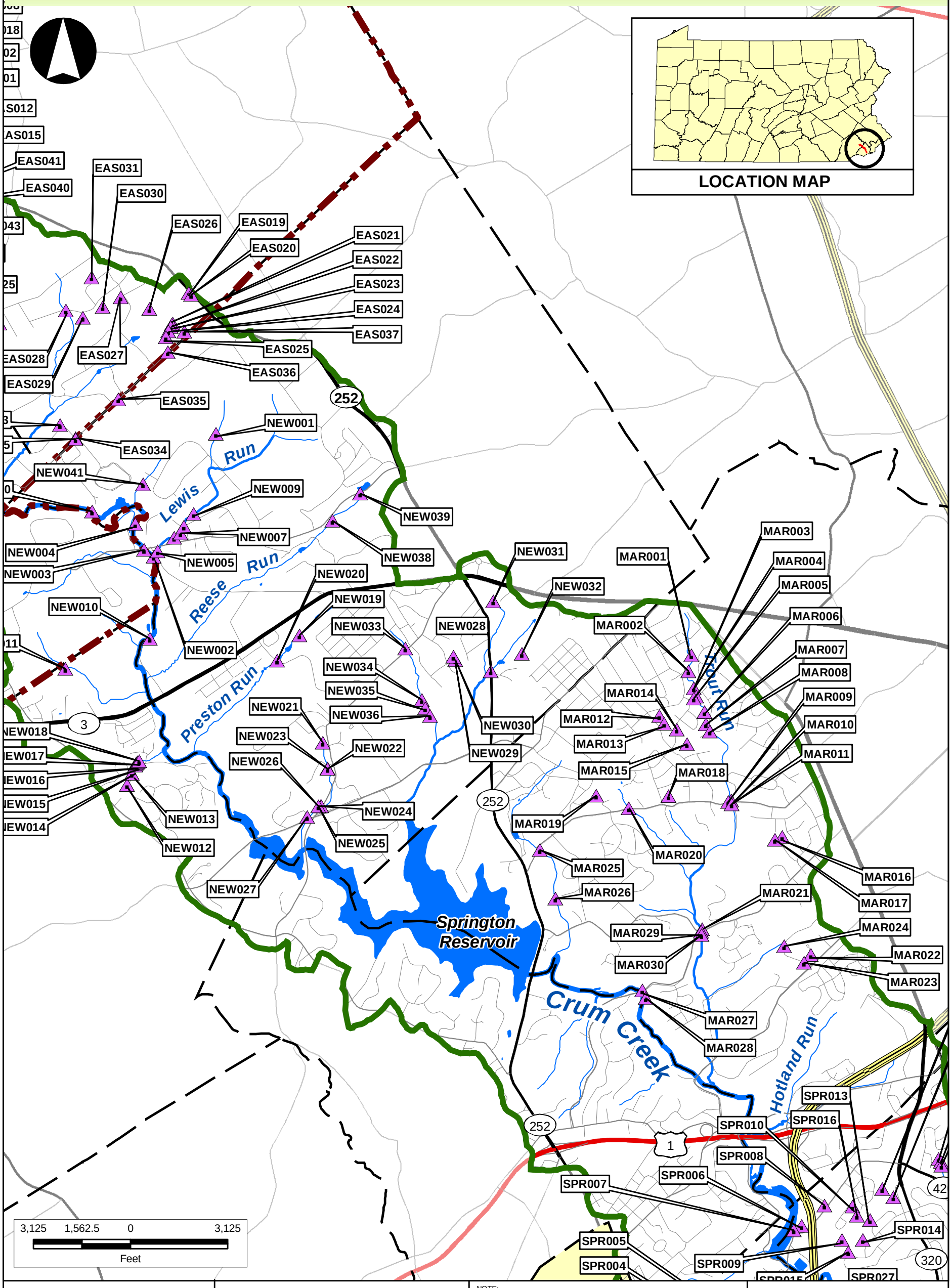
CRUM CREEK
PHASE II - ACT 167 STORMWATER MANAGEMENT PLAN



Map III-14B
OUTFALLS

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Legend

- OUTFALLS
- WATERSHED BOUNDARY
- COUNTY BOUNDARIES
- MUNICIPAL BOUNDARIES
- BOROUGH
- SURFACE WATER
- WATERWAYS

Roads

- INTERSTATE
- US HIGHWAY
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Outfalls - Municipalities, 2004-2006

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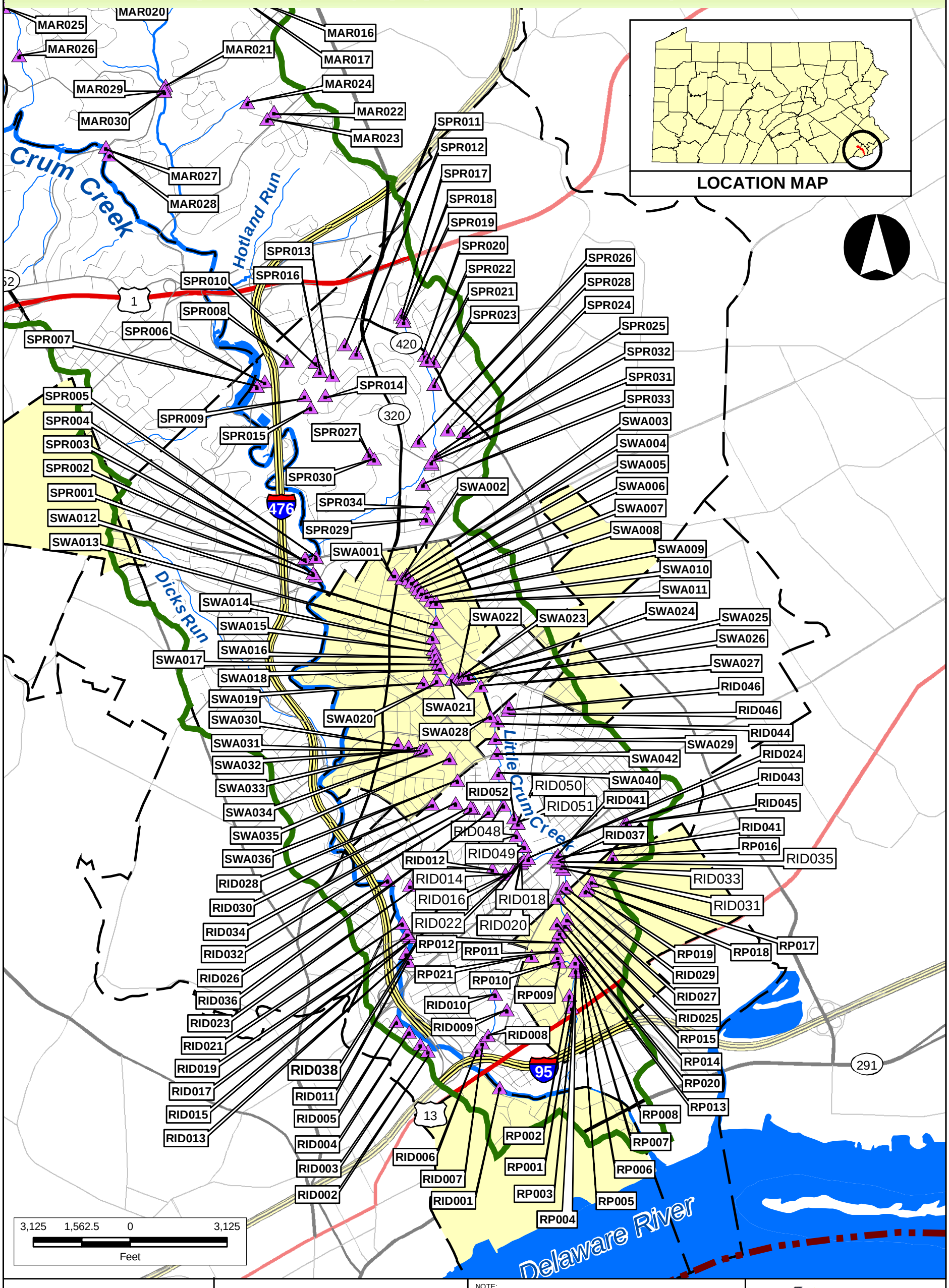
CRUM CREEK
PHASE II - ACT 167 STORMWATER MANAGEMENT PLAN



Map III-14C
OUTFALLS

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Legend

- OUTFALLS
- WATERSHED BOUNDARY
- COUNTY BOUNDARIES
- MUNICIPAL BOUNDARIES
- BOROUGH
- SURFACE WATER
- WATERWAYS

Roads

- INTERSTATE
- US HIGHWAY
- PA HIGHWAY
- OTHER ROAD

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Lakes - Aqua America, 2001
Delaware River - USFWS (derived from NWI coverages)
Outfalls - Municipalities, 2004-2006

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SECTION IV

WATERSHED TECHNICAL ANALYSIS

A. Watershed Modeling

An initial step in the preparation of this stormwater management plan was the selection of a stormwater simulation model to be utilized. It was necessary to select a model which:

- Modeled design storms of various durations and frequencies to produce routed hydrographs which could be combined.
- Was adaptable to the size of subwatersheds in this study.
- Could evaluate specific physical characteristics of the rainfall-runoff process.
- Did not require an excessive amount of input data yet yielded reliable results.

The model selected was the U. S. Army Corps of Engineers, Hydrologic Engineering Center, Hydrologic Modeling System (HEC-HMS) for the following reasons:

- It had been developed at the Hydrologic Engineering Center specifically for the analysis of the timing of surface flow contributions to peak rates at various locations in a watershed.
- Although originally developed as an urban runoff simulation model, data requirements make it easily adaptable to a rural situation.
- Input parameters provide a flexible calibration process.
- It has the ability to analyze reservoir or detention basin routing effects and location in the watershed.
- It is accepted by the Pennsylvania Department of Environmental Protection.

Although other models, such as TR-20, may provide essentially the same results as the HEC-HMS, HMS's ability to compare subwatershed contributions in a peak flow presentation table makes it specifically attractive for this study. The HEC-HMS Model generates runoff flows for selected subareas along the drainage course and compares subarea contributions to the total runoff. The model generates runoff quantities for a specified design storm based upon the physical characteristics of the subarea and routes the runoff flow through the drainage system in relation to the hydraulic characteristics of

the stream. The amount of runoff generated from each subarea is a function of its slope, soil type or permeability, percent of the subwatershed that is developed, and its vegetative cover. Composite runoff curve numbers were generated by overlaying the land cover map with the subarea and hydrologic soil group maps. The generated curve numbers were entered into the computer model. Map IV-1 displays the subarea delineation for the Crum Creek watershed on digital USGS Quadrangles or digital raster graphics (DRG's).

B. Modeling Process

After delineating the Crum Creek watershed on the USGS topographic map, the watershed was divided into subwatersheds for modeling purposes. The main considerations in the subdivision process were the location of obstructions, problem areas, and tributary confluences. The most downstream point of each of these areas is considered a "point of interest" where increased runoff must be analyzed for its potential impact.

The reason points of interest are selected is to provide watershed runoff control through effective control of individual subarea runoff. Thus, control of stormwater runoff in the entire watershed can be achieved through stormwater management in each subbasin.

The watersheds were modeled to determine the hydrologic response for the 1-, 2-, 5-, 10-, 25-, 50-, and 100-year for the 24-hour storm events. The results are shown in Volume III, Technical Appendix available at the Chester and Delaware County offices.

The modeling process addressed:

- Peak discharge values at various locations along the stream and its tributaries;
- Time to peak for the above discharges;
- Runoff contributions of individual subareas at selected downstream locations; and
- Overall watershed timing.

C. Calibration

In order to simulate storm flows for a watershed with confidence and reliability, the computer model must first be calibrated. This involves "fine tuning" the model to provide the most accurate representation of the real runoff and timing conditions of a watershed. Calibration of a model involves the adjustment of input parameters (within acceptable value ranges) to reproduce the recorded response of storm events.

CRUM CREEK
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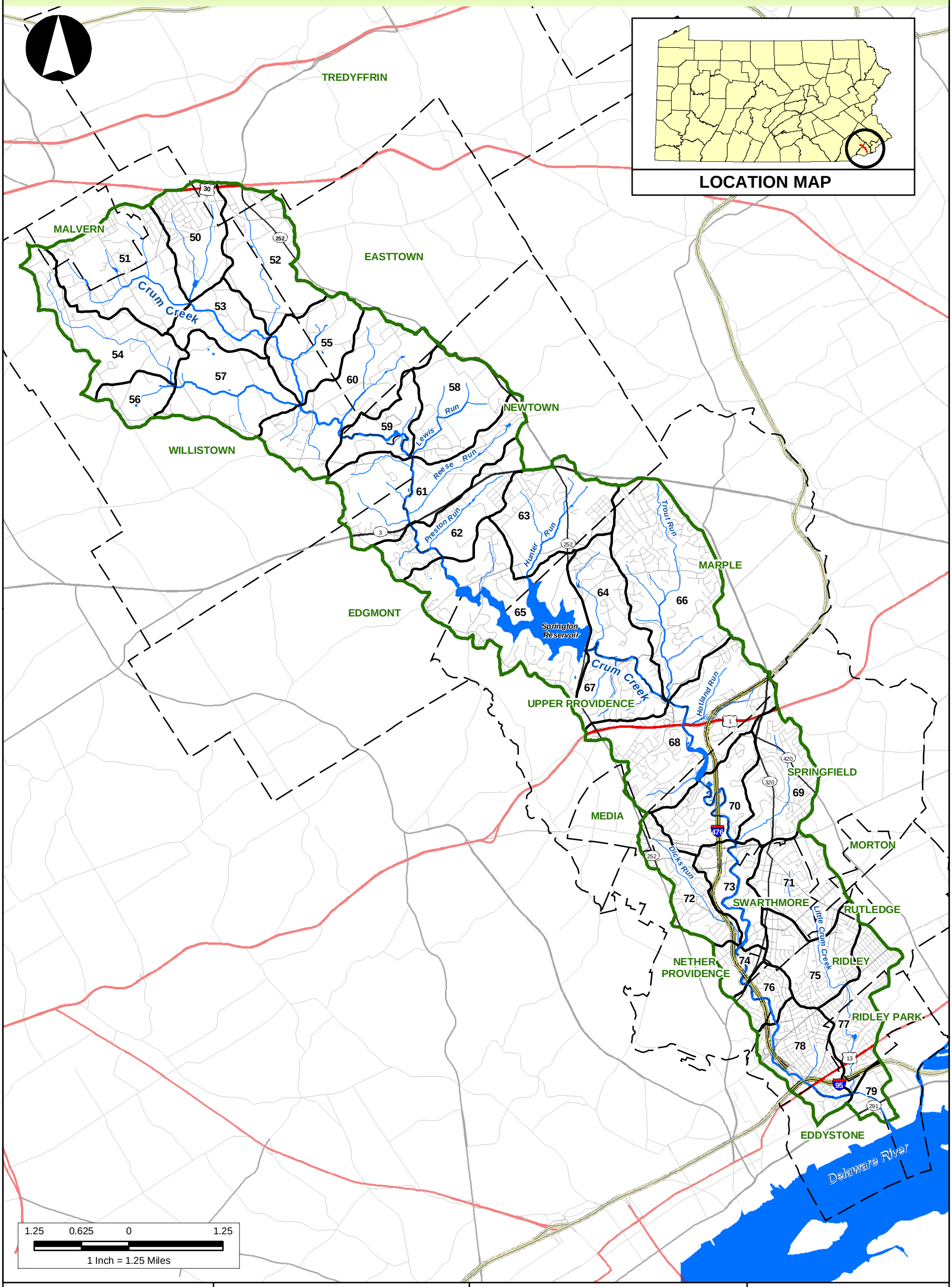

MAP IV-1
SUBAREAS

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Legend

- WATERSHED BOUNDARY
- SURFACE WATER
- STREAMS
- SUBAREAS
- MUNICIPAL BOUNDARIES

Roads

- INTERSTATE
- US HIGHWAY
- PA HIGHWAY
- OTHER ROADS

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Lakes - Aqua America, 2001
Delaware River - USFWS (derived from NWI coverages)
Subareas - Delineated by Borton-Lawson, 2006

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When actual storm event data is available (i.e., stream flow and rain gage data), this information can be entered into the model, and simulated "hydrographs" developed by the model. A hydrograph is simply a plot of time versus flow in cubic feet per second. To simulate a specific event, antecedent moisture conditions and rainfall distribution must be duplicated in the model input. Adjustments to other parameters are then made to attempt to duplicate hydrograph shapes and peak flow rates at points in the watershed where flow recordings were made. In order to utilize actual stream flow and rain gage data for calibration, sufficient data must be available. Rain gages must be in close proximity to the watershed so that actual rainfall conditions from these gages are representative of the actual rainfall that occurs over the watershed. Localized events, snowmelt, and unique conditions are typically not used for calibration due to their unique circumstances.

In order to maximize accuracy, the Crum Creek watershed HEC-HMS model was calibrated using measured stream flow data. At several key points in the watershed, HEC-HMS generated flows were compared to the discharges from several historic events as measured by USGS gages and developed from available regression models typically used in the estimation of design storm peak flows on large watersheds.

FEMA Flood Insurance Studies (FIS) were also used in the calibration and analysis in areas where detailed floodplain information was available. FIS data was investigated for cross-section information, Manning's values, channel capacities, and channel and overbank velocities. Certain areas were field verified.

There are several variables within the HEC-HMS model that can be used to calibrate the flows in the creek. These include initial abstraction, surface roughness, subbasin time of concentration, runoff curve number, hydrograph routing velocity, and travel time. As part of the calibration process, a sensitivity analysis was completed to determine which variables exerted the greatest control upon the model. Several runs were performed for the sensitivity analyses for each of the aforementioned parameters. From these runs, it was determined that the modeled flows were most sensitive to the initial rainfall abstraction and subarea travel times. To complete the calibration, these variables could be modified to an acceptable range of values for similar soil and slopes to arrive at the measured flow values from the gage data for historical events.

Historic Storm Calibration Results

Ideally, the hydrologic model would be calibrated to historic stream flow events on the watershed. This historic stream flow event data is typically available through stream gaging stations operated by the USGS at several locations throughout the United States. Within the Crum Creek watershed, three USGS stream gages (Table IV-1) were identified; however, only one gage is currently operating. The other two gages were discontinued by the USGS in 1937 and 1978. The one operating gage is located on the upstream stem of the Crum Creek near Newtown Square. The model, therefore, is not calibrated to any historical events.

TABLE IV-1
USGS Stream Gages within the
Crum Creek Watershed

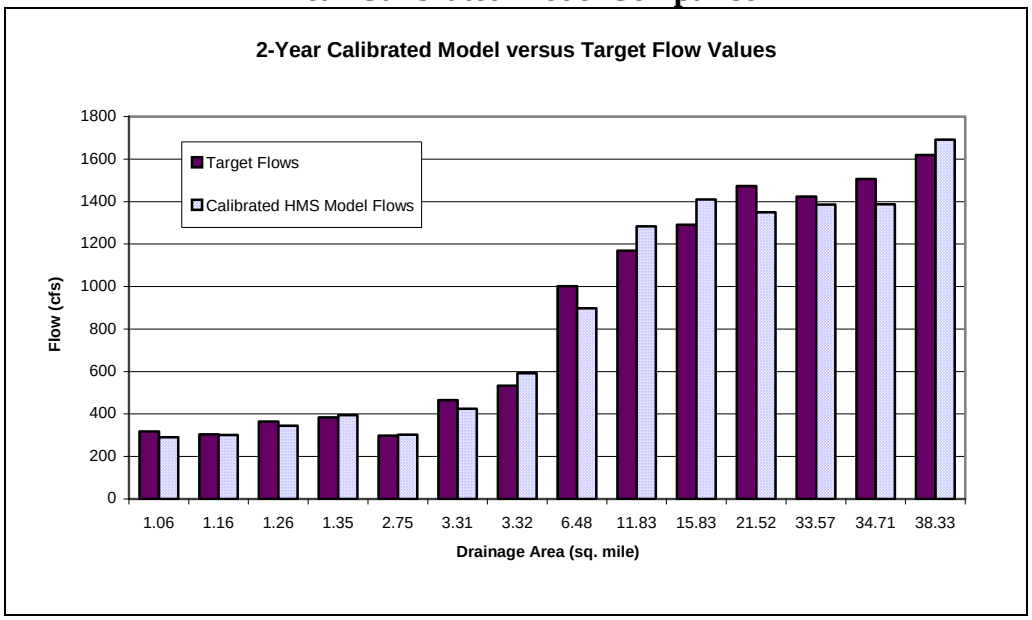
USGS Gage No.:	Location	Period of Record
01475850	Crum Creek near Newtown Square, PA	10/81-Present
01476000	Crum Creek at Woodlyn, PA	10/31-9/37
01476030	Little Crum Creek at Michigan Ave., Swarthmore, PA	5/71-9/78

Source: Borton-Lawson, 2008

Design Storm Calibration Results

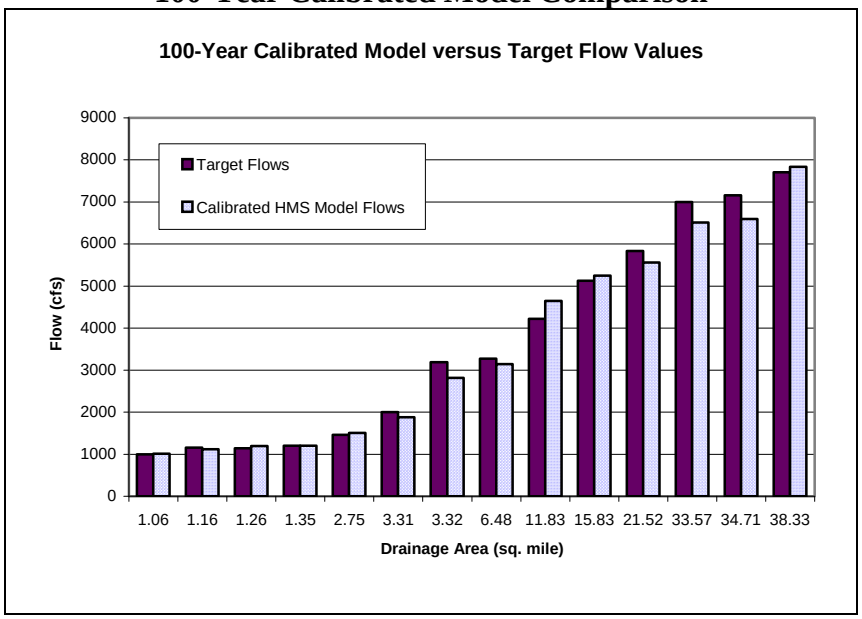
Design event flood flows for the 2-year and 100-year design storms were analyzed to compare HEC-HMS generated discharges to flows developed by the regression models and available flows that are found in the FEMA FIS. Figures IV-1 and IV-2 depict the results of peak flow values calculated from the calibrated HEC-HMS model compared to predicted flow values determined from several regression methods at various locations throughout the Crum Creek watershed. Table IV-2 compares the calibrated HEC-HMS model design discharges to flood flow values determined by FEMA. It should be noted that regression methods oftentimes do not account for localized variables such as soils and topography and flows developed via these equations may vary from those developed by the HEC-HMS model. On a subwatershed basis, the results may vary.

FIGURE IV-1
2-Year Calibrated Model Comparison



Source: Borton-Lawson, 2008

FIGURE IV-2
100-Year Calibrated Model Comparison



Source: Borton-Lawson, 2008

TABLE IV-2
Comparison of Calibrated Model to
100-Year FEMA Flow Values

Subarea No.	FEMA Drainage Area (sq. miles)	FEMA Flows (cfs)	Calibrated Model Flows (cfs)
60	11.50	4300	4646
50	1.00	1140	1010
57	3.10	2100	1876
58	1.40	1370	1205
61	15.80	5000	5253
71	1.30	1250	1115
76	35.10	6800	6510
77	3.20	2050	2815

Source: Borton-Lawson, 2008

SECTION V

STANDARDS AND CRITERIA FOR STORMWATER CONTROL

A. Watershed Level Control Philosophy

An increase in development, and in turn, an increase in impervious surfaces, results not only in an increase in peak runoff, but also an increase in runoff volume. The primary difference between on-site runoff control philosophy and the watershed level philosophy is the manner in which runoff volume is addressed. Conventional on-site control philosophy has as its primary goal the control of peak runoff and does not attempt to manage the volume of runoff from a site. Conversely, watershed level runoff control philosophy seeks to manage the increase in runoff volumes such that the peak rates of runoff throughout the watershed are not increased. The basic goal is, therefore, the same for both on-site and watershed-level philosophies, but methodologies to achieve the goal and the outcome of the implementation are often substantially different.

B. National Pollutant Discharge Elimination System (NPDES), Phase II Requirements

Federal regulations approved in December 1999 required operators of small municipal separate storm sewer systems (MS4s) to obtain NPDES Phase II permits from DEP by March 2003. This program affects all municipalities in "urbanized areas" of the state and applies to all of the Crum Creek watershed municipalities as listed in Section III, Table III-1. Therefore, all municipalities within the Crum Creek watershed are subject to the NPDES Phase II requirements mandated by the Federal Clean Water Act. Municipalities required to implement the MS4 program must address the following six minimum control measures (MCM's):

- Public Education and Outreach
- Public Involvement/Participation
- Illicit Discharge Detection and Elimination
- Construction Site Stormwater Runoff Control
- Post-Construction Stormwater Management in New Development & Redevelopment
- Pollution Prevention/Good Housekeeping for Municipal Operations

At a minimum, municipal entities regulated under MS4 must:

- Specify BMPs and implement them to the "maximum extent practicable"
- Identify measurable goals for control measures
- Develop an implementation schedule of activities or frequency of activities, and
- Define the entity responsible for implementation

The affected municipalities must, if they already do not have one in place, develop a

stormwater management program. If a municipality has an established stormwater management program and is subject to the provisions of the Phase II Rule, provisions of the Rule must be implemented to satisfy the federal requirements. Applicable information concerning some of the specifics of this permitting program can be found in Appendix 4 of this plan.

Adoption of the Crum Creek Watershed Stormwater Management Plan and Model Ordinance provisions will, at a minimum, satisfy the four basic requirements noted above and one of the six required elements of the NPDES II program, specifically, post-construction stormwater management in new development and redevelopment. [Note: will also partially address IDDE, construction, and good housekeeping.]

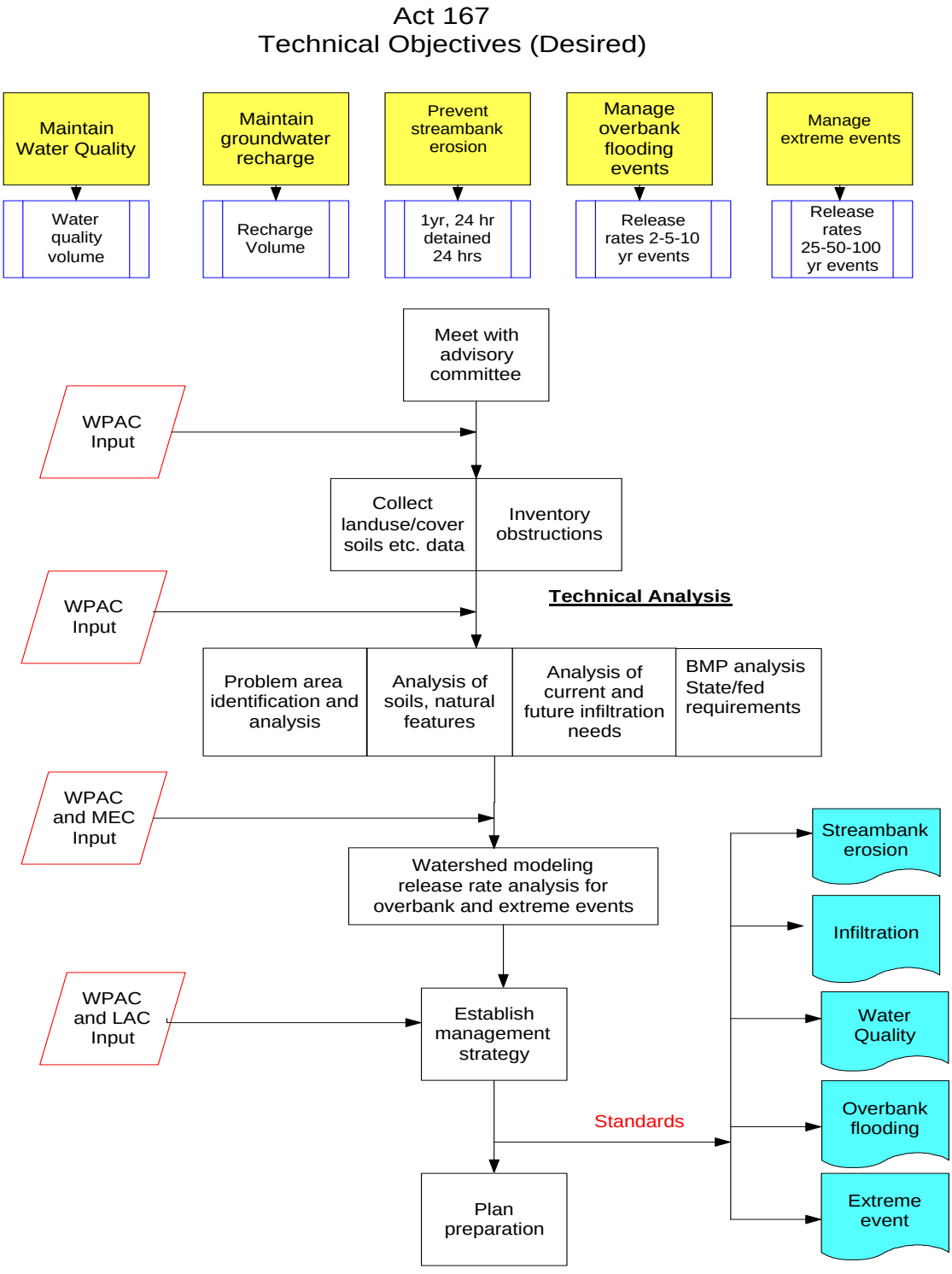
Although the NPDES program does not have exemption criteria, site disturbance up to 1 acre is allowed before water quality and peak rate controls are implemented. This stormwater management plan proposes much lower thresholds for earth disturbance and new impervious area limits that require water quality and peak rate controls. All projects within regulated municipalities will be required to comply with the additional water quality and quantity measures of the regulations. The exemption criterion of the Model Ordinance (see Section I of this chapter for further details) is found in Section 106 of the Model Ordinance that is located in Plan Appendix 1. Table 106.1 in the Model Ordinance describes what requirements a given regulated activity must meet for a range of proposed impervious and earth disturbance areas. In summary, the implementation of this plan and ordinance will ensure that municipalities automatically meet the federal NPDES requirements.

C. Standards and Criteria – Five Phased Approach

The goal of Act 167 and this stormwater management plan is to encourage planning and management of stormwater runoff that is consistent with sound water and land cover practices. In addition, the Act calls for a comprehensive stormwater management program designated to preserve and restore flood carrying capacities of streams; preserve, to the maximum extent practical, natural stormwater runoff regimes and alignment; maintain current stream cross-sections and conveyance capacity; and protect and conserve groundwater and infiltration areas. Maintaining and restoring the natural hydrologic regime in the watershed is the best means to accomplish this goal. The technical standards and criteria developed as a part of this task are watershed-wide in their interpretation and/or application. In order to attempt to achieve this goal and to address stream bank erosion, flooding, water quality, infiltration, and stormwater management measures, development and redevelopment sites must consider the five (5) objectives listed below and noted in Figure V-1:

- Maintain, restore, and protect infiltration of groundwater
- Maintain or improve water quality to water quality standards
- Reduce channel erosion
- Manage overbank flood events
- Manage extreme flood events

Figure V-1
Process Utilized in Analyzing Five Comprehensive Management Objectives



To achieve the aforementioned objectives, recommended standards and criteria are developed to assist municipal officials in the management of land development activities and ultimately the achievement of the stormwater management goals for a watershed. These standards and criteria provide for the application of a consistent methodology throughout the watershed with the intent of achieving the objectives within the entire watershed and not just within a particular municipality.

The standards and criteria provide for the following items:

- Identification of subareas within the watershed where different criteria apply;
- Creation of stormwater management districts to manage accelerated runoff from the subareas identified (above);
- Definition of design flood frequencies and identification of computational methodologies for stormwater management measures;
- Recommendation of alternate stormwater collection systems and control measures;
- Specifications for construction and maintenance of stormwater systems;
- Safety requirements for stormwater systems both during and after construction.

1. Infiltration

Infiltrating rainfall into the ground replenishes the groundwater that provides base flow to streams (a process that keeps streams flowing during the drier summer months) and maintains groundwater for drinking water purposes. As development occurs and impervious area increases, less rainfall reaches the groundwater systems, resulting in lower base flow and smaller groundwater supplies. Although detention basins can reduce the post-development peak rate of flow to the pre-development levels, the increase in runoff volume, caused by the typical increase in the amount of post-development impervious surface, still gets passed downstream unless special provisions are designed into the basin to infiltrate the increase in runoff volume. This extra volume of water passed downstream in the post-development condition is equal to the volume of water that is removed from the groundwater supply and added to surface water runoff.

Thus, in highly developed watersheds, it is not uncommon to see dry streams and severely depleted groundwater supplies during periods of drought. Stormwater management measures such as porous pavement with underground infiltration beds, infiltration/recharge structures, or other best management practices (BMPs) can be designed to promote infiltration. These measures are encouraged, particularly in hydrologic soil groups A and B, and should be utilized wherever feasible.

Two methods are outlined in the Model Ordinance Section 305 for calculating the infiltration volume. These are modified versions of Control Guidelines 1 and 2 (CG-1 and CG-2) as described in the *Pennsylvania Stormwater Best Management Practices Manual*. The volume of runoff to be infiltrated shall be determined from Section 305.A. of the Model Ordinance depending on demonstrated site conditions and shall be the greater of the volumes.

Infiltration Facility Sizing (Section 305 of Model Ordinance)

The following text has been taken directly from Section 305 of the Model Ordinance:

Providing for infiltration consistent with the natural hydrologic regime is required. Design of the infiltration facilities shall consider infiltration to compensate for the reduction in the recharge that occurs when the ground surface is disturbed or impervious surface is created.

If it cannot be physically accomplished, then the design professional shall be responsible for demonstrating to the satisfaction of the municipality that this **cannot be physically accomplished on the site** (e.g., shallow depth to bedrock or limiting zone, open voids, steep slopes, etc. vs. a financial hardship as defined in Model Ordinance Section 202). If it can be physically accomplished, the volume of runoff to be infiltrated shall be determined from Section 305.A.2 depending on demonstrated site conditions, and shall be the greatest volume that can be physically infiltrated. For example:

- Any applicant (developer or redeveloper) shall first attempt to infiltrate the volume required in Section 305.A.2.a.
- If the Section 305.A.2.a requirement cannot be physically accomplished, then the applicant is required to attempt to infiltrate the volume required in Section 305A.2.b.
- Finally, if the 305.A.2.b infiltration volume cannot be physically accomplished, the applicant must, at a minimum, infiltrate the volume required in 305.A.2.c

A. Infiltration BMPs shall meet the following minimum requirements:

1. Infiltration BMPs intended to receive runoff from developed or redeveloped areas shall be selected based on suitability of soils and site conditions and shall be constructed on soils that have the following characteristics:

   a. A minimum depth of twenty-four (24) inches between the bottom of the BMP and the top of the limiting zone.

   b. An infiltration rate sufficient to accept the additional stormwater volume and dewater completely as determined by field tests conducted by the Applicant's design professional.

   c. The infiltration facility shall be capable of completely draining the retention (infiltration) volume (Rev) within three (3) days (72 hours) from the end of the design storm.

2. The size of the infiltration facility and $\mathbf{Re_v}$ shall be based upon the following volume criteria:

a. Modified Control Guideline One (MCG-1) of the PA BMP Manual – The retention (infiltration) volume (**Re_v**) to be captured and infiltrated shall be the net 2-year 24-hour volume. The net volume is the difference between the post-development runoff volume and the pre-development runoff volume. The post-development total runoff volume for all storms equal to or less than the 2-year 24-hour duration precipitation shall not be increased. For modeling purposes, existing () non-forested pervious areas must be considered meadow in good condition or its equivalent, and twenty (20) percent of existing impervious area, when present, shall be considered meadow in good condition.

b. Infiltrating the entire Re_v volume in Section 305.A.2.a (above) may not be feasible on every site due to site-specific limitations such as shallow depth to bedrock or the water table. If it **cannot be physically accomplished**, then the following criteria from Modified Control Guideline Two (MCG-2) of the PA BMP Manual must be satisfied:

   At least the **first one-inch (1.0")** of runoff from new or replacement impervious surfaces shall be infiltrated.

   Re_v = 1 (inch) * impervious area (square feet) ÷ 12 (inches) = cubic feet (cf)

   An asterisk (*) in equations denotes multiplication.

c. Only if infiltrating the entire Re_v volume in Section 305.A.2.b (above) **cannot be physically accomplished**, then the following minimum criteria from Modified Control Guideline Two (MCG-2) of the PA BMP Manual must be satisfied:

   Wherever possible, infiltration facilities should be designed to accommodate infiltration of the entire water quality volume (WQv) (Section 306.A); however, in all cases at least the **first one-half inch (0.5")** of the WQv shall be infiltrated. The minimum infiltration volume (Re_v) required would, therefore, be computed as:

   Re_v = I * impervious area (square feet) ÷ 12 (inches) = cubic feet (cf)

   An asterisk (*) in equations denotes multiplication.
   Where:

   I = The maximum equivalent infiltration amount (inches) that the site can physically accept or 0.50 inch, whichever is greater.

The retention volume values derived from the methods in Section 305.A.2.a, 305.A.2.b, or 305.A.2.c is the minimum volume the applicant must control through an infiltration BMP facility. If site conditions preclude capture of runoff from portions of the impervious area, the infiltration volume for the remaining area should be increased an equivalent amount to offset the loss.

Only if the minimum of on-half inch (0.50") of infiltration requirement **cannot be physically accomplished**, a waiver from Section 305, Infiltration Volume Requirements, is required from the municipality.

B. Soils - A detailed soils evaluation of the project site shall be required to determine the suitability of infiltration facilities. The evaluation shall be performed by a qualified design professional and at minimum address soil permeability, depth to bedrock, and subgrade stability. The general process for designing the infiltration BMP shall be:

1. Analyze hydrologic soil groups as well as natural and man-made features within the site to determine general areas of suitability for infiltration practices. In areas where development on fill material is under consideration, conduct geotechnical investigations of sub-grade stability; infiltration may not be ruled out without conducting these tests.

2. Provide field tests such as double ring infiltrometer or hydraulic conductivity tests (at the level of the proposed infiltration surface) to determine the appropriate hydraulic conductivity rate. Percolation tests are not recommended for design purposes.

3. Design the infiltration structure for the required retention (Re_v) volume based on field- determined capacity at the level of the proposed infiltration surface.

4. If on-lot infiltration structures are proposed by the applicant's design professional, it must be demonstrated to the municipality that the soils are conducive to infiltrate on the lots identified.

C. Infiltration facilities should, to the greatest extent practicable, be located to avoid introducing contaminants via groundwater, and be in conformance with an approved source water protection assessment or source water protection plan.

D. Roadway drainage systems should provide an opportunity to capture accidental spills. Road de-icing material storage facilities shall be designed to avoid salt and chloride runoff from entering waterways and infiltration facilities. The qualified design professional shall evaluate the possibility of groundwater contamination from the proposed infiltration facility and perform a hydrogeologic justification study, if necessary.

E. The antidegredation analysis found in Chapter 93 shall be applied in HQ or EV streams.

F. An impermeable liner will be required in detention basins where the possibility of groundwater contamination exists. The municipality may require a detailed hydrogeologic investigation.

G. The applicant should provide safeguards against groundwater contamination for land uses that may cause groundwater contamination should there be a mishap or spill.

Stormwater Hotspots

Stormwater "hotspots" are defined in the Model Ordinance as "areas where land use or activities generate highly contaminated runoff with concentrations of pollutants in excess of those typically found in stormwater." If a site is designated as a hotspot, it has important implications for how stormwater is managed. First and foremost, untreated stormwater runoff from hotspots shall not be directed to infiltration facilities where it may contaminate water supplies. The Re_v should be pretreated prior to infiltration in order to minimize the potential for contamination of groundwater. Second, a greater level of stormwater treatment shall be considered at hotspot sites to prevent pollutant washoff after construction. The Environmental Protection Agency's (EPA) NPDES Stormwater Program requires some industrial sites to prepare and implement a stormwater pollution prevention plan.

Model Ordinance Section 301.T describes hotspots as follows:
Stormwater Hotspots – Stormwater runoff from hotspots shall be pretreated prior to surface or groundwater infiltration to prevent pollutant runoff. Industrial sites referenced in 40 CFR 125 are examples of hotspots.

Below is a list of examples of hotspots:

- Vehicle salvage yards and recycling facilities
- Vehicle fueling stations
- Vehicle service and maintenance facilities
- Vehicle and equipment cleaning facilities
- Fleet storage areas (bus, truck, etc.)
- Industrial sites based on Standard Industrial Classification Codes
- Marinas (service and maintenance areas)
- Outdoor liquid container storage
- Outdoor loading/unloading facilities
- Public works storage areas
- Facilities that generate or store hazardous materials
- Commercial container nursery
- Contaminated sites/brownfields
- Other land uses and activities as designated by an appropriate review authority

The following land uses and activities are not normally considered hotspots:

- Residential streets and rural highways
- Residential development
- Institutional development
- Office developments
- Nonindustrial rooftops
- Pervious areas, except golf courses and nurseries (which may need an integrated pest management (IPM) plan)

While streets and highways (average daily traffic volume (ADT) greater than thirty thousand (30,000) are not considered stormwater hotspots, it is important to ensure that highway stormwater management facilities are designed to adequately protect receiving streams and/or groundwater.

The EPA NPDES Stormwater Program requires some industrial sites to prepare and implement a stormwater pollution prevention plan.

2. Water Quality

Pollutants normally accumulate on impervious surfaces between rainfall events. Pollutant concentrations in runoff from developed land tend to be greatest at the beginning of a storm event or during the first one-half (1/2) inch to one (1.0) inch of runoff, a phenomenon commonly known as the "first flush." Typically, approximately eighty percent of the rainfall events consist of one-half inch of rainfall or less and are storms that essentially create only a "first flush." Therefore, the majority of the nonpoint source pollutants are washed into streams during this first flush. To be effective at treating nonpoint source pollution contained in the first flush, projects must construct BMPs to capture the runoff from these smaller storm events and detain the stormwater runoff to facilitate the settling out and biological breakdown or uptake of these pollutants.

Water Quality Standards (Section 306 of Model Ordinance)

Section 306 of the Model Ordinance requires applicants to comply with the following water quality requirements:

To control post-construction stormwater impacts from regulated activities and conform to state water quality requirements, BMPs which replicate pre-development stormwater infiltration and runoff conditions must be provided in the site design such that post-construction stormwater discharges do not degrade the physical, chemical, or biological characteristics of the receiving waters. This may be achieved by the following:

1. Infiltration: replication of pre-construction stormwater infiltration conditions,

2. Treatment: use of water quality treatment BMPs to provide filtering of chemical and physical pollutants from the stormwater runoff, and

3. Stream bank and stream bed protection: management of volume and rate of post-construction stormwater discharges to prevent physical degradation of receiving waters (e.g., from scouring).

A. Developed areas shall provide adequate storage and treatment facilities necessary to capture and treat stormwater runoff. The infiltration volume computed under Section 305 may be a component of the water quality volume if the Applicant chooses to manage both components in a single facility. If the calculated water quality volume (WQv) is greater than the volume required to be infiltrated as described in Section 305.A.2, then the difference between the two volumes shall be treated for water quality by an acceptable stormwater management practice(s). The required water quality volume (WQv) is the storage capacity needed to capture and treat a portion of stormwater runoff from the developed areas of the site.

To achieve this requirement, the following criterion is established:

From Control Guideline (CG-1) in the PA BMP Manual, the water quality volume shall be the net 2-year 24-hour volume. The net volume is the difference between the post-development runoff volume and the pre-development runoff volume. The post-development total runoff volume for all storms equal to or less than the 2-year 24-hour duration precipitation shall not be increased. For modeling purposes, existing () non-forested pervious areas must be considered meadow in good condition or its equivalent, and twenty (20) percent of existing impervious area, when present, shall be considered meadow in good condition.

This volume requirement can be managed by the permanent volume of a wet basin or the detained volume from other BMPs. Where appropriate, wet basins shall be utilized for water quality control and shall follow the guidelines of the PA BMP Manual referenced in Ordinance Appendix G.

Release of water can begin at the start of the storm (i.e., the invert of the water quality orifice is at the invert of the facility). The design of the facility shall provide for protection from clogging and unwanted sedimentation.

B. The temperature of receiving waters shall be protected through the use of BMPs that moderate temperature.

C. If a perennial or intermittent stream passes through, or a waterbody (i.e., lake, pond, wetland) is present on the site, the Applicant shall create a riparian buffer extending a minimum of [*fifty* (*50) to one hundred fifty (150) - subject to federal and state buffer policies and regulation)*] feet, to either side of the top-of-bank of the channel, lake, or wetland. The buffer area shall be planted with native

vegetation and maintained in a vegetated state (Refer to Appendix B, Pennsylvania Native Plant List, contained in the PA BMP Manual).

1. The following provisions also apply to riparian buffers on lots in existence at the time of adoption of this Ordinance:
   a. [If the applicable rear or side yard setback is less than [fifty (50-150) feet*], the buffer width may be reduced to twenty-five (25) percent of the setback or twenty five (25) feet, whichever is greater.
   b. If a stream traverses a site in a manner that significantly reduces the use of the site, the buffer may be either:
      i. Reduced to [twenty-five (25)] feet on either side, with municipal approval, or
      ii. Reduced to ten (10) feet with municipal waver

2. Permitted uses within the buffer include the following, subject to municipal approval and provided that they comply to all federal, state, and local regulations:
   a. Recreational trails. See Ordinance Appendix J Riparian Buffer Trail Guidelines
   b. Utility rights-of-way
   c. Bridges
   d. Other uses subject to municipal approval

D. If an existing buffer is legally prescribed (i.e., deed, covenant, easement, etc.) and it exceeds the requirements of this Ordinance, the existing buffer shall be maintained

3. Stream Bank Erosion

Preservation of stream geomorphology is an important aspect of sustainable flood protection and water quality preservation. Although a fluvial geomorphologic (FGM) survey was not conducted on the Crum Creek, comprehensive stormwater management cannot be attained without considering the impact of stormwater on the fluvial geomorphology of a watercourse.

Normally as storm flow increases, velocities in the stream also increase and are capable of creating stream bank erosion problems within a watercourse. Typically, the greatest stream velocities and stream bank erosion occurs during near-bank-full and bank-full flow events. Studies on watersheds in Southeast Pennsylvania, including the Crum Creek, have shown bank-full flow to typically occur between the 1- and 2-year storm events.

The majority of the Crum Creek watershed is underlain by the geologic formation known as the piedmont physiographic province. In the United States Geologic Survey Scientific Investigation Report (USGS SIR) 2005-5147 *Development of Regional Curves Relating Bankfull-Channel Geometry and Discharge to Drainage Area for Streams in Pennsylvania and Selected Areas of Maryland,* it was determined that bankfull flow in the Crum Creek

occurs during the 1.2-year runoff event based on the underlying geology. Therefore, controls to keep stream flows between the 1.2- and 2-year runoff events to or below the 1-year event, would aid in minimizing stream bank erosion.

Often development within a watershed can aggravate stream bank erosion problems by creating more runoff and correspondingly increasing the frequency of meeting or exceeding bank-full flows. This need not be the case if stormwater management controls are designed to mitigate this condition. With the proper design of stormwater management controls, stormwater runoff from frequent events, such as the 1.5-year event, can be detained and discharged from a control facility over an extended period of time thus reducing discharge volumes and velocities during near bank- full and bank-full flows.

Stream bank erosion criteria based upon the above discussion was incorporated into the standards and criteria of the Model Ordinance Section 307:

In addition to controlling the water quality volume (in order to minimize the impact of stormwater runoff on downstream stream bank erosion), the primary requirement to control stream bank erosion is to design a BMP to detain the proposed conditions 2-year, 24-hour design storm to the existing conditions 1-year flow using the SCS Type II distribution. Additionally, provisions shall be made (such as adding a small orifice at the bottom of the outlet structure) to release the proposed conditions 1-year storm for a minimum of twenty-four (24) hours from a point in time when the maximum volume of water from the 1-year storm is stored in a proposed BMP (i.e., the maximum water surface elevation is achieved in the facility). Release of water can begin at the start of the storm (i.e., the invert of the water quality orifice is at the invert of the facility).

A. The minimum orifice size in the outlet structure to the BMP shall be three (3) inches in diameter where possible, and a trash rack shall be installed to prevent clogging. On sites with small drainage areas contributing to this BMP that do not provide enough runoff volume to allow a 24-hour attenuation with the 3-inch orifice, the calculations shall be submitted showing this condition. When the calculated orifice size is below three (3) inches, gravel filters (or other methods) are recommended to discharge low-flow rates subject to the municipal engineer's satisfaction. When filters are utilized, maintenance provisions shall be provided to ensure filters meet the design function. All facilities shall make use of measures to extend the flow path and increase the travel time of flows in the facility.

4. Overbank Events

Flooding and stormwater problems are caused by excess stormwater quantity. Storm events which result in water overflowing the natural bank of a stream are termed as "overbank" events and are typically defined as storm events exceeding a specified expected frequency of occurrence. Based on USGS SIR 2005-5147, bankfull flow in the Crum Creek occurs at the 1.2-year runoff event. Thus, events greater than this event result in "overbank" flooding. Normally, storm events between the 2-year to 10-year

return periods are classified as “overbank” events. Effective management of these “overbank” events requires a detailed knowledge of the interrelationship between all contributing areas of a watershed. Analysis of peak runoff, timing of runoff, and duration of runoff from the various areas of a watershed is critical for establishing an effective stormwater management plan. The result of this analysis is the Management District Concept, discussed in Section D of this chapter.

5. Extreme Events

“Extreme” flooding events are separated from “overbank” flooding events by the severity of damage that is incurred. Typically, 25-, 50- and 100-year events are classified as “extreme” as they cause more substantial damage than the flooding associated with “overbank” events.

While some overbank and extreme flooding events are inevitable, the goal of stormwater management is to control stormwater in a way that development within the watershed does not increase the incidence of “overbank” flooding and the extent of damages to property and infrastructure associated with extreme events. To accomplish this stormwater management objective, different management criteria are established for the “overbank” and “extreme” event floods.

It must be recognized that there is a difference between the definition of terms “storm” and “flood.” Although a certain quantity of rain may classify a rainfall event as a 5-year storm, this does not mean that same amount of rain will result in a 5-year flood. For example, if the event occurs during a drought, a 5-year storm may result in only a 2-year flood because of the greater capacity of the soil and ground to absorb water. If the same event occurred on top of a snowmelt or at a time when the ground is saturated, a 10-year flood may occur because of the extra water volume present in the melting snow or decreased capacity of the soil to absorb the precipitation.

Similarly, the term “5-year flood” does not mean that this event will occur once every five years. Nor does it mean that once a 5-year event occurs, it will be another five years until that event may occur again. A 5-year event refers to the probability (as a fraction) that the event will occur in any given year, which is the inverse of the frequency of the event. Therefore, a 5-year event has a 20% probability of occurring in any given year.

D. Management District Concept (For Overbank and Extreme Events)

Many Act 167 plans are based upon the release rate concept where each subarea within a watershed is assigned a release rate (as a percent value). For any development scenario within a given portion of a watershed, the post-development runoff rate must not exceed a percentage (release rate) of the runoff rate. These release rates were developed by analyzing the individual subarea contribution to the overall watershed runoff.

Although similar to the release rate plans mentioned above, this plan takes a slightly different approach to the release rate concept by using management districts in lieu of

release rates. With the management district approach, the plan essentially equates release rates to equivalent design storms. Therefore, developments must reduce post-development discharge rates to runoff rates equal to or less than the runoff rate for a design storm prescribed by the plan. As discussed in the previous section, each management district contains specific criteria which are to be met in order to address "overbank" and "extreme" design events.

Table V-1 shows how the peak rate of post-development runoff would have to be reduced to the peak rate of runoff, based upon the design storm approach within the specified management districts.

TABLE V-1
Stormwater Management Districts in the Crum Creek Watershed

District	Proposed Condition Design Storm	(reduce to)	Existing Condition Design Storm
A	2-year 5-year 10-year 25-year 50-year 100-year		1-year 5-year 10-year 25-year 50-year 100-year
B	2-year 5-year 10-year 25-year 50-year 100-year		1-year 2-year 5-year 10-year 25-year 100-year

Source: Borton-Lawson, 2008

E. Redevelopment

It is not the intent of this plan to create a disincentive to redevelopment in existing urbanized areas of the watershed since this type of development may result in fewer environmental impacts than development on vacant undeveloped land. The plan is designed to present an equitable approach to both redevelopment and new development on vacant land. As the stormwater management criteria contained in this plan is based upon not exceeding the existing flow at a site and not on an absolute value disconnected from the pre-development condition, the targeted stormwater management objective for a site within a given management district is established by the site and set relative to its existing conditions. Since existing conditions include any impervious area on the site prior to the proposed development, the criteria, by default, relaxes the stormwater quantity peak rate of flow by allowing redevelopment to match existing conditions for the

design storm specified in a given management district. To encourage redevelopment projects to consider adding additional open space and properly managing stormwater runoff in the development design, the applicant may choose to reduce the total impervious surface area on a site in lieu of meeting the stormwater quantity control criteria established in Section D of this chapter. In order to satisfy this criteria and eliminate the requirements regarding stormwater quantity control established in Section D., an applicant must demonstrate that the total impervious area at the site is reduced by at least twenty percent (20%) based upon a comparison of existing impervious surface to proposed impervious surface.

F. Process to Accomplish Standards and Criteria

Table V-2 provides a process to accomplish the required standards and criteria, on a priority basis, looking at means other than detention to promote infiltration, improve water quality, prevent stream bank erosion and to reduce post-development peak flows to the required existing conditions rate.

TABLE V-2
Process to Achieve the Standards and Criteria - Order of Required Consideration
(Ultimate Goal - Match Existing Conditions Hydrograph)

1. Maximize use of Non-structural Stormwater Management Alternatives
   - Minimize disturbance of natural features
   - Minimize grading
   - Minimize impervious surfaces, Maximize pervious surfaces
   - Break up large impervious surfaces
2. Satisfy groundwater recharge (infiltration) objective
3. Satisfy water quality
4. Satisfy stream bank erosion requirements
5. Apply BMPs near the source of the runoff
6. Satisfy the runoff peak attenuation objective considering all measures other than detention basins
7. After satisfying the above requirements, incorporate dua-purpose detention measures, if necessary, to attenuate peaks. Dual-purpose detention is recommended, e.g., recycling water, wetlands basins, water storage for fire flow, etc.

Source: Borton-Lawson, 2010

The sources listed in the Reference Section of this plan should be consulted to aid the design engineer in BMP selection and design.

Stormwater Management standards and criteria required by this plan are summarized in Table V-3, while recommended standards and criteria are listed in Table V-4. Although reducing the post-development peak rate of runoff to levels is a mandatory element of this stormwater management plan, the ultimate stormwater management goal is to match the hydrograph, not just the peak rate of runoff. To achieve this objective requires innovative planning and design of both structural and non-structural stormwater

management measures. Non-structural measures are referred to as conservation design or Low Impact Development (LID). Conservation design focuses on preserving those areas of a project that are most beneficial to environmental conservation and directing development to those areas of a site that are less environmentally significant. Typically, this type of design usually includes development of an opportunity and constraints map, which shows areas of a site with environmentally sensitive features and areas suitable for development. Various conservation design measures are discussed in more detail in Section G of this chapter. Another reference on this subject is Chapter 5 of *Pennsylvania Stormwater Best Management Practices Manual*.

TABLE V-3
Required Criteria and Standards in the Crum Creek Watershed

Required Standard	**Benefit**
Peak Rate Control A and B Management Districts	Prevents increase in runoff on a watershed wide basis and provides stormwater attenuation.
Recharge/Infiltration/Retention All proposed development shall investigate the implementation of infiltration or retention structures for the stormwater control measures as opposed to surface detention (in all Hydrologic Soils Groups) and adhere to the recharge requirements of the Model Ordinance. This also pertains to the portions of the watershed that have storm sewers. Recharge structures installed prior to tapping into the storm sewers are recommended where soils and physical conditions permit. Impacts on subsurface mine pools and Karst areas should be evaluated before recommending this type of practice.	Augments groundwater/stream recharge and base flow providing flow attenuation.
Water Quality Provide adequate storage and treatment facilities necessary to capture and treat the Water Quality Volume (WQ_v).	Allows pollutants to settle thus providing improved water quality.
Riparian Buffer The minimum required width is 50 to 100 feet measured from the top of bank on both sides of the stream, and may only be reduced for existing lots depending on site conditions and municipal approval.	Water quality, flood drainage reduction, habitat enhancement erosion reduction.
Stream Bank Protection Reduce 2-year post-development flow to 1-year pre-development flow.	Reduces the number of erosive storms thereby reducing stream bank erosion.
Erosion and Sediment Pollution Control Network with administrative and regulatory agencies to sequence and control earth disturbance sites to maintain and protect areas designated for recharge or leave areas of native vegetation intact.	Infiltration, structure integrity, surface water quality, safe conveyance, stream, culvert, and channel capacity.
Existing Storm Sewers or Culverts Discharge into existing sewer networks or culverts shall be based on system capacity or design storm(s), whichever is more restrictive.	Preserve sewer/culvert capacity thereby reducing Operation and Maintenance and replacement costs.
Discharge of Accelerated Runoff All stormwater control criteria must be met before runoff is safely discharged into existing drainage patterns and storm sewers without adversely affecting properties or causing channel scouring and erosion.	Safe conveyance, continued surface and groundwater quality, flow attenuation.

TABLE V-3 Required Criteria and Standards in the Crum Creek Watershed (continued)	
Outlets If discharging stormwater conveyance systems from a development site to a stream, tributary, stabilized channel, or storm sewer is not possible, runoff shall be collected in a BMP and discharged at a non-erosive rate. Proposed developments discharging runoff onto adjacent properties must have adjacent property owner(s)' written permission, prior to design and construction of outlets.	Safe conveyance, reduced environmental impacts, and reduced property damage.
Minimize Wetland Impacts Refer wetland impacts to state agency for review.	Maintain aquatic ecosystems and habitat, water quality improvements.

Note: *See the Model Ordinance for more detailed standards and criteria*

TABLE V-4
Recommended Criteria and Standards in the Crum Creek Watershed

Recommended Standard	**Benefit**
Floodplains Those floodplains in which the floodplain stores floodwaters shall not be filled or covered with impervious surface so as to not reduce the storage capacity.	Natural stormwater detention/flood control downstream.
Roof Drains, Residential/Commercial Prevent all roof drains from discharging into storm sewers, roadside ditches, or channels. Discharge to lawn; recharge basin or storage facilities for re-use.	Promotes infiltration, flow attenuation, and increases runoff time of concentration, flow attenuation.
Pervious Surfaces The use of pervious materials will be encouraged for parking surfaces and sidewalks. Compaction of soils is discouraged and natural or undisturbed areas onsite are encouraged in order to keep open space pervious. Aquifer or infiltration beds are encouraged.	Infiltration, groundwater recharge.
Structures Concentrate on locating facilities within areas conducive to recharge and accommodate recharge to meet management district requirements. No stormwater structures are allowed in floodplains that would reduce the storage volume.	Infiltration, groundwater recharge, stream base flow, floodplain storage.
Steep Slopes Regulate activities in critical slope areas where management of stormwater by structure is inappropriate. Slopes should be vegetated with native vegetation.	Stream base flow, flow attenuation, conveyance integrity, surface water quality.
Green Roof Construct rooftop gardens	Flow attenuation and small storm retention
Note: *See the Model Ordinance for more detail standards and criteria.*	

G. Alternative Runoff Control Techniques

Each developer must not allow the runoff from his site to exceed the applicable release rate applied to the subwatershed where the site is located. This runoff control can be obtained in a number of different ways. The following tables indicate an overview of general measures that can be applied to reduce or delay stormwater runoff as well as the advantages and disadvantages for several types of runoff control measures. It is the responsibility of the developer or the developer's engineer to select the technique that is the most appropriate to the type of project and physical characteristics of the site.

In determining what measures or combination of measures to install, the following parameters should be considered:

- Soil characteristics (HSG, etc.)
- Subsurface conditions (high water table, depth to bedrock, etc.)
- Topography (steepness of slope, etc.)
- Existing drainage patterns
- Economics
- Advantages and disadvantages of each technique

Some runoff control techniques are classified as "structural" stormwater management controls, meaning they are physical facilities for runoff abatement. Others are "non-structural" controls, referring to land cover management techniques geared toward minimizing storm runoff impacts through control of the type and extent of new development throughout the study area. The Crum Creek Watershed Stormwater Management Plan is based on the assumption that new development of various types will occur throughout the study area (except as regulated by floodplain regulations) and that structural controls may be required to minimize the runoff implications of the new development.

Non-structural Runoff Controls - Non-structural methods of controlling stormwater runoff quantity and quality, such as innovative site planning, impervious area and grading reduction, protection of natural depression areas, temporary ponding on-site, and other techniques are recommended. Non-structural BMPs are increasingly recognized as a critical feature of stormwater BMP plans, particularly with respect to site design. In most cases, non-structural BMPs shall be combined with structural BMPs to meet all stormwater requirements. The key benefit of non-structural BMPs is that they can reduce the generation of stormwater from the site, thereby reducing the size and cost of structural BMPs. In addition, they can provide partial removal of many pollutants. The non-structural BMPs have been classified into broad categories including, but not limited to:

- Natural area conservation including riparian buffers
- Limiting disturbed areas
- Conservation design

A list of non-structural stormwater management measures and a description of each are shown in Table V-5.

It should be noted that maintaining or restoring natural buffers has many stormwater related benefits. Refer to Table V-6.

TABLE V-5
Non-structural Stormwater Best Management Practices

Non-structural Stormwater Management Measure	Description
Natural Area Conservation	Conservation of natural areas such as forest, wetlands, riparian buffers, or other sensitive areas in a protected easement thereby retaining their existing conditions hydrologic and water quality characteristics.
Disconnection of Rooftop Runoff	Rooftop runoff is disconnected and then directed over a undisturbed area where it may either infiltrate into the soil or filter over it. This is typically obtained by grading the site to promote overland flow or by providing bioretention on single-family residential lots.
Disconnection of Non-Rooftop Runoff	Disconnect surface impervious cover by directing it to undisturbed areas where it is either infiltrated or filtered though the soil.
Riparian Buffers	Riparian buffers effectively treat stormwater runoff. Effective treatment constitutes capturing runoff from pervious and impervious areas adjacent to the buffer and treating the runoff through overland flow across a undisturbed grass or forested area.
Grass Channel (Open Section Roads)	Open grass channels are used to reduce the volume of runoff and pollutants during smaller storms.
Environmentally Sensitive Rural Development	Environmental site design techniques are applied to low density or rural residential development.

TABLE V-6
Twenty Benefits of Buffers

1. Reduce watershed impervious area.
2. Maintain distance from impervious cover.
3. Help prevent small drainage problems and complaints.
4. Provide for lateral movement of stream “right-of-way”.
5. Provide effective flood water storage.
6. Protect from stream bank erosion.
7. Increase property values.

TABLE V-6
Twenty Benefits of Buffers
(continued)

8. Increase pollutant removal.
9. Provide foundation for present or future greenways.
10. Provide food and habitat for wildlife.
11. Mitigate stream warming.
12. Protect wetlands.
13. Prevent disturbance of steep slopes.
14. Preserve important terrestrial habitat.
15. Create conservation corridors.
16. Enhance essential habitat for amphibians.
17. Reduce barriers to fish migration.
18. Discourage excessive storm drain enclosures/channel hardening.
19. Provide space for stormwater ponds.
20. Enable future restoration.

Structural Runoff Controls - Structural controls for managing storm runoff can be categorized as either volume controls or rate controls. Volume controls are designed to prevent a certain amount of the total rainfall from becoming runoff by providing an opportunity for the rainfall to infiltrate into the ground. Greater opportunity for infiltration can be provided by minimizing the amount of impervious cover associated with development, by draining impervious areas over undisturbed areas or into specific infiltration devices and by using grassed swales or channels to convey runoff in lieu of storm sewer systems. Rate controls are designed to regulate the peak discharge of runoff by providing temporary storage of runoff that would otherwise leave the site at an unacceptable peak value. Rate controls, much more so than volume controls, are adaptable to regional considerations for controlling much larger watershed areas than just one development site.

Innovative BMPs - The use of traditional and innovative best management practices (BMPs) is encouraged to meet the recharge, water quality, and water quantity criteria established in this plan. The PA BMP Manual should be used to design and maintain these practices/facilities.

BMPs that Moderate Temperature - Runoff from blacktop during hot summer months can provide a “slug” of warm water into the streams, which could affect trout. For areas within defined Special Protection subwatersheds, which include Exceptional Value (EV) and High Quality (HQ) waters, the temperature of receiving waters shall be protected

through the use of BMPs that moderate temperature. BMPs that reduce temperature, provide shading, or temporary underground storage. A list of some techniques that moderate temperature and the source for further information on them can be found in Table V-7.

TABLE V-7
Techniques that Moderate Temperature

To minimize temperature increases caused by new development in watersheds Stormwater BMP designs should:

- Provide shading for pools and channels (particularly south side)
- Maintain existing forested buffers
- Bypass available base flow and/or spring flow
- Utilize underground storage where possible
- Utilize infiltration

Quantity Control - Proposed conditions development runoff from a site must not exceed the applicable existing conditions rate applied to the subwatershed where the site is located. This runoff control can be obtained in a number of different ways. The following tables indicate an overview of general measures that can be applied to reduce or delay stormwater runoff as well as the advantages and disadvantages for several types of runoff control measures. The applicant must select the technique that is the most appropriate to the type of project and physical characteristics of the site. Stormwater BMPs can be utilized to manage water quality, infiltration, stream bank erosion, and quantity (peak and volume). The runoff control(s) most applicable to a development site may vary widely depending upon site characteristics, such as:

- Type of development proposed
- Soil characteristics (HSG, etc.)
- Subsurface conditions (high water table, bedrock, etc.)
- Topography (steepness of slope, etc.)
- Existing drainage patterns
- Economics
- Advantages and disadvantages of each technique
- Applicable performance standard

Table V-8 provides assorted on-site stormwater control methods, while Table V-9 explains the advantages and limitations of various on-site stormwater control methods. ***Source:*** *Urban Hydrology for Small Watersheds. Technical Release No. 55.*

TABLE V-8
Possible On-site Stormwater Control Methods

AREA	REDUCING RUNOFF	DELAYING RUNOFF
Rooftops	1. Cistern storage 2. Rooftop gardens 3. Pool storage or fountain storage	1. Ponding on roof by constricted downspouts
Parking Lots	1. Porous pavement 2. Concrete vaults and cisterns beneath parking lots in high value areas 3. Vegetated ponding areas around parking lots 4. Gravel trenches	1. Grassy strips on parking lots 2. Grassed waterways draining parking lot 3. Ponding and detention measures for impervious areas a. Rippled pavement b. Depressions c. Basins
Residential	1. Cisterns for individual homes or groups of homes 2. Gravel driveways (porous) 3. Contoured landscape 4. Infiltration: a. Perforated pipe b. Gravel (sand) c. Trench d. Dry wells 5. Vegetated depressions	1. Retention or detention basins 2. Planting a high delaying grass (high roughness) 3. Grassy gutters or channels 4. Increased length of travel of runoff by means of vegetated swales, diversions, etc.

TABLE V-9
Advantages and Limitations of Various
On-site Stormwater Control Methods

Bioretention Facility

ADVANTAGES:

1. If designed properly, has shown ability to remove significant amounts of dissolved heavy metals, phosphorous, total suspended solids (TSS), and fine sediments.
2. Requires relatively little engineering design in comparison to other stormwater management facilities (e.g., sand filters).
3. Provides groundwater recharge when the runoff is allowed to infiltrate into the subsurface.
4. Enhances the appearance of parking lots and provides shade and wind breaks, absorbs noise, and improves an area's landscape.
5. Maintenance on a bioretention facility is limited to the removal of leaves from the bioretention area each fall.
6. The vegetation recommended for use in bioretention facilities is generally hardier than the species typically used in parking lot landscapes. This is a particular advantage in urban areas where plants often fare poorly due to poor soils and air pollution.

TABLE V-9
Advantages and Limitations of Various
On-site Stormwater Control Methods
(continued)

LIMITATIONS:

1. Low removal of nitrates.
2. Not applicable on steep, unstable slopes or landslide areas (slopes greater than 20%).
3. Requires relatively large areas.
4. Not appropriate at locations where the water table is within 6 feet of the ground surface and where the surrounding soil stratum is unstable.
5. Clogging may be a problem, particularly if the BMP receives runoff with high sediment loads.

Catch Basin Inserts

ADVANTAGES:

1. Provides moderate removal of larger particles and debris as pretreatment.
2. Low installation costs.
3. Units can be installed in existing traditional stormwater infrastructure.
4. Ease of installation.
5. Requires no additional land area.

LIMITATIONS:

1. Vulnerable to accumulated sediments being resuspended at low flow rates.
2. Severe clogging potential if exposed soil surfaces exist upstream.
3. Maintenance and inspection of catch basin inserts may be required before and after each rainfall event; excessive cleaning and maintenance.
4. Available head to meet design criteria.
5. Dissolved pollutants are not captured by filter media.
6. Limited pollutant removal capabilities.

Cisterns

ADVANTAGES:

1. Low installation cost.
2. Requires little space for installation.
3. Reduces amount of stormwater runoff.
4. Conserves water usage.

LIMITATIONS:

1. Limited amount of stormwater runoff can be captured.
2. Restricted to structure runoff.
3. Aesthetically unpleasing.

Constructed Wetlands

ADVANTAGES:

1. Artificial wetlands offer natural aesthetic qualities, wildlife habitat, erosion control, and pollutant removal.
2. Artificial wetlands can offer good treatment following treatment by other BMPs, such as wet ponds, that rely upon settling of larger sediment particles (Urbonas, 1992). They are useful for large basins when used in conjunction with other BMPs.
3. Wetlands that are permanently flooded are less sensitive to polluted water inflows because the ecosystem does not depend upon the polluted water inflow.
4. Can provide uptake of soluble pollutants such as phosphorous through plant uptake.
5. Can be used as a regional facility.

TABLE V-9
Advantages and Limitations of Various On-site Stormwater Control Methods (continued)

LIMITATIONS:

1. Although the use of natural wetlands may be more cost effective than the use of an artificial wetland, environmental, permitting, and legal issues may make it difficult to use natural wetlands for this purpose.
2. Wetlands require a continuous baseflow.
3. If not properly maintained, wetlands can accumulate salts and scum which can be flushed out by large storm flows.
4. Regular maintenance, including plant harvesting, is required to provide nutrient removal.
5. Frequent sediment removal is required to maintain the proper functioning of the wetland.
6. A greater amount of space is required for a wetland system than is required for an extended/dry detention basin treating the same amount of area.
7. Although artificial wetlands are designed to act as nutrient sinks, on occasion, the wetland may periodically become a nutrient source.
8. Wetlands that are not permanently flooded are more likely to be affected by drastic changes in inflow of polluted water.
9. Cannot be used on steep, unstable slopes or in densely populated areas.
10. Threat of mosquitoes.
11. Hydraulic capacity may be reduced with plant overgrowth.

Dry Wells

ADVANTAGES:

1. Recommended in residential areas.
2. Requires minimal space to install.
3. Low installation costs.
4. Reduces amount of runoff.
5. Provides groundwater recharge.
6. Can serve small impervious areas like rooftops.
7. Helps to disconnect impervious surfaces.

LIMITATIONS:

1. Offers little pretreatment which may cause clogging.
2. Dry wells should not be installed where hazardous or toxic materials are used, handled, or stored or where a spill of such materials would drain into the dry well.
3. Risk of groundwater contamination in very coarse soils may require groundwater monitoring.
4. Not suitable on fill sites or steep slopes.
5. Must have a minimum of 3 to 4 feet between the bottom of the dry well and the seasonal high water table.
6. Dry wells service a limited drainage area, typically only rooftop runoff.
7. Dry wells must be located at least 10 feet away from building foundations on the down slope side of the structure to prevent seepage.
8. Stormwater runoff carrying bacteria, sediment, fertilizer, pesticides, and other chemicals may flow directly into the groundwater.
9. Loss of infiltrative capacity and high maintenance cost in fine soils.
10. Low removal of dissolved pollutants in very coarse soils.
11. Soils must be permeable.
12. Not recommended for use with commercial rooftops unless adequacy of pretreatment is assured.

TABLE V-9
Advantages and Limitations of Various
On-site Stormwater Control Methods
(continued)

Extended / Dry Detention Basins or Underground Tanks

ADVANTAGES:

1. Modest removal efficiencies for the larger particulate fraction of pollutants.
2. Removal of sediment and buoyant materials. Nutrients, heavy metals, toxic materials, and oxygen-demanding particles are also removed with sediment substances associated with the particles.
3. Can be designed for combined flood control and stormwater quality control.
4. Requires less capital cost and land area when compared to a wet pond BMP.
5. Downstream channel protection when properly designed and maintained.

LIMITATIONS:

1. Require sufficient area and hydraulic head to function properly.
2. Generally not effective in removing dissolved and finer particulate size pollutants from stormwater.
3. Some constraints other than the existing topography include, but are not limited to, the location of existing and proposed utilities, depth to bedrock, location and number of existing trees, and wetlands.
4. Extended/dry detention basins have moderate to high maintenance requirements.
5. Sediments can be resuspended if allowed to accumulate over time and escape through the hydraulic control to downstream channels and streams.
6. Some environmental concerns with using extended/dry detention basins include potential impact on wetlands, wildlife habitat, aquatic biota, and downstream water quality.
7. May create mosquito breeding conditions and other nuisances.

Infiltration Basins

ADVANTAGES:

1. High removal capability for particulate pollutants and moderate removal for soluble pollutants.
2. Groundwater recharge helps to maintain dry-weather flows in streams.
3. Can minimize increases in runoff volume.
4. When properly designed and maintained, it can replicate hydrology more closely than other BMP options.
5. Basins provide more habitat value than other infiltration systems.

LIMITATIONS:

1. High failure rate due to clogging and high maintenance burden.
2. Low removal of dissolved pollutants in very coarse soils.
3. Not suitable on fill slopes or steep slopes.
4. Risk of groundwater contamination in very coarse soils may require groundwater monitoring.
5. Should not be used if significant upstream sediment load exists.
6. Slope of contributing watershed needs to be less than 20%.
7. Not recommended for discharge to a sole source aquifer.
8. Cannot be located within 100 feet of drinking water wells.
9. Metal and petroleum hydrocarbons could accumulate in soils to potentially toxic levels.
10. Relatively large land requirement.
11. Only feasible where soil is permeable and there is sufficient depth to bedrock and water table.
12. Need to be located a minimum of 10 feet down gradient and 100 feet up gradient from building foundations because of seepage problems.

TABLE V-9
Advantages and Limitations of Various
On-site Stormwater Control Methods
(continued)

Infiltration Trenches

ADVANTAGES:

1. Provides groundwater recharge.
2. Trenches fit into small areas.
3. Good pollutant removal capabilities.
4. Can minimize increases in runoff volume.
5. Can fit into medians, perimeters, and other unused areas of a development site.
6. Helps replicate hydrology and increases dry weather baseflow.

LIMITATIONS:

1. Slope of contributing watershed needs to be less than 20%.
2. Soil should have an infiltration rate greater than 0.3 inch per hour and clay content less than 30%.
3. Drainage area should be between 1 and 10 acres.
4. The bottom of the infiltration trench should be at least 4 feet above the underlying bedrock and the seasonal high water table.
5. High failure rates of conventional trenches and high maintenance burden.
6. Low removal of dissolved pollutants in very coarse soils.
7. Not suitable on fill slopes or steep slopes.
8. Risk of groundwater contamination in very coarse soils may require groundwater monitoring.
9. Cannot be located within 100 feet of drinking water wells.
10. Need to be located a minimum of 10 feet down gradient and 100 feet up gradient from building foundations because of seepage problems.
11. Should not be used if upstream sediment load cannot be controlled prior to entry into the trench.
12. Metals and petroleum hydrocarbons could accumulate in soils to potentially toxic levels.

Media Filtration

ADVANTAGES:

1. May require less space than other treatment control BMPs and can be located underground.
2. Does not require continuous baseflow.
3. Suitable for individual developments and small tributary areas up to 100 acres.
4. Does not require vegetation.
5. Useful in watersheds where concerns over groundwater quality or site conditions prevent use of infiltration.
6. High pollutant removal capability.
7. Can be used in highly urbanized settings.
8. Can be designed for a variety of soils.
9. Ideal for aquifer regions.

LIMITATIONS:

1. Given that the amount of available space can be a limitation that warrants the consideration of a sand filter BMP, designing one for a large drainage area where there is room for more conventional structures may not be practical.
2. Available head to meet design criteria.
3. Requires frequent maintenance to prevent clogging.
4. Not effective at removing liquid and dissolved pollutants.
5. Severe clogging potential if exposed soil surfaces exist upstream.
6. Sand filters may need to be placed off-line to protect it during extreme storm events.

TABLE V-9
Advantages and Limitations of Various
On-site Stormwater Control Methods
(continued)

Porous Pavement

ADVANTAGES:

1. Porous pavements operate in a similar fashion to infiltration trenches and, thus, provide similar water quality benefits, including reductions in fine-grained sediments, nutrients, organic matter, and trace metals.
2. In addition to water quality benefits, porous pavements also provide significant reductions in surface runoff with up to 90% of rainfall retained within the BMP (Schueler, 1992).
3. An added benefit provided by the on-site infiltration is the extent to which the stormwater runoff is able to contribute to groundwater recharge.
4. Reduces pavement ponding.

LIMITATIONS:

1. Only applicable for low-traffic volume areas.
2. To maintain effectiveness, porous pavements require frequent maintenance.
3. Porous pavements are not intended to remove sediments.
4. Easily clogged by sediments if not situated properly.
5. Porous pavements are limited to treating small areas (0.25 to 10 acres).
6. Contributing drainage area slopes should be 5% or less to limit the amount of sediments that could potentially lead to clogging of the porous pavement.
7. On average, porous pavements clog within 5 years.
8. Underlying soil strata must have an adequate infiltration capacity of at least 0.3 inch per hour but preferably 0.5 inch per hour or more. Adequate soil permeability should extend for a depth of at least 4 feet.
9. The bottom of the reservoir layer should be at least 4 feet above the seasonally high water table. Porous pavements should be no closer than 100 feet from drinking wells and 100 feet up gradient and 10 feet down gradient from building foundations. Due to the risk of groundwater contamination, porous pavements should not be used for gas stations or other areas with a relatively high potential for chemical spills. Similarly, special consideration should be given to the use of porous pavements in wellhead protection areas serviced by sole source aquifers.
10. The porous pavement should not be located where run-on from adjacent areas can introduce sediments to the pavement surface. Similarly, areas subject to wind-blown sediment loads should be avoided.
11. Extended rain can reduce the pavement's load-bearing capacity.
12. More expensive than traditional paving surfaces.

Storm Drain Inserts

ADVANTAGES:

1. Low installation costs.
2. Prefabricated for different standard storm drain designs.
3. Require minimal space to install.

LIMITATIONS:

1. Some devices may be vulnerable to accumulated sediments being resuspended during heavy storms.
2. Can only handle limited amounts of sediment and debris.
3. Maintenance and inspection of storm drain inserts are required before and after each rainfall event.
4. High maintenance costs.
5. Hydraulic losses.

TABLE V-9
Advantages and Limitations of Various
On-site Stormwater Control Methods
(continued)

Vegetated Filter Strips

ADVANTAGES:

1. Lowers runoff velocity (Schueler, 1987).
2. Slightly reduces runoff volume (Schueler, 1987).
3. Slightly reduces watershed imperviousness (Schueler, 1987).
4. Slightly contributes to groundwater recharge (Schueler, 1987).
5. Aesthetic benefit of vegetated "open spaces" (Colorado Department of Transportation, 1992).
6. Preserves the character of riparian zones, prevents erosion along stream banks, and provides excellent urban wildlife habitat (Schueler, 1992).

LIMITATIONS:

1. Filter strips cannot treat high velocity flows and do not provide enough storage or infiltration to effectively reduce peak discharges to levels for design storms (Schueler, 1992). This lack of quantity control dictates use in rural or low-density development.
2. Requires slopes of less than 5%.
3. Requires low to fair permeability of natural subsoil.
4. Large land requirement.
5. Often concentrates water, which significantly reduces effectiveness.
6. Pollutant removal is unreliable in urban settings.

Vegetated Swale

ADVANTAGES:

1. Relatively easy to design, install, and maintain.
2. Vegetated areas that would normally be included in the site layout, if designed for appropriate flow patterns, may be used as a vegetated swale.
3. Relatively inexpensive.
4. Vegetation is usually pleasing to residents.

LIMITATIONS:

1. Irrigation may be necessary to maintain vegetative cover.
2. Potential for mosquito breeding areas.
3. Possibility of erosion and channelization over time.
4. Requires dry soils with good drainage and high infiltration rates for better pollutant removal.

Wet Ponds

ADVANTAGES:

1. Wet ponds have recreational and aesthetic benefits due to the incorporation of permanent pools in the design.
2. Wet ponds offer flood control benefits in addition to water quality benefits.
3. Wet ponds can be used to handle a maximum drainage area of 10 mi^2.
4. High pollutant removal efficiencies for sediment, total phosphorus, and total nitrogen are achievable when the volume of the permanent pool is at least three times the water quality volume (the volume to be treated).
5. A wet pond removes pollutants from water by both physical and biological processes; thus, they are more effective at removing pollutants than extended/dry detention basins.
6. Creation of aquatic and terrestrial habitat.

LIMITATIONS:

1. Wet ponds may be feasible for stormwater runoff in residential or commercial areas with a combined drainage area greater than 20 acres but no less than 10 acres.

TABLE V-9
Advantages and Limitations of Various
On-site Stormwater Control Methods
(continued)

2. An adequate source of water must be available to ensure a permanent pool throughout the entire year.
3. If the wet pond is not properly maintained or the pond becomes stagnant, floating debris, scum, algal blooms, unpleasant odors, and insects may appear.
4. Sediment removal is necessary every 5 to 10 years.
5. Heavy storms may cause mixing and subsequent resuspension of solids.
6. Evaporation and lowering of the water level can cause concentrated levels of salt and algae to increase.
7. Cannot be placed on steep, unstable slopes.
8. Pending volume and depth, pond designs may require approval from the State Division of Dams Safety.

Source: *Advantages/Limitations adapted from Los Angeles County Development Planning for Storm Water Management Manual, September 2002.*

H. Sub-Regional (Combined Site) Storage

Traditionally, the approach to stormwater management has been to control the runoff on an individual site basis. There is a growing commitment to finding cost-effective comprehensive control techniques that both preserve and protect the natural drainage system. In other words, two developers developing sites adjacent to each other could pool their capital resources to provide for a community stormwater storage facility in the most hydrologic advantageous location.

The goal should be the development and use of the most cost-effective and environmentally sensitive stormwater runoff controls. These controls will significantly improve the capability and flexibility of land developers and communities to control runoff consistent with the Crum Creek Watershed Stormwater Management Plan.

There is also the possibility that the stormwater could be managed "off-site;" that is, in a location off the property(ies) in question. These stormwater management facilities could be constructed in an offsite location more hydrologically advantageous to the watershed. These facilities could be publicly owned detention, retention, lake, pond, or other physical facilities to serve multiple developments. The design and release rate would need to be consistent with the plan.

I. Exemptions

Table V-10 (Table 106.1 from the Model Ordinance) summarizes the exemptions from this Ordinance. Exemptions are for the items noted in Table V-11 only and shall not relieve the Applicant from implementing the requirements of the municipal Ordinance or from implementing such measures as are necessary to protect public health, safety, and property. An exemption shall not relieve the Applicant from complying with the special requirements for watersheds draining to identified high quality (HQ) or exceptional value

(EV) waters or any other current or future federal, state or municipal water quality protection requirements. If a drainage problem is documented or known to exist downstream of, or is expected from the proposed activity, then the Municipality may withdraw exemptions listed in the Exemptions Table and require the Applicant to comply with all requirements of the Municipal Ordinance.

TABLE V-10
Ordinance Exemptions for the Crum Creek Watershed

Ordinance Article or Section	Type of Project	Proposed Impervious Surface			Earth Disturbance		
		0-499 sq. ft.	500-999 sq. ft.	1,000+ sq. ft.	0-4,999 sq. ft. disturbance	5,000 sq. ft. - < 1 acre	≥ 1 acre
Article IV SWM Site Plan Requirements	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Exempt	Modified[1]	Not Exempt
Section 304 Nonstructural Project Design	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Exempt	Not Exempt	Not Exempt
Section 305 Infiltration Volume Requirements	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Exempt	Exempt	Not Exempt
Section 306 Water Quality Requirements	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Modified[2]	Modified[2]	Not Exempt
Section 307 Stream Bank Erosion Requirements	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Exempt	Exempt	Not Exempt
Section 308 Stormwater Peak Rate Control and Management Districts	Development Redevelopment	Exempt	Exempt	Not Exempt	Exempt	Not Exempt	Not Exempt
Erosion and Sediment Pollution Control Requirements	Must comply with Title 25, Chapter 102 of the PA Code and other applicable state and municipal codes, including the Clean Streams Law.						Not Exempt

Legend:

- **"Proposed Impervious Surface" in Table 106.1 includes new, additional, or replacement impervious surface/cover as part of development or redevelopment.**
- Exempt - Exempt from required section provision only – SWM site plan submission may still be required if other section provisions are applicable.
- Modified[1] - Modified SWM site plan need only consist of items in Sections 402.A.2 and 4; 402B.7, 8, 11, and 22; and 402.D.1 and 3 and related supportive material needed to determine compliance with Sections 304 and 308. Modified SWM site plan is required that includes all elements of Section 304 as applicable, except sections; 304.B.6, 304.B.7, and 304.B.8.
- Modified[2] - Modified SWM site plan need only consist of items and related material needed to determine compliance with section 306.C.
- Simplified Approach **– Must comply with provisions of Appendix B of the Ordinance.**
- Redevelopment – See Section 308.I for alternate stormwater peak rate control criteria.

Requirements vary based on size and nature of development and are meant to be functional without being overly burdensome. They are as follows:

1. Regulated activities with proposed impervious surfaces between 0 and 499 square feet or earth disturbance between 0 and 4,999 square feet are exempt from fulfilling any requirements of the Model Ordinance, with the exception of existing erosion and sedimentation requirements, and in the case of earth disturbance, Section 306.C of the Ordinance.

2. Regulated activities involving earth disturbance between 5,000 square feet and 1 acre are required to submit a modified Stormwater Management (SWM) plan that only needs to consist of the items in Sections 402.A.2 and 4; 402.B.7, 8, 11, and 22; and 402.D.1 and 3 of the Model Ordinance. Additionally, the SWM site plan also needs to contain any related supportive material needed to determine compliance with Sections 304, 306, and 308 of the Model Ordinance, as applicable. It must satisfy the nonstructural project design, stormwater peak rate control, and management district requirements of the Model Ordinance, but is exempt from all other requirements of the Model Ordinance.

3. All regulated activities with proposed impervious surfaces between 500 and 999 square feet must use the simplified approach found in Appendix B of the Model Ordinance. The simplified approach requires that the first one inch (1.0”) of runoff from all new impervious surfaces be captured. The simplified approach includes a description of several different types of BMPs that can be used to capture the first one inch (1.0”) of runoff and step by step instructions used to determine the size of the BMPs based on the amount of proposed impervious surface. The simplified approach requires the submission of a worksheet showing calculations for BMP sizing, a simple sketch plan, and a signed operations and maintenance agreement all of which are found in Appendix B of the Model Ordinance.

4. All regulated activities that have impervious surfaces greater than 1,000 square feet and/or having greater than 1 acre of earth disturbance must meet all requirements of the Model Ordinance.

Any regulated activity that is exempt from some provisions of the Ordinance is exempt only from those provisions. If development is to take place in phases, the developer is responsible for implementing the requirements of the Ordinance as the impervious cover/earth disturbance threshold is met. The date of the municipal Ordinance adoption shall be the starting point from which to consider tracts as “parent tracts” in which future subdivisions and respective impervious area and earth disturbance computations shall be cumulatively considered. Exemption shall not relieve the applicant from implementing such measures as are necessary to protect health, safety, and property.

For example:
If a property owner proposes a 150 square foot shed after adoption of the municipal stormwater management Ordinance, the property owner would be exempt from water quality and quantity requirements of the Ordinance as noted in Table I-1. If, at a later date, the property owner proposes to construct a 499 square foot room addition, the

applicant would be required to comply with the requirements for the Simplified Method for the full 649 square feet of impervious cover created since adoption of the municipal Ordinance. If an additional 700 square foot swimming pool/patio is proposed later, the property owner would be required to implement the full stormwater quantity and quality control submission requirements of the Model Ordinance for the total 1,349 square feet of additional impervious surface added to the original property since adoption of the municipal Ordinance.

Exemptions for Specific Activities:

1. Use of land for gardening or home consumption.

2. Agriculture when operated in accordance with a conservation plan, nutrient management plan, or erosion and sedimentation control plan approved by the County Conservation District. This includes activities such as growing crops, rotating crops, tilling soil, and grazing animals. For agriculture with an approved conservation plan, installation of new or expansion of existing farmsteads, animal housing, waste storage, and production areas having impervious surfaces that result in a net increase in impervious surface of between 500-999 square feet shall apply the simplified approach. Net increases in impervious surface of greater than or equal to 1,000 square feet shall be subject to the provisions of this Ordinance.

3. Forest management operations which are following the Pennsylvania Department of Environmental Protection (PADEP) management practices contained in its publication, "Soil Erosion and Sedimentation Control Guidelines for Forestry," and are operating under an approved erosion and sedimentation plan and must comply with the stream buffer requirements in Section 306.C.

4. Repaving without reconstruction.

5. Emergency Exemption - Emergency maintenance work performed for the protection of public health, safety, and welfare. A written description of the scope and extent of any emergency work performed shall be submitted to the Municipality within two (2) calendar days of the commencement of the activity. If the Municipality finds that the work is not an emergency, then the work shall cease immediately and the requirements of this Ordinance shall be addressed as applicable.

6. Maintenance Exemption - Any maintenance to an existing stormwater management system made in accordance with plans and specifications approved by the municipal Engineer or Municipality.

7. Recreational trails, facilities, and appurtenances subject to review provided they comply with all federal, state, and local floodplain policies and regulations.

SECTION VI

MUNICIPAL ORDINANCE INTRODUCTION

Municipalities within the Commonwealth of Pennsylvania are empowered to regulate land use activities that affect runoff by the authority of the Act of October 4, 1978, 32 P.S., P.L. 864 (Act 167) Section 680.1 et seq., as amended, "The Storm Water Management Act." Act 167 requires that:

- Counties prepare a watershed stormwater management plan in conformance with the requirements of Act 167 for each watershed within their boundaries.

- The plans evaluate present and future runoff within the watershed and make technical recommendations for the control and management of runoff from new development (both quantity and quality).

- Municipalities implement the plan via a stormwater ordinance developed as part of the plan.

- Developers control the quantity and quality of runoff from new development (including redevelopment) in accordance with each municipality's implementing ordinance.

The Storm Water Management Act emphasizes locally administered stormwater programs with watershed municipalities taking the lead role to execute the provisions of the plan. Implementation and enforcement of the watershed plan standards and criteria require municipalities to adopt the appropriate ordinance provisions that regulate the alteration or development of land, including subdivision and land development within a municipality (Section 13 of Act 167). As part of the preparation of the Crum Creek Watershed Stormwater Management Plan, a model municipal ordinance was created that will serve as a tool to implement the plan provisions. This single purpose ordinance can be adopted by each municipality "as is" with limited revisions to fulfill the required stormwater management needs of a particular municipality with respect to Act 167.

In addition to adopting the ordinance itself, municipalities must revise their existing subdivision and land development and zoning ordinances and building codes to incorporate necessary linking provisions into the existing ordinances. These linking provisions are placed in the existing ordinances to refer parties engaging in various activities that may affect stormwater within the watershed to the single purpose ordinance. Key provisions of the model stormwater ordinance include stormwater management standards and criteria, performance standards for stormwater management, and maintenance provisions for stormwater facilities.

The model stormwater ordinance is worded and designed to be understandable, applied fairly and uniformly throughout the watershed, and to allow for creative solutions to stormwater management problems. It is provided so that the municipalities within the

Crum Creek watershed can adopt a uniform regulatory approach for stormwater management within the Crum Creek watershed.

The implementation of the runoff control strategy for development within the watershed will be through municipal adoption of the appropriate ordinance provisions. The "Crum Creek Watershed Act 167 Stormwater Management Ordinance" will not completely replace the existing storm drainage ordinance provisions currently in effect in the municipalities. The reasons for this are as follows:

- Not all of the municipalities in the Crum Creek watershed are completely within the watershed. For those portions of the municipality outside of the Crum Creek watershed, the existing municipal ordinance provisions would still apply unless the Crum Creek ordinance is adopted municipality-wide.

- Permanent and temporary stormwater control facilities are regulated by the Act 167 ordinance. Stormwater management and erosion and sedimentation control during construction would continue to be regulated under the existing stormwater ordinance and Chapter 102 Erosion and Sediment and Pollution Controls, Title 25 of PADEP Regulations.

- The Act 167 ordinance contains only those minimum stormwater runoff control standards and criteria that are necessary or desirable from a total watershed perspective. Additional stormwater management design criteria (i.e., inlet spacing, inlet type, collection system details, etc.) that should be based on sound engineering practice should be regulated under the current ordinance provisions or as part of the general responsibilities of the municipal engineer.

The following model ordinance, presented in Appendix 3 of this plan and summarized below, has been developed specifically for municipalities within the Crum Creek watershed in order to implement the Crum Creek Stormwater Management Plan. Municipalities may elect to either create a single-purpose stormwater ordinance (recommended) or amend existing zoning and subdivision ordinances or other codes ordinances to implement the associated stormwater management plan.

All of the provisions within this model ordinance (unless specifically designated as optional) are required to be part of the municipal stormwater ordinance or other ordinances implementing the requirements of the stormwater management plan.

A. Organization

This model ordinance contains the following eight articles, each with specific provisions.

Article I - General Provisions: This article includes general administrative provisions including applicable land areas and regulated activities. This article also includes the stormwater management exemption criterion.

Article II - Definitions: This article provides a list of common terms and associated definitions used throughout the ordinance.

Article III - Stormwater Management: This article represents the technical provisions for stormwater management within the Crum Creek watershed and includes the stormwater management district implementation provisions, water quality requirements, design criteria, calculation methods, erosion and sedimentation requirements, streambank erosion, and infiltration.

Article IV - Stormwater Management (SWM) Site Plan Requirements: This article lists the specific requirements for submittal, content, and review of SWM site plans required by the ordinance.

Article V - Inspections: This article describes inspection procedures for permanent stormwater management and water quality facilities.

Article VI - Fees and Expenses: This article contains the provisions for a municipal review fee.

Article VII - Maintenance Responsibilities: This article outlines the applicants' responsibilities for operation and maintenance of stormwater management facilities.

Article VIII - Prohibitions: This article outlines the prohibited discharges, prohibited connections, roof drain requirements, and requirements concerning the alteration of BMPs.

Article IX - Enforcement and Penalties: This article describes municipal enforcement procedures, remedies, and the appeals process.

Appendices: This section of the model ordinance contains several technical support appendices necessary to implement the ordinance provisions.

Please note that the plan and associated ordinance provisions were developed under the authority of, and in strict conformance with, the requirements of Act 167. These documents were prepared in consultation with a Watershed Plan Advisory Committee (WPAC) comprised of designated representatives from each of the watershed municipalities, County Planning and Conservation District staff, Chester-Ridley-Crum Watershed Association, and Chester County Water Resources Authority. Other advisory members invited to serve on the WPAC include representatives from the Natural Resource Conservation Service and Aqua America Pennsylvania. All of the proposed ordinance provisions were reviewed and accepted by a majority of the voting members of the WPAC who attended the meetings.

Within six months following County adoption and PADEP approval of a watershed stormwater management plan, each municipality within the watershed is required to

adopt or amend stormwater ordinances as laid out in the plan. These ordinances must regulate development within the Crum Creek watershed in a manner consistent with the watershed stormwater management plan and the provisions of the Act.

The following amendment is required for municipalities that issue an occupancy permit:

- An occupancy permit shall not be secured or issued unless the provisions of the Crum Creek Stormwater Management Ordinance have been followed. The occupancy permit shall be required for each lot owner and/or developer of all major and minor subdivisions and land development in the municipality.

For municipalities without an occupancy permit, they may want to adopt the above draft and include other regulatory items in the occupancy permit requirement for their own use.

B. Ordinance Requirements

The following ordinance provisions must be retained when a municipality either elects to create a single-purpose stormwater ordinance or amends existing subdivision or zoning ordinances to implement the stormwater management plan.

- Article I - General Provisions
- Article II - Definitions
- Article III - Design Criteria for Stormwater Management Facilities Sections 301, 302, 303, 304, 305, 306, 307, 308 (except G and H), 309, 310
- Article IV - SWM Site Plan Contents – Section 402
- Article V - Inspections (language may be modified by municipality)
- Article VII - Maintenance (language may be modified by municipality) Sections 701, 702, 703, 704, 705, 706, 707
- Article VIII - Prohibitions
- Article IX - Enforcement and Penalties (only when enacting a single-purpose Ordinance)

The following Ordinance provisions are optional, but recommended to be retained:

- Section 708 - Municipal Stormwater Control and BMP Operation and Maintenance Fund
- Article VI - Fees and Expenses

All other provisions are optional and may be modified to be consistent with other municipal ordinances related to land development.

Note: If a municipality chooses to use the model ordinance to implement the stormwater management plan, it is recommended that the ordinance be submitted to the municipal solicitor, engineer, and PADEP for review prior to enactment.

C. NPDES Requirements

Federal regulations approved October 1999 require operators of small municipal separate storm sewer systems (MS4s) to obtain NPDES Phase II permits from PADEP by March 2003. (NPDES II is an acronym for the National Pollutant Discharge Elimination System Phase II Stormwater Permitting Regulations.) This program affects all municipalities in "urbanized areas" of the state. This definition applies to all Crum Creek watershed municipalities. Therefore, all municipalities within the Crum Creek watershed will be subject to the NPDES Phase II requirements mandated by the Federal Clean Water Act as administered by PADEP. For more information on NPDES II requirements, contact the PADEP Regional Office.

This plan and model ordinance are consistent with PADEP's post-construction stormwater management requirement in effect for the NPDES II/MS4 communities at the time of approval of this plan.

D. Implementation

In order to aid the municipalities and developers in the implementation process, flow charts have been developed as shown in Ordinance Appendix D.

E. Administration

As stated in Section 105 of the model ordinance, all regulated activities and all activities that may affect stormwater runoff, including land development and earth disturbance activity, within the portion of the municipality located in the Crum Creek Watershed, as delineated in Appendix A, are subject to regulation by the Ordinance.

SECTION VII

PRIORITIES FOR IMPLEMENTATION

The Crum Creek Stormwater Management Plan preparation process is complete with Chester and Delaware Counties' adoption of the plan and its submission to the PADEP for approval. This sets in motion the mandatory schedule of adoption of ordinances needed to implement stormwater management criteria. After approval of the plan by the counties and PADEP, the individual municipalities in the Crum Creek watershed have six months from the date of the PADEP approval to adopt the necessary ordinance provisions.

A. PADEP Approval of the Plan

Upon adoption of the Crum Creek watershed plan by Chester and Delaware Counties, the plan was submitted to PADEP for approval. A draft of the stormwater management plan containing the draft model ordinance was sent to PADEP prior to adoption of the plan. The PADEP review process involved determination that all of the activities specified in the Scope of Study had been completed. PADEP also reviewed the plan for consistency with municipal floodplain management plans, state programs that regulate dams, encroachments and other water obstructions, as well as state and federal flood control programs. The review process also ensured that the plan is compatible with other watershed stormwater plans in the basin and that the plan is consistent with the policies of Act 167.

B. Publishing the Final Plan

Upon PADEP approval, the Delaware County Planning Department published and provided a minimum of two copies of the plan to each municipality. The plan includes this report, appendices, figures, and the Crum Creek Model Ordinance.

C. Municipal Adoption of Ordinance to Implement the Plan

The essential ingredient for implementation of the Crum Creek Stormwater Management Plan is the adoption of the necessary ordinance provisions by the watershed municipalities. Provided as part of the plan is the Act 167 Stormwater Management Plan Model Ordinance which is a single purpose stormwater ordinance that could be adopted by each municipality essentially "as is" to implement the plan. The single purpose ordinance was chosen for ease of incorporation into the existing structure of municipal ordinances. All that is required of any municipality would be to adopt the ordinance itself and adopt the necessary provisions for tying into the existing subdivision and land development ordinance, zoning ordinance, and building code as outlined in the Municipal Ordinance Matrix in the Appendix 2 of this plan. The tying provisions would simply refer any applicable regulated activities within the Crum Creek watershed from the other ordinances to the single purpose ordinance. Therefore, it is recommended that the delineation of the watershed subareas and the stormwater management criteria assigned to each subarea be enacted as part of, or cross-referenced in, each municipality's zoning

or subdivision ordinance and building code. This way the requirements for management of stormwater will be applicable to all changes in land cover and not be limited to activities that are subject to subdivision and land development regulations.

D. Level of Government Involvement in Stormwater Management

The existing institutional arrangements for the management of stormwater include federal, state, and county governments, as well as every municipality within the watershed.

In the absence of a single entity with responsibility for all aspects of stormwater management within a watershed, it is clear that the "management" that occurs is primarily a function of a multiple permitting process where a developer attempts to satisfy the requirements of all of the permitting agencies. Each public agency has established its own regulations based on its own objectives and legislative mandates as well as its own technical standards according to its particular stormwater concerns.

The minimum objectives of this plan and the minimum mandates of Act 167 can be accomplished without significant modification of existing institutional arrangements. Actions must be taken at the municipal level. Participation by the Counties in the technical review of stormwater management plans is necessary. In addition, there must be maintenance and operation of the computer model (as necessary) as well as compilation of data required for periodically updating the plan. In addition, upon adoption of the plan, all future public facilities, facilities for the provision of public utility services, and facilities owned or financed by state funds were required to be consistent with the plan.

The primary municipal level activity will be the adoption or amendment of development regulations to incorporate watershed stormwater management standards. Act 167 requires that this be accomplished within six months of the plan's adoption and approval. Model ordinance provisions will be distributed to all of the watershed municipalities. The Chester and Delaware County planning agencies will be available upon request to assist municipalities in the adoption of the model ordinance provisions to fit particular municipal ordinance structures.

E. Countywide Coordination

There are possible situations of stormwater management functions and concerns, which may not be adequately addressed within the structure of the existing institutional arrangements or by the adoption and enforcement of new regulations at the municipal level, as outlined above.

For example, the construction of regional storage facilities may offer an economic and technically sound alternative to the construction of individual, on-site detention basins. There is, however, no organization that is capable of implementing such a concept. To do so would require a multi-municipal entity capable of planning, financing, constructing, operating, and maintaining the shared storage facilities in a manner similar to the

management required for the collection, treatment, and disposal of sanitary wastes; such an organization for stormwater is not currently enabled.

The Crum Creek watershed is a drainage system. All of its parts are interrelated. What happens upstream affects what happens downstream, and what happens downstream places limitations on what happens upstream. If runoff is not controlled in upstream communities, downstream communities will flood. If the capacity of a drainage channel can be safely increased in a downstream facility, more upstream runoff may be released, thus reducing the cost of required upstream control facilities.

The reduced peak rate flow standard proposed in this plan is one way to manage stormwater on a watershed basis. It is a very simple concept that can be implemented on a property-by-property basis. The same technical tool that allowed the modeling of rainfall routing throughout the watershed as the development of a usable standard for property-level control is also capable of testing numerous, technically feasible, solutions that would work for combinations of properties and subareas. Some of these potential solutions may be preferable to those that would result from the application of release rates to individual properties.

There are ways to work out agreements on a case-by-case basis to permit the accomplishment of almost any objective, whether a public or a private undertaking. As the number of stormwater detention and control facilities increases during future years, continuing maintenance to ensure the integrity of structures and their performance will become very important. A proliferation of "special agreements" to handle special situations may make future accountability very difficult.

Section 5.B.9 of Act 167 calls for an evaluation of areas to be served by stormwater collection and control facilities, a schedule for development, and associated costs. This plan critically evaluated such elements, and it was determined that it is not feasible during this planning cycle; however, it will be a priority for review during the next planning cycle.

F. Correction of Existing Drainage Problems

The development of the watershed plan has provided a framework for the correction of existing drainage problems, a logical first step in the process of implementation of a stormwater management ordinance. It will prevent the worsening of existing drainage problems and prevent the creation of new drainage problems as well. The step-by-step outline below is by no means a mandatory action to be taken by the municipalities with watershed plan adoption options; it is just one method of solving problems uniformly throughout the watershed in order to solve current runoff situations.

1. Prioritize a list of storm drainage problems within the municipalities based on frequency of occurrence, potential for injury, as well as damage history.

2. Develop a detailed engineering evaluation to determine the exact nature of the

top priority drainage problems within the municipalities in order to determine solutions, cost estimates, and a recommended course of municipal action.

3. Incorporate implementation of recommended solutions regarding stormwater runoff in the annual municipal capital or maintenance budget.

G. Culvert Replacement

The general procedures for municipalities to determine size of replacement culverts using Act 167 data is as follows:

1. Determine the location and municipality of obstruction on the obstruction map and obtain the obstruction number.

2. From Section 105.161 of DEP's Chapter 105, determine the design storm frequency.

3. From "Municipal Stream Obstruction Data" tables, locate the municipality and obstruction number. Locate the flow value (cfs) for the design storm frequency determined in #2 above.

4. Have the culvert sized for this design flow and obtain any necessary approvals/permits.

Note: Any culverts/stream crossings not identified on the obstruction map need to have storm flows computed for sizing purposes (i.e., those culverts which were not measured due to lack of maintenance and therefore the inability to determine the actual size of the obstruction).

H. PENNVEST Funding

One way in which the completion and implementation of this plan can be of assistance in addressing storm drainage problems is by opening the avenue of funding assistance through the PENNVEST program. The PENNVEST Act of 1988, as amended, provides low interest loans to governmental entities for the construction, improvement or rehabilitation of stormwater projects including the transports, storage and infiltration of stormwater, and best management practices to address nonpoint source pollution associated with stormwater.

In order to qualify for a loan under PENNVEST, the municipality or county:

1. Must be located in a watershed for which there is an existing county adopted and PADEP approved stormwater plan with enacted stormwater ordinances consistent with the plan, or

2. Must have enacted a stormwater control ordinance consistent with the Stormwater Management Act.

I. Landowner's/Developer's Responsibilities

As stated in Pennsylvania Act 167, Section 13, "Any landowner and any person engaged in the alteration or development of land that may affect stormwater runoff characteristics shall implement such measures consistent with the provisions of the applicable watershed stormwater plan as are reasonably necessary to prevent injury to health, safety or other property. Such measures shall include such actions as are required:

1. To assure the maximum rate of stormwater runoff is no greater after development than prior to development activities; or

2. To manage the quantity, velocity and direction of resulting stormwater runoff in a manner that otherwise adequately protects health and property from possible injury."

Many developers throughout the state, after realizing the natural resource, public safety, and potential economic advantages of proper stormwater management, are constructing development consistent with natural resources protection.

SECTION VIII

PLAN REVIEW, ADOPTION, AND UPDATING PROCEDURES

A. County Adoption

Prior to plan completion, Delaware County transmitted a draft of the proposed Crum Creek Stormwater Management Ordinance for review and comment to affected municipal planning commissions, local governing bodies, the WPAC, and other interested parties. Delaware County transmitted a draft plan, which included the draft ordinance for review and comment to the municipal planning commission and the governing body of each involved municipality, the County Planning Department or Commission and the WPAC by official correspondence. This review included an evaluation of the plan's consistency with other plans and programs affecting the watershed. The reviews and comments were submitted to the County by official correspondence. The County received, tabulated, and responded to the comments and revised the plan as necessary.

Chester and Delaware Counties held a joint public hearing. A public hearing notice was published in a newspaper of general circulation in each county two weeks prior to the hearing date. The hearing notice contained a summary of the principal provisions of the plan and stated where copies of the plan could be examined or obtained within each municipality. The comments received at the public hearing were reviewed by the Counties, and appropriate modifications to the plan were made.

The plan was passed as a resolution by the respective County governing bodies for the purpose of adoption. The resolution included references to the volumes, figures, appendices, and model ordinance. The County resolutions were recorded in the minutes of a regular meeting of Delaware County Council and the Chester County Commissioners.

Delaware County submitted to PADEP the following information: a letter of transmittal; three copies of the adopted plan; the review by each affected municipal planning agency, local governing body, and the County Planning Department; public hearing notice and minutes; and the resolution of adoption of the plan by each County. The letter of transmittal stated that Delaware County has complied with all procedures outlined in Act 167 and requested that the PADEP approve the adopted plan.

B. Provisions for Plan Revision

Section 5 of the Stormwater Management Act requires that the stormwater management plan be updated at least every five years. This requirement considers the changes in land cover, obstructions, flood control projects, floodplain identification, and management objectives or policy that may take place within the watershed.

It will be necessary to collect and manage the required data in a consistent manner and preferably store it in a central location. This data is not only needed to prepare an updated

plan, but also, if required, to make interim runs on the runoff simulation model to analyze the impact of a proposed major development or a proposed major stormwater management facility.

The following recommendations are the minimum requirements to maintain an effective technical position for periodically reviewing and revising the plan:

1. It is recommended that the Delaware County Council authorize the County Planning Department to undertake the task of organizing stormwater management plans and supporting data submitted for review. The Planning Department should also assume responsibility for periodically reviewing, revising, and updating the stormwater management plan.

2. It is recommended that the Delaware County Planning Department prepare a workable program for the identification, collection, and management of the required data. The program should not be limited to the cooperative efforts of the constituent member municipalities within the Crum Creek watershed, but should also include both State and County agencies concerned with stormwater management.

3. It is recommended that the WPAC convene biannually or as needed to review the Stormwater Management Plan and determine if the plan is adequate for minimizing the runoff impacts of new development. At a minimum, the information (to be reviewed by the WPAC) will be as follows:

    a. Development activity data as monitored by the County planning agencies
    b. Information regarding additional storm drainage problem areas as provided by the municipal representatives to the WPAC
    c. Zoning and Subdivision amendments within the watershed
    d. Impacts associated with any regional or subregional detention alternatives implemented in the watershed
    e. Adequacy of the administrative aspects of regulated activity review
    f. Additional hydrologic data available through preparation of the Stormwater Management Plan for the Crum Creek watershed

The WPAC will review the information noted above and make recommendations to the Counties for revisions to the Crum Creek Watershed Stormwater Management Plan. The Counties will review the recommendations of the WPAC and determine if revisions are to be made. A revised plan would be subject to the same rules of adoption as the original plan. Should the Counties determine that no revisions to the plan are required for a period of five consecutive years, the Counties will adopt a resolution stating that the plan has been reviewed and been found satisfactory to meet the requirements of Act 167. The resolution will then be forwarded to PADEP.

SECTION IX

FORMATION OF THE CRUM CREEK WATERSHED ADVISORY COMMITTEE

The following is a listing of the meetings held by the WPAC during the preparation and adoption of the detailed watershed stormwater management plan.

WPAC meetings and their purposes were as follows:

Meeting	Date	Purpose
1	9/17/2004	Provided an introduction to stormwater management; reviewed Act 167; distributed data collection forms; discussed coordination with other study initiatives; progress report; summary of Scope of Study result; reviewed Model NPDES / Stormwater Management Ordinance.
2	11/14/2005	Provided a summary of data collection, field work and GIS mapping; status of data collection form collection; reviewed / commented on NPDES – Act 167 Post Construction Stormwater Management Ordinance Implementation; TMDLs.
3	1/11/2007	Reviewed Act 167 and NPDES / Act 167 Ordinance; provided a status of the project and progress report – technical portion, obstruction data, modeling results, and preliminary management districts.
4	2/5/2008	Reviewed goals of Act 167; provided a report on status of project indicating that modeling, GIS mapping, data collection, draft Act 167 Plan, and draft Act 167 Ordinance were complete; discussed standards and criteria to be placed in Model Ordinance; outlined final steps to complete Act 167 Plan and Model Ordinance.
5	10/28/2008	Reviewed Model Ordinance and compared with Darby-Cobbs Model Ordinance; outlined final steps to complete Act 167 Plan and Model Ordinance.
6	5/1/2009	Reviewed Model Ordinance, discussed plan implementation, and NPDES II requirements.

SECTION X

REFERENCES

1. Delaware County Planning Department, *Natural Features Inventory of Delaware County*, 1985.

2. Delaware County Planning Department & Borton-Lawson Engineering, Act 167 Stormwater Management Plan for the Crum Creek Watershed, Phase I Scope of Study (2000).

3. Department of Environmental Protection, Pennsylvania Stormwater Best Management Practices Manual, December 2006.

4. Federal Emergency Management Agency, Flood Insurance Study – Chester County, Pennsylvania, September 29, 2006.

5. Federal Emergency Management Agency, Flood Insurance Study – Delaware County, Pennsylvania, May 2, 1995.

6. Maryland Department of the Environment, Maryland Stormwater Design Manual, Volumes I & II.

7. Pennsylvania Association of Conservation Districts, *Pennsylvania Handbook of Best Management Practices for Developing Areas* (November 1997).

8. Pennsylvania Department of Conservation and Natural Resources, *Pennsylvania Geologic Survey*, 2001.

9. The Nature Conservancy, *Natural Areas Inventory of Delaware County*, 1992 & 1998.

10. USDA, Soil Conservation Service (sic Natural Resources Conservation Service), *Soil Survey of Delaware County, PA*, 1963, revised 1972.

11. USDA, Soil Conservation Service (sic Natural Resources Conservation Service), *Soil Survey of Chester County, PA*, 1963, revised 1972.

12. United States Geological Survey, *Groundwater Resources of Delaware County*, 1996.

PLAN APPENDIX 1

MODEL ORDINANCE

CRUM CREEK WATERSHED STORMWATER MANAGEMENT MODEL ORDINANCE

ORDINANCE NO._____ OF _____

_[*Municipality*], __[*County*] _ COUNTY,

PENNSYLVANIA

Adopted at a Public Meeting held on

_____, 20__

TABLE OF CONTENTS

PAGE

TABLE OF CONTENTS
(continued) **PAGE**

ORDINANCE APPENDICES

TABLE OF CONTENTS
(continued) **PAGE**

ARTICLE I – GENERAL PROVISIONS

Section 101. Short Title

This Ordinance shall be known as the "Crum Creek Watershed Stormwater Management Ordinance."

Section 102. Statement of Findings

The governing body of the Municipality finds that:

A. Inadequate management of accelerated stormwater runoff resulting from development throughout a watershed increases flood flows and velocities, contributes to erosion and sedimentation, overtaxes the carrying capacity of existing streams and storm sewers, greatly increases the cost of public facilities to convey and manage stormwater, undermines floodplain management and flood reduction efforts in upstream and downstream communities, reduces infiltration, and threatens public health and safety.

B. Inadequate planning and management of stormwater runoff resulting from land development throughout a watershed can also harm surface water resources by changing the natural hydrologic patterns, accelerating stream flows (which increase scour and erosion of stream beds and stream banks, thereby elevating sedimentation), destroying aquatic habitat, and elevating aquatic pollutant concentrations and loadings such as sediments, nutrients, heavy metals, and pathogens. Groundwater resources are also impacted through loss of recharge.

C. A comprehensive program of stormwater management, including minimization of impacts of development, redevelopment, and activities causing accelerated erosion and loss of natural infiltration, is fundamental to the public health, safety, welfare, and the protection of the people of the Municipality and all of the people of the Commonwealth, their resources, and the environment.

D. Stormwater can be an important water resource by providing infiltration for water supplies and baseflow of streams, which also protects and maintains surface water quality.

E. Impacts from stormwater runoff can be minimized by using project designs that maintain the natural hydrologic regime and sustain high water quality, infiltration, stream baseflow, and aquatic ecosystems. The most cost-effective and environmentally advantageous way to manage stormwater runoff is through nonstructural project design that minimizes impervious surfaces and sprawl, avoids sensitive areas (i.e., stream buffers, floodplains, steep slopes), and considers topography and soils to maintain the natural hydrologic regime.

F. Public education on the control of pollution from stormwater is an essential component in successfully addressing stormwater.

G. Federal and state regulations require certain municipalities to implement a program of stormwater controls. These municipalities are required to obtain a permit for stormwater discharges from their separate storm sewer systems under the National Pollutant Discharge Elimination System (NPDES).

H. Nonstormwater discharges to municipal separate storm sewer systems can contribute to pollution of waters of the Commonwealth by the Municipality.

Section 103. Purpose

The purpose of this Ordinance is to promote the public health, safety, and welfare within the Municipality by maintaining the natural hydrologic regime and minimizing the impacts described in Section 102 of this Ordinance through provisions designed to:

A. Promote alternative project designs and layouts that minimize the impacts on surface and groundwater.

B. Promote nonstructural best management practices (BMPs).

C. Minimize increases in runoff stormwater volume.

D. Minimize impervious surfaces.

E. Manage accelerated stormwater runoff and erosion and sedimentation problems and stormwater runoff impacts at their source by regulating activities that cause these problems.

F. Provide review procedures and performance standards for stormwater planning and management.

G. Utilize and preserve existing natural drainage systems as much as possible.

H. Manage stormwater impacts close to the runoff source, requiring a minimum of structures and relying on natural processes.

I. Focus on infiltration of stormwater to maintain base flow, to prevent degradation of surface and groundwater quality, and to otherwise protect water resources.

J. Protect base flows and quality of streams and watercourses, where possible.

K. Meet legal water quality requirements under state law, including regulations at 25 Pennsylvania Code Chapter 93.4.a requiring protection and maintenance of “existing uses” and maintenance of the level of water quality to support those uses in all streams, and the protection and maintenance of water quality in “special protection” streams.

L. Address the quality and quantity of stormwater discharges from the development site.

M. Provide standards to meet certain NPDES MS4 permit requirements.

N. Implement an illicit discharge detection and elimination program that addresses non-stormwater discharges into the Municipality's separate storm sewer system (MS4).

O. Preserve the flood-carrying capacity of streams.

P. Prevent accelerated scour, erosion and sedimentation of stream channels.

Q. Provide performance standards and design criteria based on watershed-wide stormwater management planning.

R. Provide proper operation and maintenance of all permanent stormwater management facilities and BMPs that are implemented within the Municipality.

Section 104. Statutory Authority

The Municipality is empowered or required to regulate land use activities that affect runoff and surface and groundwater quality and quantity by the authority of:

A. Act of October 4, 1978, 32 P.S., P.L. 864 (Act 167) Section 680.1 et seq., as amended, the "Storm Water Management Act" (hereinafter referred to as "the Act");

B. Borough Code, 53 P.S. Section 46201 et seq.;

C. First Class Township Code, 53, Section 55101 et seq;

D. Second Class Township Code, 53 P.S. Sections 66501 et seq., 66601 et seq.;

E. Act of July 31, 1968, P.L. 805, No. 247, Pennsylvania Municipalities Planning Code, Act 247, as amended.

Section 105. Applicability/Regulated Activities

All regulated activities and all activities that may affect stormwater runoff, **including but not limited to land development, redevelopment, and earth disturbance activity** located within the Crum Creek watershed, as delineated in Appendix A, are subject to regulation by this Ordinance.

This Ordinance contains the stormwater management performance standards and design criteria that are necessary from a watershed-wide perspective. Local stormwater management design criteria (e.g., inlet spacing, inlet type, collection system design and details, outlet structure design, etc.) shall continue to be regulated by the applicable municipal ordinances and applicable state regulations.

Section 106. Exemptions

An exemption shall not relieve the Applicant from implementing the requirements of the municipal Ordinance or from implementing such measures as are necessary to protect public health, safety, and property. An exemption shall not relieve the Applicant from complying with the special requirements for watersheds draining to identified high quality (HQ) or exceptional value (EV) waters or any other current or future state or municipal water quality protection requirements. If a drainage problem is documented or known to exist downstream of, or is expected from the proposed activity, then the Municipality may withdraw exemptions listed in Table 106 and require the Applicant to comply with all requirements of this Ordinance. Even though the Applicant is exempt, he is not relieved from complying with other municipal ordinances or regulations.

General Exemptions

Table 106.1 summarizes the exemptions from certain provisions of this Ordinance. Exemptions are for the items noted in Table 106.1 only, and shall not relieve the Applicant from other applicable sections of this Ordinance.

Any regulated activity that is exempt from some provisions of the Ordinance are exempt only from those provisions. If development is to take place in phases, the developer is responsible for implementing the requirements of the Ordinance as the impervious cover/earth disturbance threshold is met. The date of the municipal Ordinance adoption shall be the starting point from which to consider tracts as "parent tracts" in which future subdivisions and respective impervious area and earth disturbance computations shall be cumulatively considered. Exemption shall not relieve the applicant from implementing such measures as are necessary to protect health, safety, and property. For example:

If a property owner proposes a **150 square foot shed** after adoption of the municipal stormwater management Ordinance, that property owner would be **exempted from water quality and quantity requirements of the Ordinance as noted in Table 106.1 of the Ordinance**. If, at a later date, the property owner proposes to construct a 499 square foot room addition, the applicant would be required to comply with the requirements for the **Simplified Method for the full 649 square feet of impervious cover created since adoption of the municipal Ordinance**. If an additional 700 square foot swimming pool/patio is proposed later, the property owner would be required to implement the full stormwater quantity and quality control submission requirements of this Ordinance for the **total 1,349 square feet of additional impervious surface added to the original property since adoption of the municipal Ordinance**.

TABLE 106.1
Ordinance Exemptions for the Crum Creek Watershed

Ordinance Article or Section	Type of Project	Proposed Impervious Surface			Earth Disturbance		
		0-499 sq. ft.	500-999 sq. ft.	1,000+ sq. ft.	0-4,999 sq. ft. disturbance	5,000 sq. ft. - < 1 acre	≥ 1 acre
Article IV SWM Site Plan Requirements	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Exempt	Modified[1]	Not Exempt
Section 304 Nonstructural Project Design	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Exempt	Not Exempt	Not Exempt
Section 305 Infiltration Volume Requirements	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Exempt	Exempt	Not Exempt
Section 306 Water Quality Requirements	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Modified[2]	Modified[2]	Not Exempt
Section 307 Stream Bank Erosion Requirements	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Exempt	Exempt	Not Exempt
Section 308 Stormwater Peak Rate Control and Management Districts	Development Redevelopment	Exempt	Exempt	Not Exempt	Exempt	Not Exempt	Not Exempt
Erosion and Sediment Pollution Control Requirements	Must comply with Title 25, Chapter 102 of the PA Code and other applicable state and municipal codes, including the Clean Streams Law.						Not Exempt

Legend:

- **"Proposed Impervious Surface" in Table 106.1 includes new, additional, or replacement impervious surface/cover as part of development or redevelopment.**
- Exempt - Exempt from required section provision only – SWM site plan submission may still be required if other section provisions are applicable.
- Modified[1] - Modified SWM site plan need only consist of items in Sections 402.A.2 and 4; 402B.7, 8, 11, and 22; and 402.D.1 and 3 and related supportive material needed to determine compliance with Sections 304 and 308. Modified SWM site plan is required that includes all elements of Section 304, as applicable.
- Modified[2] - Modified SWM site plan need only consist of items and related material needed to determine compliance with Section 306.C.
- Simplified Approach **– Must comply with provisions of Appendix B of the Ordinance.**
- Redevelopment – See Section 308.I for alternate stormwater peak rate control criteria.

A. Exemptions for Specific Activities

1. Use of land for gardening or home consumption.

2. Agriculture when operated in accordance with a conservation plan, nutrient management plan, or erosion and sedimentation control plan approved by the County Conservation District, including activities such as growing crops, rotating crops, tilling soil, and grazing animals. For agriculture with an approved conservation plan, installation of new or expansion of existing farmsteads, animal housing, waste

storage, and production areas having impervious surfaces that result in a net increase in impervious surface of between 500-999 square feet shall apply the simplified approach, and net increases in impervious surface of greater than or equal to 1,000 square feet shall be subject to the provisions of this Ordinance.

3. Forest management operations which are following the Department of Environmental Protection's (PADEP) management practices contained in its publication "Soil Erosion and Sedimentation Control Guidelines for Forestry," are operating under an approved erosion and sedimentation plan, and must comply with the stream buffer requirements in Section 306.C.

4. Repaving without reconstruction.

5. Emergency Exemption - Emergency maintenance work performed for the protection of public health, safety, and welfare. A written description of the scope and extent of any emergency work performed shall be submitted to the [*Municipality*] within two (2) calendar days of the commencement of the activity. If the [*Municipality*] finds that the work is not an emergency, then the work shall cease immediately, until a stormwater site-plan in accordance with this ordinance is submitted and approved by the municipality.

6. Maintenance Exemption - Any maintenance to an existing stormwater management system made in accordance with plans and specifications approved by the municipal Engineer or [*Municipality*].

Section 107. Repealer

Any ordinance or ordinance provision of the Municipality inconsistent with any of the provisions of this and other federal and state regulations are hereby repealed to the extent of the inconsistency only.

Section 108. Severability

Should any section or provision of this Ordinance be declared invalid by a court of competent jurisdiction, such decision shall not affect the validity of any of the remaining provisions of this Ordinance.

Section 109. Compatibility with Other Ordinances or Legal Requirements

A. Approvals issued pursuant to this Ordinance do not relieve the Applicant of the responsibility to secure required permits or approvals for activities regulated by any other applicable code, rule, act, or ordinance.

B. To the extent that this Ordinance imposes more rigorous or stringent requirements for stormwater management, the specific requirements contained in this Ordinance shall be followed.

C. Nothing in this Ordinance shall be construed to affect any of the Municipality's requirements regarding stormwater matters that do not conflict with the provisions of this Ordinance, such as local stormwater management design criteria (e.g., inlet spacing, inlet type, collection system design and details, outlet structure design, etc.). Conflicting provisions in other municipal ordinances or regulations shall be construed to retain. The requirements of this Ordinance shall supersede any conflicting requirements in other municipal ordinance or regulations.

ARTICLE II – DEFINITIONS

Section 201. Interpretation

For the purposes of this Ordinance, certain terms and words used herein shall be interpreted as follows:

A. Words used in the present tense include the future tense; the singular number includes the plural, and the plural number includes the singular; words of masculine gender include feminine gender; and words of feminine gender include masculine gender.

B. The word "includes" or "including" shall not limit the term to the specific example, but is intended to extend its meaning to all other instances of like kind and character.

C. The word "person" includes an individual, firm, association, organization, partnership, trust, company, corporation, unit of government, or any other similar entity.

D. The words "shall" and "must" are mandatory; the words "may" and "should" are permissive.

E. The words "used" or "occupied" include the words "intended, designed, maintained, or arranged to be used, occupied, or maintained."

Section 202. Definitions

Accelerated Erosion – The removal of the surface of the land through the combined action of man's activity and the natural processes of a rate greater than would occur because of the natural processes alone.

Agricultural Activities – The work of producing crops and raising livestock including tillage, plowing, disking, harrowing, pasturing, nursery and sod operations, excluding greenhouse structures, and installation of conservation measures. Construction of new buildings or impervious area is not considered an agricultural activity.

Alteration – As applied to land, a change in topography as a result of the moving of soil and rock from one location or position to another; also the changing of surface conditions by causing the surface to be more or less impervious; land disturbance.

Applicant – A landowner or other person who has filed an application to the Municipality for approval to engage in any regulated activity defined in Section 105 of this Ordinance.

As-built Drawings – Engineering or site drawings maintained by the contractor as he constructs the project and upon which he documents the actual locations of the building components and changes to the original contract documents. These documents, or a copy of same, are turned over to the municipal Engineer at the completion of the project.

Bankfull – The channel at the top-of-bank or point from where water begins to overflow onto a floodplain.

Baseflow – Portion of stream discharge derived from groundwater; the sustained discharge that does not result from direct runoff or from water diversions, reservoir releases, piped discharges, or other human activities.

Bioretention – A stormwater retention area that utilizes woody and herbaceous plants and soils to remove pollutants before infiltration occurs.

BMP (Best Management Practice) – Activities, facilities, designs, measures, or procedures used to manage stormwater impacts from regulated activities, to meet state water quality requirements, to promote infiltration, and to otherwise meet the purposes of this Ordinance. Stormwater BMPs are commonly grouped into one of two broad categories or measures: "structural" or "nonstructural." In this Ordinance, nonstructural BMPs or measures refer to operational and/or behavior-related practices that attempt to minimize the contact of pollutants with stormwater runoff whereas structural BMPs or measures are those that consist 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.

Buffer – See Riparian Buffer

Channel – An open drainage feature through which stormwater flows. Channels include, but shall not be limited to, natural and man-made drainageways, swales, streams, ditches, canals, and pipes flowing partly full.

Channel Erosion – The widening, deepening, or headward cutting of channels and waterways caused by stormwater runoff or bankfull flows.

Cistern – An underground reservoir or tank for storing rainwater.

Conservation District – The [*Insert*] County Conservation District.

Conveyance – A facility or structure used for the transportation or transmission of something from one place to another.

Culvert – A structure with its appurtenant works, which carries water under or through an embankment or fill.

Dam – A man-made barrier, together with its appurtenant works constructed for the purpose of impounding or storing water or another fluid or semi-fluid. A dam may include a refuse bank,

fill, or structure for highway, railroad, or other purposes which impounds or may impound water or another fluid or semi-fluid.

Department – The Pennsylvania Department of Environmental Protection.

Designee – The agent of the [*Insert*] County Planning [*Commission or Department*], [*Insert*] County Conservation District, and/or agent of the Governing Body involved with the administration, review, or enforcement of any provisions of this Ordinance by contract or memorandum of understanding.

Design Professional (Qualified) – A Pennsylvania Registered Professional Engineer, Registered Landscape Architect, Registered Professional Land Surveyor trained to develop SWM site plan, or any person licensed by the Pennsylvania Department of State or qualified by law to perform the work required by the Ordinance.

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., twenty-four (24) hours), used in the design and evaluation of stormwater management systems.

Detention or **To Detain** – The prevention of, or to prevent, the discharge, directly or indirectly, of a given volume of stormwater runoff into surface waters by temporary storage.

Detention Basin – An impoundment designed to collect and retard stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate. Detention basins are designed to drain completely soon after a rainfall event and become dry until the next rainfall event.

Developer – A person who seeks to undertake any regulated earth disturbance activities at a project site in the Municipality.

Development, Land – Any human-induced change to improved or unimproved real estate, whether public or private, including, but not limited to, land development, construction, installation, or expansion of a building or other structure, land division, street construction, drilling, and site alteration such as embankments, dredging, grubbing, grading, paving, parking or storage facilities, excavation, filling, stockpiling, or clearing. As used in this Ordinance, development encompasses both new development and redevelopment.

Development Site – The specific tract or parcel of land where any regulated activity set forth in Section 105 is planned, conducted, or maintained.

Diameter at Breast Height (DBH) – The outside bark diameter at breast height which is defined as four and one half (4.5) feet (1.37m) above the forest floor on the uphill side of the tree.

Diffused Drainage Discharge – Drainage discharge that is not confined to a single point location or channel, including sheet flow or shallow concentrated flow.

Discharge – 1. (verb) To release water from a project, site, aquifer, drainage basin, or other point of interest; 2. (noun) The rate and volume of flow of water such as in a stream, generally expressed in cubic feet per second (see Peak Discharge).

Discharge Point – The point of discharge for a stormwater facility.

Disturbed Area – Unstabilized land area where an earth disturbance activity is occurring or has occurred.

Ditch – A man-made waterway constructed for irrigation or stormwater conveyance purposes.

Downslope Property Line – That portion of the property line of the lot, tract, or parcels of land being developed, located such that overland or pipe flow from the project site would be directed towards it by gravity.

Drainage Conveyance Facility – A stormwater management facility designed to transport stormwater runoff that includes channels, swales, pipes, conduits, culverts, and storm sewers.

Drainage Easement – A right granted by a landowner to a grantee allowing the use of private land for stormwater management purposes.

Drainage Permit – A permit issued by the Municipality after the stormwater management site plan has been approved.

Earth Disturbance Activity – A construction or other human activity which disturbs the surface of the land, including, but not limited to, clearing and grubbing; grading; excavations; embankments; road maintenance; building construction; the moving, depositing, stockpiling, or storing of soil, rock, or earth materials.

Emergency Spillway – A conveyance area that is used to pass peak discharge greater than the maximum design storm controlled by the stormwater facility.

Encroachment – A structure or activity that changes, expands, or diminishes the course, current, or cross-section of a watercourse, floodway, or body of water.

Erosion – The process by which the surface of the land, including water/stream channels, is worn away by water, wind, or chemical action.

Erosion and Sediment Control Plan – A plan that is designed to minimize accelerated erosion and sedimentation. Said plan must be submitted to and approved by the appropriate Conservation District before construction can begin.

Exceptional Value (EV) Waters – Surface waters of high quality which satisfy Pennsylvania Code Title 25 Environmental Protection, Chapter 93, Water Quality Standards, §93.4b(b) (relating to anti-degradation).

Existing Conditions – The initial condition of a project site prior to the proposed alteration. If the initial condition of the site is undeveloped land, the land use shall be considered as "meadow" unless the natural land cover is proven to generate a lower curve number or Rational "c" value, such as forested lands.

FEMA – Federal Emergency Management Agency.

Financial Hardship – A situation where the greatest possible profit cannot be fully realized from development/redevelopment on a given parcel of land due to added costs or burdens associated with the design, construction, and/or maintenance of stormwater structures, facilities, buffers and/or setbacks.

Flood – A temporary condition of partial or complete inundation of land areas from the overflow of streams, rivers, and other waters of this Commonwealth.

Floodplain – Any land area susceptible to inundation by water from any natural source or as delineated by the applicable Department of Housing and Urban Development, Federal Insurance Administration Flood Hazard Boundary Map as being a special flood hazard area.

Floodway – The channel of a watercourse and those portions of the adjoining floodplains which are reasonably required to carry and discharge the 100-year frequency flood. Unless otherwise specified, the boundary of the floodway is as indicated on maps and flood insurance studies provided by FEMA. In an area where no FEMA maps or studies have defined the boundary of the 100-year frequency floodway, it is assumed, absent evidence to the contrary, that the floodway extends from the stream to fifty (50) feet from the top-of-bank.

Fluvial Geomorphology – The study of landforms associated with river channels and the processes that form them.

Forest Management/Timber Operations – Planning and associated activities necessary for the management of forest lands. These include timber inventory and preparation of forest management plans, silvicultural treatment, cutting budgets, logging road design and construction, timber harvesting, and reforestation.

Freeboard – A vertical distance between the elevation of the design high-water and the top of a dam, levee, tank, basin, swale, or diversion berm. The space is required as a safety margin in a pond or basin.

Grade – 1. (noun) A slope, usually of a road, channel, or natural ground, specified in percent and shown on plans as specified herein. 2. (verb) To finish the surface of a roadbed, the top of an embankment, or the bottom of an excavation.

Grassed Waterway – A natural or man-made waterway, usually broad and shallow, covered with erosion-resistant grasses used to convey surface water.

Groundwater – Water beneath the earth's surface that supplies wells and springs and is often between saturated soil and rock.

Groundwater Recharge – The replenishment of existing natural underground water supplies from rain or overland flow.

HEC-HMS – The U.S. Army Corps of Engineers, Hydrologic Engineering Center (HEC) - Hydrologic Modeling System (HMS). This model was used to model the Darby-Cobbs and Crum Creek watersheds during the Act 167 plan development and was the basis for the standards and criteria of this Ordinance.

High Quality (HQ) Waters – Surface waters having quality which exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water by satisfying Pennsylvania Code Title 25 Environmental Protection, Chapter 93, Water Quality Standards, § 93.4b(a).

Hotspots – Areas where land use or activities generate highly contaminated runoff with concentrations of pollutants in excess of those typically found in stormwater.

Hydrograph – A graph representing the discharge of water versus time for a selected point in the drainage system.

Hydrologic Regime – The hydrologic cycle or balance that sustains quality and quantity of stormwater, baseflow, storage, and groundwater supplies under natural conditions.

Hydrologic Soil Group – A classification of soils by the Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service (SCS), into four runoff potential groups. The groups range from A soils, which are very permeable and produce little runoff, to D soils, which are not very permeable and produce much more runoff.

Impervious Surface – A surface that prevents the infiltration of water into the ground. Impervious surfaces include, but are not limited to, streets, sidewalks, pavements, driveway areas, or roofs. Any surface areas designed to be gravel or crushed stone shall be regarded as impervious surfaces.

Impoundment – A retention or detention basin designed to retain stormwater runoff and release it at a controlled rate.

Infill – Development that occurs on smaller parcels that remain undeveloped but are within or in very close proximity to urban or densely developed areas. Infill development usually relies on existing infrastructure and does not require an extension of water, sewer, or other public utilities.

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

Infiltration Structures – A structure designed to direct runoff into the underground water (e.g., French drains, seepage pits, or seepage trenches).

Inflow – The flow entering the stormwater management facility and/or BMP.

Inlet – The upstream end of any structure through which water may flow.

Intermittent Stream – A stream that flows only part of the time. Flow generally occurs for several weeks or months in response to seasonal precipitation or groundwater discharge.

Invert – The lowest surface, the floor or bottom of a culvert, drain, sewer, channel, basin, BMP, or orifice.

Land Development – Any of the following activities:

(i) The improvement of one (1) lot or two (2) or more contiguous lots, tracts, or parcels of land for any purpose involving:
   a. 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
   b. 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;

(ii) A subdivision of land;

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

Limiting Zone – A soil horizon or condition in the soil profile or underlying strata that includes one of the following:

(i) A seasonal high water table, whether perched or regional, determined by direct observation of the water table or indicated by soil mottling.

(ii) A rock with open joints, fracture or solution channels, or masses of loose rock fragments, including gravel, with insufficient fine soil to fill the voids between the fragments.

(iii) A rock formation, other stratum, or soil condition that is so slowly permeable that it effectively limits downward passage of water.

Lot – A designated parcel, tract, or area of land established by a plat or otherwise as permitted by law and to be used, developed, or built upon as a unit.

Main Stem (Main Channel) – Any stream segment or other runoff conveyance used as a reach in watershed-specific hydrologic models.

Manning Equation (Manning Formula) – A method for calculation of velocity of flow (e.g., feet per second) and flow rate (e.g., cubic feet per second) in open channels based upon channel shape, roughness, depth of flow, and slope. “Open channels” may include closed conduits so long as the flow is not under pressure.

Maximum Design Storm – The maximum (largest) design storm that is controlled by the stormwater facility.

Municipal Engineer – A professional engineer licensed as such in the Commonwealth of Pennsylvania, duly appointed as the Engineer for a Municipality, planning agency, or joint planning commission.

Municipality – [*Municipality*], [*Insert*] County, Pennsylvania.

Natural Condition – Pre-development condition.

Natural Hydrologic Regime – See Hydrologic Regime.

Natural Recharge Area – Undisturbed surface area or depression where stormwater collects and a portion of which infiltrates and replenishes the underground and groundwater.

Nonpoint Source Pollution – Pollution that enters a waterbody from diffuse origins in the watershed and does not result from discernible, confined, or discrete conveyances.

Nonstormwater Discharges – Water flowing in stormwater collection facilities, such as pipes or swales, which is not the result of a rainfall event or snowmelt.

Nonstructural Best Management Practice (BMPs) – Methods of controlling stormwater runoff quantity and quality, such as innovative site planning, impervious area and grading reduction, protection of natural depression areas, temporary ponding on site, and other techniques.

NPDES – National Pollutant Discharge Elimination System, the federal government's system for issuance of permits under the Clean Water Act, which is delegated to PADEP in Pennsylvania.

NRCS – Natural Resource Conservation Service (previously SCS).

Open Channel – A conveyance channel that is not enclosed.

Outfall – "Point source" as described in 40 CFR § 122.2 at the point where the Municipality's storm sewer system discharges to surface waters of the Commonwealth.

Outflow – The flow exiting the stormwater management facility and/or BMP.

Outlet – Points of water disposal to a stream, river, lake, tidewater, or artificial drain.

Parent Tract – The parcel of land from which a land development or subdivision originates, determined from the date of municipal adoption of this Ordinance.

Parking Lot Storage – Involves the use of parking areas as temporary impoundments with controlled release rates during rainstorms.

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

Pennsylvania Stormwater Best Management Practices Manual (Document Number 363-0300-002) (December 2006) - The Best Management Practices Manual published by the Pennsylvania Department of Environmental Protection. The manual is to supplement federal and state regulations and the Department of Environmental Protection's Comprehensive Stormwater Management Policy that emphasizes effective site planning as the preferred method of managing runoff while also providing numerous examples of BMPs that can be employed in Pennsylvania to further avoid and minimize flooding and water resource problems.

Pervious Area – Any area not defined as impervious.

Pipe – A culvert, closed conduit, or similar structure (including appurtenances) that conveys stormwater.

Planning Commission – The Planning Commission of [*Municipal Name*].

Point Source – Any discernible, confined, and discrete conveyance including, but not limited to, any pipe, ditch, channel, tunnel, or conduit from which stormwater is or may be discharged, as defined in state regulations at 25 Pennsylvania Code § 92.1.

Post-construction – Period after construction during which disturbed areas are stabilized, stormwater controls are in place and functioning, and all proposed improvements in the approved land development plan are completed.

Pre-construction – Prior to commencing construction activities.

Pre-development Condition – Undeveloped/natural condition.

Pretreatment – Techniques employed in stormwater BMPs to provide storage or filtering to trap coarse materials and other pollutants before they enter the system, but not necessarily designed to meet the water quality volume requirements of Section 306.

Project Site – The specific area of land where any regulated activities in the Municipality are planned, conducted, or maintained.

Qualified Professional – See Design Professional (Qualified).

Rational Formula – A rainfall-runoff relation used to estimate peak flow.

Reach – Any stream segment or other runoff conveyance used in the watershed-specific hydrologic models.

Recharge – The replenishment of groundwater through the infiltration of rainfall, other surface waters, or land application of water or treated wastewater.

Reconstruction – Demolition and subsequent rebuilding of impervious surface.

Record Drawings – Original documents revised to suit the as-built conditions and subsequently provided by the Engineer to the client. The Engineer reviews the contractor's as-builts against his/her own records for completeness, then either turns these over to the client or transfers the information to a set of reproducibles, in both cases for the client's permanent records.

Redevelopment – Any development that requires demolition or removal of existing structures or impervious surfaces at a site and replacement with new impervious surfaces. Maintenance activities such as top-layer grinding and re-paving are not considered to be redevelopment. Interior remodeling projects and tenant improvements are also not considered to be redevelopment.

Regulated Activities – Any earth disturbances activities or any activities that involve the alteration or development of land in a manner that may affect stormwater runoff, including redevelopment.

Regulated Earth Disturbance Activity – Activity involving earth disturbance subject to regulation under 25 Pennsylvania Code Chapters 92, Chapter 102, or the Clean Streams Law.

Release Rate – The percentage of existing conditions peak rate of runoff from a site or subarea to which the proposed conditions peak rate of runoff must be reduced to protect downstream areas.

Repaving – Resurfacing of the impervious surface that does not involve reconstruction of an existing paved (impervious) surface.

Replacement Paving – Reconstruction of and full replacement of an existing paved (impervious) surface.

Retention or **To Retain** – The prevention of direct discharge of stormwater runoff into receiving waters or water bodies by temporary or permanent containment in a pond or depression; examples include systems which discharge by percolation to groundwater, and/or evaporation processes and which generally have residence times of less than three (3) days.

Retention Basin – A structure in which stormwater is stored and not released during the storm event. Retention basins are designed for infiltration purposes and do not have an outlet.

Return Period – The average interval, in years, within which a storm event of a given magnitude can be expected to recur. For example, the 25-year return period rainfall would be expected to recur on the average of once every twenty-five (25) years.

Riparian – Pertaining to anything connected with or immediately adjacent to the banks of a stream or other body of water.

Riparian Buffer – An area of land adjacent to a body of water and managed to maintain the integrity of stream channels and shorelines to 1) reduce the impact of upland sources of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals, and 2) supply food, cover and thermal protection to fish and other wildlife.

Riser – A vertical pipe extending from the bottom of a pond that is used to control the discharge rate from the pond for a specified design storm.

Road Maintenance – Earth disturbance activities within the existing road cross-section, such as grading and repairing existing unpaved road surfaces, cutting road banks, cleaning or clearing drainage ditches, and other similar activities.

Roof Drains – A drainage conduit or pipe that collects water runoff from a roof and leads it away from the structure.

Rooftop Detention – The temporary ponding and gradual release of stormwater falling directly onto flat roof surfaces using controlled-flow roof drains in building designs.

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

SALDO – Subdivision and land development ordinance.

Sediment – Soil or other materials transported by surface water as a product of erosion.

Sediment Basin – A barrier, dam, or retention or detention basin located and designed in such a way as to retain rock, sand, gravel, silt, or other material transported by water during construction.

Sediment Pollution – The placement, discharge, or any other introduction of sediment into the waters of the Commonwealth.

Sedimentation – The process by which mineral or organic matter is accumulated or deposited by the movement of water or air.

Seepage Pit/Seepage Trench – An area of excavated earth filled with loose stone or similar coarse material into which surface water is directed for infiltration into the underground water.

Separate Storm Sewer System – A conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) primarily used for collecting and conveying stormwater runoff.

Shallow Concentrated Flow – Stormwater runoff flowing in shallow, defined ruts prior to entering a defined channel or waterway.

Sheet Flow – A flow process associated with broad, shallow water movement on sloping ground surfaces that is not channelized or concentrated.

Soil Cover Complex Method – A method of runoff computation developed by NRCS that is based on relating soil type and land use/cover to a runoff parameter called curve number (CN).

Source Water Protection Areas (SWPA) – The zone through which contaminants, if present, are likely to migrate and reach a drinking water well or surface water intake.

Special Protection Subwatersheds – Watersheds that have been designated by PADEP as EV or HQ waters.

Spillway – A conveyance that is used to pass the peak discharge of the maximum design storm that is controlled by the stormwater facility.

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

Storage Indication Method – A reservoir routing procedure based on solution of the continuity equation (inflow minus outflow equals the change in storage) with outflow defined as a function of storage volume and depth.

Storm Frequency – The number of times that a given storm "event" occurs or is exceeded on the average in a stated period of years (see Return Period).

Storm Sewer – A system of pipes and/or open channels that conveys intercepted runoff and stormwater from other sources but excludes domestic sewage and industrial wastes.

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

Stormwater Management District – Those subareas of a watershed in which some type of detention is required to meet the plan requirements and the goals of Act 167.

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

Stormwater Management Plan – The watershed plan, known as the "Crum Creek Watershed Act 167 Stormwater Management Plan," for managing stormwater runoff in the Crum Creek watershed, adopted by Delaware and Chester Counties as required by the Act of October 4, 1978, P.L. 864 (Act 167), as amended, and known as the "Storm Water Management Act."

Stormwater Management (SWM) Site Plan – The plan prepared by the Applicant or his representative indicating how stormwater runoff will be managed at the particular site of interest according to this Ordinance, and including all necessary design drawings, calculations, supporting text, and documentation to demonstrate that Ordinance requirements have been met, hereafter referred to as "SWM site plan."

Stream – A natural watercourse.

Stream Buffer – The land area adjacent to each side of a stream essential to maintaining water quality (see also Riparian Buffer).

Stream Enclosure – A bridge, culvert, or other structure in excess of one hundred (100) feet in length upstream to downstream which encloses a regulated water of the Commonwealth.

Subarea (Subwatershed) – The smallest drainage unit of a watershed for which stormwater management criteria have been established in the stormwater management plan.

Subdivision – The division or redivision of a lot, tract, or parcel of land by any means into two (2) or more lots, tracts, 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 into parcels of more than ten (10) acres not involving any new street or easement of access or any residential dwelling shall be exempted.

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

Swale – A low-lying stretch of land that gathers or carries surface water runoff.

SWM Site Plan – See Stormwater Management Site Plan.

Timber Operations – See Forest Management.

Time-of-concentration (Tc) – The time required for surface runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. This time is the combined total of overland flow time and flow time in pipes or channels, if any.

Top-of-bank – Highest point of elevation in a stream channel cross-section at which a rising water level just begins to flow out of the channel and over the floodplain.

USDA – United States Department of Agriculture.

Undeveloped Condition – Natural condition (see also Pre-development Condition).

Vernal Pond – Seasonal depressional wetlands that are covered by shallow water for variable periods from winter to spring but may be completely dry for most of the summer and fall.

Watercourse – A channel or conveyance of surface water having a defined bed and banks, whether natural or artificial, with perennial or intermittent flow.

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 body of water, whether natural or artificial.

Wellhead – 1. A structure built over a well, 2. The source of water for a well.

Wellhead Protection Area – The surface and subsurface area surrounding a water supply well, well field, or spring supplying a public water system through which contaminants are reasonably likely to move toward and reach the water source.

Wet Basin – Pond for urban runoff management that is designed to detain urban runoff and always contains water.

Wetland – Those 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. Wetlands generally include swamps, marshes, bogs, fens, and similar areas.

Woods – A natural groundcover with more than one (1) viable tree of a DBH of six (6) inches or greater per fifteen hundred (1,500) square feet which existed within three (3) years of application; a cover condition for which SCS curve numbers have been assigned or to which equivalent Rational Method runoff coefficients have been assigned.

ARTICLE III – STORMWATER MANAGEMENT

Section 301. General Requirements

A. Applicants proposing regulated activities in the Municipality which do not fall under the exemption criteria shown in Section 106 shall submit a stormwater management site plan consistent with this Ordinance and the Crum Creek Watershed Stormwater Management Plan to the Municipality for review. The stormwater management criteria of this Ordinance shall apply to the total proposed development even if development is to take place in stages.

B. No regulated activity within the Municipality shall commence until the Municipality issues approval of a SWM plan, which demonstrates compliance with the requirements of this ordinance.

The following language may be added to section 301.B. See box below.

> For any site with proposed regulated earth disturbance equal to or greater than one acre where, after a close evaluation of alternative site designs, it proves to be impracticable to meet the mandatory minimum volume and infiltration control standards of this ordinance onsite, the Municipal may approve measures other than those in this ordinance after consultation with and evaluation by PADEP that the alternate site design meets State water quality requirements and does not conflict with State law, including, but not limited to, the Clean Streams Law.
>
> For any site with proposed regulated earth disturbance that is less than one acre where, after a close evaluation of alternative site designs, it proves to be impracticable to meet any one or more of the mandatory minimum standards of this ordinance onsite, the Municipality may approve measures other than those in this ordinance.
> "Regulated earth disturbance" is defined to mean any activity involving earth disturbance subject to regulation under 25 Pa. Code Chapter 92, 25 Pa. Code Chapter 102, or the Clean Streams Law.

C. The Applicant is required to design the site to minimize surface discharge of stormwater and the creation of impervious surfaces in order to maintain, as much as possible, the natural hydrologic regime.

D. The SWM site plan must be designed consistent with the sequencing provisions of Section 304 to ensure maintenance of the natural hydrologic regime, to promote infiltration, and to protect groundwater and surface water quality and quantity. The SWM site plan designer must proceed sequentially in accordance with Article III of this Ordinance.

E. Stormwater drainage systems shall be designed in order to preserve natural flow conditions to the maximum extent practicable.

F. Existing drainage discharge onto adjacent property shall not be altered in any manner without [*written permission/notification from/to*], and a maintenance access agreement with, the affected property owner(s). Such discharge shall be subject to any applicable discharge criteria specified in this Ordinance and **still must meet the requirements of Act 167.**

G. Areas of existing diffused drainage discharge, whether proposed to be concentrated or maintained as diffused drainage areas, shall be subject to any applicable discharge criteria in the general direction of existing discharge, except as otherwise provided by this Ordinance. If diffused drainage discharge is proposed to be concentrated and discharged onto adjacent property, the Applicant must document that adequate downstream conveyance facilities exist to safely transport the concentrated discharge or otherwise prove that no erosion, sedimentation, flooding, or other impacts will result from the concentrated discharge.

H. Where a development site is traversed by a stream, drainage easements of [*__feet*] shall be provided on either side of, and conform to the line of such streams.

I. Minimization of impervious surfaces and infiltration of runoff through seepage beds, infiltration trenches, etc., is encouraged where soil conditions permit in order to reduce the size or eliminate the need for detention facilities or other structural BMPs.

J. All stormwater runoff from new development or redevelopment shall be pretreated for water quality prior to discharge to surface or groundwater. Rooftop runoff may go directly to an infiltration BMP or be evapotranspirated.

K. All regulated activities within the Municipality shall be designed, implemented, operated, and maintained to meet the purposes of this Ordinance, through these two elements:

1. Erosion and sediment control during earth disturbance activities (e.g., during construction), and

2. Water quality protection measures after completion of earth disturbance activities (i.e., after construction), including operations and maintenance.

L. The BMPs shall be designed, implemented, and maintained to meet state water quality requirements and any other more stringent requirements as determined by the Municipality.

M. Post-construction water quality protection shall be addressed as required by Section 306.

N. Operations and maintenance of permanent stormwater BMPs shall be addressed as required by Article VII.

O. All BMPs used to meet the requirements of this Ordinance shall conform to the state water quality requirements and any more stringent requirements as set forth by the Municipality.

P. Techniques described in Appendix E (Low Impact Development) of this Ordinance shall be considered because they reduce the costs of complying with the requirements of this Ordinance and the state water quality requirements.

Q. In selecting the appropriate BMPs or combinations thereof, the Applicant shall consider the following:

1. Total contributing drainage area.
2. Permeability and infiltration rate of the site's soils.
3. Slope and depth to bedrock.
4. Seasonal high water table.
5. Proximity to building foundations and wellheads.
6. Erodibility of soils.
7. Land availability and configuration of the topography.
8. Peak discharge and required volume control.
9. Stream bank erosion.
10. Efficiency of the BMPs to mitigate potential water quality problems.
11. The volume of runoff that will be effectively treated.
12. The nature of the pollutant being removed.
13. Maintenance requirements.
14. Creation/protection of aquatic and wildlife habitat.
15. Recreational value.
16. Enhancement of aesthetic and property values.

R. The design of all stormwater management facilities shall incorporate sound engineering principles and practices in a manner that does not aggravate existing stormwater problems. The Municipality reserves the right to disapprove any design that would result in construction in or continuation of a stormwater problem area.

S. The applicant may meet the stormwater management criteria through off-site stormwater management measures as long as the proposed measures are in the same subwatershed as shown in Ordinance Appendix A.

T. Stormwater Hotspots – Stormwater runoff from hotspots shall be pretreated prior to surface or groundwater infiltration to prevent pollutant runoff. Industrial sites referenced in 40 CFR 125 are examples of hotspots.

Below is a list of examples of hotspots:

- Vehicle salvage yards and recycling facilities
- Vehicle fueling stations

- Vehicle service and maintenance facilities
- Vehicle and equipment cleaning facilities
- Fleet storage areas (bus, truck, etc.)
- Industrial sites based on Standard Industrial Classification Codes
- Marinas (service and maintenance areas)
- Outdoor liquid container storage
- Outdoor loading/unloading facilities
- Public works storage areas
- Facilities that generate or store hazardous materials
- Commercial container nursery
- Contaminated sites/brownfields
- Other land uses and activities as designated by an appropriate review authority

The following land uses and activities are not normally considered hotspots:

- Residential streets and rural highways
- Residential development
- Institutional development
- Office developments
- Nonindustrial rooftops
- Pervious areas, except golf courses and nurseries (which may need an integrated pest management (IPM) plan)

While streets and highways (average daily traffic volume (ADT) greater than thirty thousand (30,000)) are not considered stormwater hotspots, it is important to ensure that highway stormwater management facilities are designed to adequately protect receiving streams and/or groundwater.

The Environmental Protection Agency's (EPA) NPDES stormwater program requires some industrial sites to prepare and implement a stormwater pollution prevention plan.

U. The following standards for protection of downgradient properties from off-site conveyance must be accomplished:
For any location where a new concentrated discharge of stormwater from any frequency rainfall event, up to and including the 100-year, 24-hour event, will flow onto a downgradient property, the following are required

1. A drainage easement (or other legal agreement/approval) must be obtained for conveyance of discharges onto or through adjacent properties.
2. The conveyance must be designed to avoid erosion, flooding, or other damage to the properties through which it is being conveyed.

Section 302. Permit Requirements by Other Governmental Entities

The following permit requirements may apply to certain regulated earth disturbance activities and must be met prior to commencement of regulated earth disturbance activities, as applicable:

A. All regulated earth disturbance activities subject to permit requirements by PADEP under regulations at Title 25 Pennsylvania Code Chapter 102.

B. Work within natural drainageways subject to permit by PADEP under Title 25 Pennsylvania Code Chapter 105.

C. Any stormwater management facility that would be located in or adjacent to surface waters of the Commonwealth, including wetlands, subject to permit by PADEP under Title 25 Pennsylvania Code Chapter 105.

D. Any stormwater management facility that would be located on or discharging to a state highway right-of-way, or require access to or from a state highway shall be subject to approval by PennDOT.

E. Culverts, bridges, storm sewers, or any other facilities which must pass or convey flows from the tributary area and any facility which may constitute a dam subject to permit by PADEP under Title 25 Pennsylvania Code Chapter 105.

Section 303. Erosion and Sediment Control During Regulated Earth Disturbance Activities

A. No regulated earth disturbance activities within the Municipality shall commence until the Municipality receives an approval from the PADEP in compliance with Title 25 Chapter 102 of the Pennsylvania Code of an erosion and sediment control plan for construction activities if applicable.

B. PADEP has regulations regarding an erosion and sediment control under Title 25 Pennsylvania Code Chapter 102.

C. In addition, under Title 25 Pennsylvania Code Chapter 92, a PADEP "NPDES Construction Activities" Permit is required for regulated earth disturbance activities.

D. Evidence of any necessary permit(s) for regulated earth disturbance activities from the appropriate PADEP regional office or County Conservation District must be provided to the Municipality. The issuance of an NPDES Construction Permit (or permit coverage under the statewide General Permit (PAG-2)) satisfies the requirements of subsection 403.A.

E. A copy of the erosion and sediment control plan and any required permit, as required by PADEP regulations, shall be available on the project site at all times.

F. Additional erosion and sediment control design standards and criteria are recommended to be applied where infiltration BMPs are proposed. At a minimum, they shall include the following:

1. Areas proposed for infiltration BMPs shall be protected from sedimentation and compaction during the construction phase to maintain maximum infiltration capacity.

2. Infiltration BMPs shall not be constructed nor receive runoff until the entire drainage area contributory to the infiltration BMP has achieved final stabilization.

Section 304. Nonstructural Project Design Process (Sequencing to Minimize Stormwater Impacts)

The design of all regulated activities shall include the following to minimize stormwater impacts to reduce the surface discharge of stormwater, reduce the creation of unnecessary impervious surfaces, prevent the degradation of waters of the Commonwealth, and maintain as much as possible the natural hydrologic regime of the site.

A. The Applicant shall apply Low Impact Development (LID) methods such as those listed in Appendix E, provided that use of this method does not conflict with other local codes.

B. The Applicant shall demonstrate that the design process follows the sequence noted below. The goal of the sequence is to minimize the increases in stormwater runoff and impacts to water quality resulting from the proposed regulated activity:

1. The following items in this subsection shall be addressed prior to development of other stormwater management site plan design elements:
   a. Prepare an Existing Resource and Site Analysis Map (ERSAM) showing environmentally sensitive areas including, but not limited to, steep slopes, ponds, lakes, streams, wetlands, hydric soils, vernal pools, stream buffers, and hydrologic soil groups. Land development, any existing recharge areas, and other requirements outlined in the municipal SALDO shall also be included.
   b. Establish a stream buffer according to Section 306.C.
   c. Prepare a draft project layout avoiding sensitive areas identified in Section 304.B.1.a.
   d. Identify site-specific existing conditions drainage areas, discharge points, recharge areas, and hydrologic soil groups A and B (areas conducive to infiltration).
   e. Evaluate nonstructural stormwater management alternatives:
      i. Minimize earth disturbance.

ii. Minimize impervious surfaces.
iii. Break up large impervious surfaces.

f. Determine into what management district the site falls (Ordinance Appendix A), and conduct an existing conditions runoff analysis.

2. The following items in this subsection may be addressed in any order provided that all items in Section 304.B.1 have been completed.

a. Satisfy the infiltration objective (Section 305) and provide for stormwater pretreatment prior to infiltration.

b. Provide for water quality protection in accordance with Section 306 water quality requirements.

c. Provide stream bank erosion protection in accordance with Section 307 stream bank erosion requirements.

d. Prepare final project design to maintain existing conditions drainage areas and discharge points, to minimize earth disturbance and impervious surfaces, and, to the maximum extent possible, to ensure that the remaining site development has no surface or point discharge.

e. Conduct a proposed conditions runoff analysis based on the final design that meets the management district requirements (Section 308).

f. Manage any remaining runoff prior to discharge through detention, bioretention, direct discharge, or other structural control.

Section 305. Infiltration Volume Requirements

Providing for infiltration consistent with the natural hydrologic regime is required. Design of the infiltration facilities shall consider infiltration to compensate for the reduction in the recharge that occurs when the ground surface is disturbed or impervious surface is created.

If it cannot be physically accomplished, then the design professional shall be responsible for demonstrating to the satisfaction of the municipality that this **cannot be physically accomplished on the site** (e.g., shallow depth to bedrock or limiting zone, open voids, steep slopes, etc. vs. a financial hardship as defined in Section 202). If it can be physically accomplished, the volume of runoff to be infiltrated shall be determined from Section 305.A.2 depending on demonstrated site conditions, and shall be the greatest volume that can be physically infiltrated. For example:

- Any applicant (developer or redeveloper) shall first attempt to infiltrate the volume required in Section 305.A.2.a.

- If the Section 305.A.2.a requirement cannot be physically accomplished, then the applicant is required to attempt to infiltrate the volume required in Section 305A.2.b.
- Finally, if the 305.A.2.b infiltration volume cannot be physically accomplished, the applicant must, at a minimum, infiltrate the volume required in 305.A.2.c

A. Infiltration BMPs shall meet the following minimum requirements:

1. Infiltration BMPs intended to receive runoff from developed or redeveloped areas shall be selected based on suitability of soils and site conditions and shall be constructed on soils that have the following characteristics:

   a. A minimum depth of twenty-four (24) inches between the bottom of the BMP and the top of the limiting zone.

   b. An infiltration rate sufficient to accept the additional stormwater volume and dewater completely as determined by field tests conducted by the Applicant's design professional.

   c. The infiltration facility shall be capable of completely draining the retention (infiltration) volume (Rev) within three (3) days (72 hours) from the end of the design storm.

2. The size of the infiltration facility and $\mathbf{Re_v}$ shall be based upon the following volume criteria:

   a. Modified Control Guideline One (MCG-1) of the *Pennsylvania Stormwater Best Management Practices* (PA BMP) Manual – The retention (infiltration) volume ($\mathbf{Re_v}$) to be captured and infiltrated shall be the net 2-year 24-hour volume. The net volume is the difference between the post-development runoff volume and the pre-development runoff volume. The post-development total runoff volume for all storms equal to or less than the 2-year 24-hour duration precipitation shall not be increased. For modeling purposes, existing (pre-development) non-forested pervious areas must be considered meadow in good condition or its equivalent, and twenty (20) percent of existing impervious area, when present, shall be considered meadow in good condition.

   b. Infiltrating the entire Re_v volume in Section 305.A.2.a (above) may not be feasible on every site due to site-specific limitations such as shallow depth to bedrock or the water table. If it **cannot be physically accomplished**, then the following criteria from Modified Control Guideline Two (MCG-2) of the PA BMP Manual must be satisfied:

      At least the **first one-inch (1.0")** of runoff from new or replacement impervious surfaces shall be infiltrated.

Re_v = 1 (inch) * impervious area (square feet) ÷ 12 (inches) = cubic feet (cf)

An asterisk (*) in equations denotes multiplication.

c. Only if infiltrating the entire Re_v volume in Section 305.A.2.b (above) **cannot be physically accomplished**, then the following minimum criteria from Modified Control Guideline Two (MCG-2) of the PA BMP Manual must be satisfied:

Wherever possible, infiltration facilities should be designed to accommodate infiltration of the entire water quality volume (WQv) (Section 306.A); however, in all cases at least the **first one-half inch (0.5")** of the WQv shall be infiltrated. The minimum infiltration volume (Re_v) required would, therefore, be computed as:

Re_v = I * impervious area (square feet) ÷ 12 (inches) = cubic feet (cf)

An asterisk (*) in equations denotes multiplication.

Where:

I = The maximum equivalent infiltration amount (inches) that the site can physically accept or 0.50 inch, whichever is greater.

The retention volume values derived from the methods in Section 305.A.2.a, 305.A.2.b, or 305.A.2.c is the minimum volume the Applicant must control through an infiltration BMP facility. If site conditions preclude capture of runoff from portions of the impervious area, the infiltration volume for the remaining area should be increased an equivalent amount to offset the loss.

Only if the minimum of 0.50 inch of infiltration requirement **cannot be physically accomplished**, a waiver from Section 305, Infiltration Volume Requirements is required from the Municipality.

B. Soils - A detailed soils evaluation of the project site shall be required to determine the suitability of infiltration facilities. The evaluation shall be performed by a qualified design professional and at minimum address soil permeability, depth to bedrock, and subgrade stability. The general process for designing the infiltration BMP shall be:

1. Analyze hydrologic soil groups as well as natural and man-made features within the site to determine general areas of suitability for infiltration practices. In areas where development on fill material is under consideration,

conduct geotechnical investigations of sub-grade stability; infiltration may not be ruled out without conducting these tests.

2. Provide field tests such as double ring infiltrometer or hydraulic conductivity tests (at the level of the proposed infiltration surface) to determine the appropriate hydraulic conductivity rate. Percolation tests are not recommended for design purposes.

3. Design the infiltration structure for the required retention (Re_v) volume based on field determined capacity at the level of the proposed infiltration surface.

4. If on-lot infiltration structures are proposed by the Applicant's design professional, it must be demonstrated to the Municipality that the soils are conducive to infiltrate on the lots identified.

C. Infiltration facilities should, to the greatest extent practicable, be located to avoid introducing contaminants via groundwater, and be in conformance with an approved source water protection assessment or source water protection plan.

D. Roadway drainage systems should provide an opportunity to capture accidental spills. Road de-icing material storage facilities shall be designed to avoid salt and chloride runoff from entering waterways and infiltration facilities. The qualified design professional shall evaluate the possibility of groundwater contamination from the proposed infiltration facility and perform a hydrogeologic justification study if necessary.

E. The antidegredation analysis found in Chapter 93 shall be applied in HQ or EV streams.

F. An impermeable liner will be required in detention basins where the possibility of groundwater contamination exists. The Municipality may require a detailed hydrogeologic investigation.

G. The applicant should provide safeguards against groundwater contamination for land uses that may cause groundwater contamination should there be a mishap or spill.

Section 306. Water Quality Requirements

The Applicant shall comply with the following water quality requirements of this Article.

To control post-construction stormwater impacts from regulated activities and conform to state water quality requirements, BMPs which replicate pre-development stormwater infiltration and runoff conditions must be provided in the site design such that post-construction stormwater discharges do not degrade the physical, chemical, or biological characteristics of the receiving waters. This may be achieved by the following:

1. Infiltration: replication of pre-construction stormwater infiltration conditions,

2. Treatment: use of water quality treatment BMPs to provide filtering of chemical and physical pollutants from the stormwater runoff, and

3. Stream bank and stream bed protection: management of volume and rate of post-construction stormwater discharges to prevent physical degradation of receiving waters (e.g., from scouring).

A. Developed areas shall provide adequate storage and treatment facilities necessary to capture and treat stormwater runoff. The infiltration volume computed under Section 305 may be a component of the water quality volume if the Applicant chooses to manage both components in a single facility. If the calculated water quality volume (WQv) is greater than the volume required to be infiltrated as described in Section 305.A.2, then the difference between the two volumes shall be treated for water quality by an acceptable stormwater management practice(s). The required water quality volume (WQv) is the storage capacity needed to capture and treat a portion of stormwater runoff from the developed areas of the site.

To achieve this requirement, the following criterion is established:

From Control Guideline (CG-1) in the PA BMP Manual, the water quality volume shall be the net 2-year 24-hour volume. The net volume is the difference between the post-development runoff volume and the pre-development runoff volume. The post-development total runoff volume for all storms equal to or less than the 2-year 24-hour duration precipitation shall not be increased. For modeling purposes, existing (pre-development) non-forested pervious areas must be considered meadow in good condition or its equivalent, and twenty (20) percent of existing impervious area, when present, shall be considered meadow in good condition.

This volume requirement can be managed by the permanent volume of a wet basin or the detained volume from other BMPs. Where appropriate, wet basins shall be utilized for water quality control and shall follow the guidelines of the PA BMP manual referenced in Ordinance Appendix G.

Release of water can begin at the start of the storm (i.e., the invert of the water quality orifice is at the invert of the facility). The design of the facility shall provide for protection from clogging and unwanted sedimentation.

B. The temperature of receiving waters shall be protected through the use of BMPs that moderate temperature.

C. If a perennial or intermittent stream passes through, or a waterbody (i.e., lake, pond, wetland) is present on the site, the Applicant shall create a riparian buffer extending a minimum of [*fifty* (*50) to one hundred fifty (150) - subject to federal*

and state buffer policies and regulation)] feet, to either side of the top-of-bank of the channel, lake, or wetland. The buffer area shall be planted with native vegetation and maintained in a vegetated state (Refer to Appendix B, Pennsylvania Native Plant List, contained in the PA BMP Manual).

1. The following provisions also apply to riparian buffers on lots in existence at the time of adoption of this Ordinance:
   a. If the applicable rear or side yard setback is less than *[fifty (50-150) feet*]*, the buffer width may be reduced to twenty-five (25) percent of the setback or twenty-five (25) feet, whichever is greater.
   b. If a stream traverses a site in a manner that significantly reduces the use of the site, the buffer may be either:
      i. Reduced to twenty-five (25) feet on either side, with municipal approval, or
      ii. Reduced to ten (10) feet with municipal waiver

2. Permitted uses within the buffer include the following, subject to municipal approval and provided that they comply with all federal, state, and local regulations:
   a. Recreational trails. See Ordinance Appendix J Riparian Buffer Trail Guidelines
   b. Utility rights-of-way
   c. Bridges
   d. Other uses subject to municipal approval

D. If an existing buffer is legally prescribed (i.e., deed, covenant, easement, etc.) and it exceeds the requirements of this Ordinance, the existing buffer shall be maintained.

Section 307. Stream Bank Erosion Requirements

A. In addition to controlling the water quality volume (in order to minimize the impact of stormwater runoff on downstream stream bank erosion), the primary requirement to control stream bank erosion is to design a BMP to detain the proposed conditions 2-year, 24-hour design storm to the existing conditions 1-year flow using the SCS Type II distribution. Additionally, provisions shall be made (such as adding a small orifice at the bottom of the outlet structure) to release the proposed conditions 1-year storm for a minimum of twenty-four (24) hours from a point in time when the maximum volume of water from the 1-year storm is stored in a proposed BMP (i.e., the maximum water surface elevation is achieved in the facility). Release of water can begin at the start of the storm (i.e., the invert of the water quality orifice is at the invert of the facility).

B. The minimum orifice size in the outlet structure to the BMP shall be three (3) inches in diameter where possible, and a trash rack shall be installed to prevent clogging. On sites with small drainage areas contributing to this BMP that do not provide enough runoff volume to allow a 24-hour attenuation with the 3-inch

orifice, the calculations shall be submitted showing this condition. When the calculated orifice size is below three (3) inches, gravel filters (or other methods) are recommended to discharge low-flow rates subject to the municipal engineer's satisfaction. When filters are utilized, maintenance provisions shall be provided to ensure filters meet the design function. All facilities shall make use of measures to extend the flow path and increase the travel time of flows in the facility.

Section 308. Stormwater Peak Rate Control

A. The Crum Creek watershed has been divided into stormwater management districts as shown on the Management District Map in Appendix A.

1. In addition to the requirements specified in Table 308.1 below, the erosion and sedimentation control (Section 303), the nonstructural project design (Section 304), the infiltration (Section 305), the water quality (Section 306), and the stream bank erosion (Section 307) requirements shall be implemented.

2. Standards for managing runoff from each subarea in the Crum Creek watershed for the 2-, 5-, 10-, 25-, 50-, and 100-year design storms are shown in Table 308.1. Development sites located in each of the management districts must control proposed conditions runoff rates to existing conditions runoff rates for the design storms in accordance with Table 308.1.

B. General - Proposed conditions rates of runoff from any regulated activity shall not exceed the peak release rates of runoff from existing conditions for the design storms specified on the Stormwater Management District Watershed Map (Ordinance Appendix A) and this section of the Ordinance.

C. District Boundaries - The boundaries of the stormwater management districts are shown on an official map that is available for inspection at the municipal and County Planning offices. A copy of the official map at a reduced scale is included in Ordinance Appendix A. The exact location of the stormwater management district boundaries as they apply to a given development site shall be determined by mapping the boundaries using the 2-foot topographic contours (or most accurate data required) provided as part of the SWM site plan.

D. Sites Located in More than One (1) District or Watershed - For a proposed development site located within two (2) or more stormwater management district subareas, the peak discharge rate from any subarea shall meet the management district criteria for which the discharge is located. The natural hydrology of each respective subarea shall be maintained, and drainage shall not be redirected from one subarea to another. Under circumstances where the Applicant shows this cannot be accomplished, a waiver is required by the Municipality.

TABLE 308.1

PEAK RATE CONTROL STANDARDS IN THE CRUM CREEK WATERSHED

District	Proposed Condition (reduce to) Design Storm	Existing Condition Design Storm
A	2-year	1-year
	5-year	5-year
	10-year	10-year
	25-year	25-year
	50-year	50-year
	100-year	100-year
B	2-year	1-year
	5-year	2-year
	10-year	5-year
	25-year	10-year
	50-year	25-year
	100-year	100-year

E. Off-site Areas - Off-site areas that drain through a proposed development site are not subject to release rate criteria when determining allowable peak runoff rates. On-site drainage facilities shall be designed to safely convey off-site flows through the development site.

F. Site Areas - Where the site area to be impacted by a proposed development activity differs significantly from the total site area, only the proposed impact area utilizing stormwater management measures shall be subject to the peak rate control standards noted above. Unimpacted areas for which the discharge point has not changed are not subject to the peak rate control standards.

The following article provisions are optional. Please see box below.

G. Hardship Option for regulated activities less than one acre - There may be certain instances, where the peak rate criteria are too restrictive for a particular landowner or Applicant. The existing drainage network in some areas may be capable of safely transporting slight increases in flows without causing a problem or increasing flows elsewhere. This must be demonstrated as per Section 308.H below in order for the hardship option to be considered. If an Applicant or homeowner cannot meet the stormwater standards due to lot conditions or if conformance would become a hardship to an owner, the hardship option may be applied. The Applicant would have to plead his/her

case to the Governing Body with the final determination made by the Municipality. Any landowners pleading the "hardship option" will assume all liabilities that may arise due to exercising this option. Cost or financial burden cannot be considered as a hardship. The Applicant may consider off-site management controls or contributing to the Municipal Stormwater Control and BMP Operation and Maintenance Fund (Section 708) as long as the stormwater management controls are within the same subwatershed.

H. "Downstream Hydraulic Capacity Analysis" - Any downstream capacity hydraulic analysis conducted in accordance with this Ordinance shall use the following criteria for determining adequacy for accepting increased peak flow rates:

1. Natural or man-made channels or swales must be able to convey the increased runoff associated with a 2-year storm event within their banks at velocities consistent with protection of the channels from erosion. Velocities shall be based upon criteria and methodologies acceptable to the municipality.

2. Natural or man-made channels or swales must be able to convey increased 25-year storm event runoff without creating any increased hazard to persons or property.

3. Culverts, bridges, storm sewers or any other hydraulic facilities which must pass or convey flows from the tributary area must be designed in accordance with PADEP Chapter 105 regulations (if applicable) and, at a minimum, pass the increased 25-year storm event runoff.

4. Water quality requirements defined in Section 307 must be met.

5. Post construction peak rates shall not exceed the existing peak rates for the respective subarea.

I. Alternate Criteria for Redevelopment Sites - For redevelopment sites, one of the following minimum design parameters shall be accomplished, whichever is most appropriate for the given site conditions as determined by [*Municipality*];

1. Meet the full requirements specified by Table 308.1 and Sections 308.A through 308.H, or

2. Reduce the total impervious surface on the site by at least twenty percent (20%); based upon a comparison of existing impervious surface to proposed impervious surface. In this case, calculations must be provided that show the peak rate has not increased.

Section 309. Calculation Methodology

A. Stormwater runoff from all development sites with a drainage area of greater than five (5) acres shall be calculated using a generally accepted calculation technique that is based on the NRCS Soil Cover Complex Method. Table 309.1 summarizes acceptable computation methods. The method selected by the design professional shall be based on the individual limitations and suitability of each method for a particular site. The use of the Rational Method to estimate peak discharges for drainage areas greater than five (5) acres shall be permitted only upon approval of the municipality.

TABLE 309.1

ACCEPTABLE COMPUTATION METHODOLOGIES FOR SWM SITE PLAN

METHOD	DEVELOPED BY	APPLICABILITY
TR-20 (or commercial computer package based on TR-20)	USDA NRCS	Applicable where use of full hydrology computer model is desirable or necessary.
TR-55 (or commercial computer package based on TR-55)	USDA NRCS	Applicable for land development plans where limitations described in TR-55.
HEC-1/ HEC-HMS	US Army Corps of Engineers	Applicable where use of a full hydrologic computer model is desirable or necessary.
Rational Method (or commercial computer package based on Rational Method)	Emil Kuichling (1889)	For sites up to five (5) acres, or as approved by the Municipality and/or municipal Engineer.
Other Methods	Varies	Other computation methodologies approved by the Municipality and/or municipal Engineer.

B. All calculations consistent with this Ordinance using the Soil Cover Complex Method shall use the appropriate design rainfall depths for the various return period storms. Rainfall depths shall be according to NOAA Atlas 14 values consistent with a partial duration series. When stormwater calculations are performed for routing procedures or water quality functions, the duration of rainfall shall be twenty-four (24) hours.

C. The following criteria shall be used for peak rate runoff calculations:

1. For development sites not considered redevelopment, the ground cover used in determining the existing conditions flow rates shall be as follows:

   a. Wooded sites shall use a ground cover of "woods in good condition." Portions of a site having more than one viable tree measuring a diameter at breast height (DBH) of six (6) inches or greater per fifteen hundred (1,500) square feet shall be considered wooded where such trees existed within three (3) years of application.

   b. The undeveloped portion of the site including agriculture, bare earth, and fallow ground shall be considered as "meadow in good condition," unless the natural ground cover generates a lower curve (CN) number or Rational "c" value (i.e., woods) as listed in Tables F-1 or F-2 in Appendix F of this Ordinance.

2. For redevelopment sites, the ground cover used in determining the existing conditions flow rates for the developed portion of the site shall be based upon actual land cover conditions.

D. All calculations using the Rational Method shall use rainfall intensities consistent with appropriate times-of-concentration (duration) and storm events with rainfall intensities obtained from NOAA Atlas 14 partial duration series estimates, or the latest version of the PennDOT Drainage Manual (PDM Publication 584). Times-of-concentration shall be calculated based on the methodology recommended in the respective model used. Times of concentration for channel and pipe flow shall be computed using Manning's equation.

E. Runoff curve numbers (CN) for both existing and proposed conditions to be used in the Soil Cover Complex Method shall be obtained from Table F-1 in Appendix F of this Ordinance.

F. Runoff coefficients (c) for both existing and proposed conditions for use in the Rational Method shall be obtained from Table F-2 in Appendix F of this Ordinance.

G. Hydraulic computations to determine the capacity of pipes, culverts, and storm sewers shall be consistent with methods and computations contained in the Federal Highway Administration Hydraulic Design Series Number 5 (Publication No. FHWA-NHI-01-020 HDS No. 5). Hydraulic computations to determine the capacity of open channels shall be consistent with methods and computations contained in the Federal Highway Administration Hydraulic Engineering Circular Number 15 (Publication No. FHWA-NHI-05-114 HEC 15). Values for Manning's roughness coefficient (n) shall be consistent with Table F-3 in Appendix F of the Ordinance.

H. Outlet structures for stormwater management facilities shall be designed to meet the performance standards of this Ordinance using any generally accepted hydraulic analysis technique or method.

I. The design of any stormwater detention facilities intended to meet the performance standards of this Ordinance shall be verified by routing the design storm hydrograph through these facilities using an acceptable method. The design storm hydrograph shall be computed using a calculation method that produces a full hydrograph. The Municipality may approve the use of any generally accepted full hydrograph approximation technique that shall use a total runoff volume that is consistent with the volume from a method that produces a full hydrograph.

Section 310. Other Requirements

A. All wet basin designs shall incorporate biologic controls consistent with the West Nile Guidance found in Appendix H, PADEP document 363-0300-001 "Design Criteria – Wetlands Replacement/Monitoring," or contact the Pennsylvania State Cooperative Wetland Center (www.wetlands.psu.edu/) or the Penn State Cooperative Extension Office (www.extension.psu.edu/extmap.html).

B. Any stormwater basin required or regulated by this Ordinance designed to store runoff and requiring a berm or earthen embankment shall be designed to provide an emergency spillway to handle flow up to and including the 100-year proposed conditions. The height of embankment must provide a minimum [*recommended 1.0 foot*] of freeboard above the maximum pool elevation computed when the facility functions for the 100-year proposed conditions inflow. Should any stormwater management facility require a dam safety permit under PADEP Chapter 105, the facility shall be designed in accordance with Chapter 105 and meet the regulations of Chapter 105 concerning dam safety. Chapter 105 may require the passing of storms larger than 100-year event.

C. Any drainage conveyance facility and/or channel not governed by Chapter 105 regulations must be able to convey, without damage to the drainage structure or roadway, runoff from the 25-year storm event. The larger the events (50-year and 100-year) must also be safely conveyed in the direction of natural flow without creating additional damage to any drainage structures, nearby structures, or roadways.

D. Conveyance facilities to or exiting from stormwater management facilities (i.e., detention basins) shall be designed to convey the design flow to or from the facility.

E. Roadway crossings or structures located within designated floodplain areas must be able to convey runoff from a 100-year design storm consistent with Federal Emergency Management Agency National Flood Insurance Program – Floodplain Management Requirements.

F. Any facility located within a PennDOT right-of-way must meet PennDOT minimum design standards and permit submission requirements.

G. Adequate erosion protection and energy dissipation shall be provided along all open channels and at all points of discharge. Design methods shall be consistent with the Federal Highway Administration Hydraulic Engineering Circular Number 11 (Publication No. FHWA-IP-89-016) and the PADEP Erosion and Sediment Pollution Control Program Manual (Publication No. 363-2134-008).

ARTICLE IV – STORMWATER MANAGEMENT (SWM) SITE PLAN REQUIREMENTS

Section 401. General Requirements

For any of the activities regulated by this Ordinance, the preliminary or final approval of subdivision and/or land development plans, the issuance of any building or occupancy permit, or the commencement of any earth disturbance activity may not proceed until the property owner, Applicant, or his/her agent has received written approval of a SWM site plan from the Municipality and an adequate erosion and sediment control plan review by the Conservation District unless the project qualifies for an exemption in Section 106.

Section 402. SWM Site Plan Contents

The SWM site plan shall consist of a general description of the project including sequencing items described in Section 304, calculations, maps, and plans. A note on the maps shall refer to the associated computations and erosion and sediment control plan by title and date. The cover sheet of the computations and erosion and sediment control plan shall refer to the associated maps by title and date. All SWM site plan materials shall be submitted to the Municipality in a format that is clear, concise, legible, neat, and well organized; otherwise, the SWM site plan shall not be accepted for review and shall be returned to the Applicant.

The following items shall be included in the SWM site plan, when applicable:

A. General

1. General description of the project, including those areas described in Section 304.B.

2. General description of proposed permanent stormwater management techniques, including construction specifications of the materials to be used for stormwater management facilities.

3. Complete hydrologic, hydraulic, and structural computations for all stormwater management facilities.

4. An erosion and sediment control plan, including all reviews and letters of adequacy from the Conservation District.

5. A general description of proposed nonpoint source pollution controls.

6. The SWM Site Plan Application and completed fee schedule form and associated fee (Ordinance Appendix C-1).

7. The SWM Site Plan Checklist (Appendix C-2).

B. Maps

Map(s) of the project area shall be submitted on 24-inch x 36-inch sheets and/or shall be prepared in a form that meets the requirements for recording at the offices of the Recorder of Deeds of *[Insert]* County. If the SALDO has more stringent criteria than this Ordinance, then the more stringent criteria shall apply. The contents of the map(s) shall include, but not be limited to:

1. The location of the project relative to highways, municipal boundaries, or other identifiable landmarks.

2. Existing contours at intervals of two (2) feet. In areas of slopes greater than [___] percent, 5-foot contour intervals may be used.

3. Existing streams, lakes, ponds, or other waters of the Commonwealth within the project area.

4. Other physical features including flood hazard boundaries, stream buffers, existing drainage courses, areas of natural vegetation to be preserved, and the total extent of the upstream area draining through the site.

5. The locations of all existing and proposed utilities, sanitary sewers, and water lines within fifty (50) feet of property lines.

6. An overlay showing soil names and boundaries.

7. Limits of earth disturbance, including the type and amount of impervious area that would be added.

8. Proposed structures, roads, paved areas, and buildings.

9. Final contours at intervals of two (2) feet. In areas of steep slopes (greater than [___] percent), 5-foot contour intervals may be used.

10. The name of the development, the name and address of the owner of the property, and the name of the individual or firm preparing the plan.

11. The date of submission.

12. A graphic and written scale of one (1) inch equals no more than fifty (50) feet; for tracts of twenty (20) acres or more, the scale shall be one (1) inch equals no more than one hundred (100) feet.

13. A north arrow.

14. The total tract boundary and size with distances marked to the nearest foot and bearings to the nearest degree.

15. Existing and proposed land use(s).

16. A key map showing all existing man-made features beyond the property boundary that would be affected by the project.

17. Location of all open channels.

18. Overland drainage patterns and swales.

19. A 15-foot wide access easement around all stormwater management facilities that would provide ingress to and egress from a public right-of-way.

20. The location of all erosion and sediment control facilities.

21. A note on the plan indicating the location and responsibility for maintenance of stormwater management facilities that would be located off site. All off-site facilities shall meet the performance standards and design criteria specified in this Ordinance.

22. A statement, signed by the Applicant, acknowledging that any revision to the approved SWM site plan must be approved by the Municipality, and that a revised erosion and sediment control plan must be submitted to the Conservation District for a determination of adequacy.

23. The following signature block for the Design Engineer:

"I, (Design Engineer), on this date (date of signature), hereby certify that the SWM site plan meets all design standards and criteria of the *[Municipality]* Stormwater Management Ordinance." [Note: license stamp should be included here]

C. Supplemental information to be submitted to the Municipality:

1. A written description of the following information shall be submitted by the Applicant and shall include:

   a. The overall stormwater management concept for the project designed in accordance with Section 304.

   b. Stormwater runoff computations as specified in this Ordinance.

   c. Stormwater management techniques to be applied both during and after development.

   d. Expected project time schedule.

e. Development stages or project phases, if so proposed.

f. An operations and maintenance plan in accordance with Section 702 of this Ordinance.

2. An erosion and sediment control plan.

3. A description of the effect of the project (in terms of runoff volumes and peak flows) on adjacent properties and on any existing municipal stormwater collection system that may receive runoff from the project site.

4. A Declaration of Adequacy and Highway Occupancy Permit from the Pennsylvania Department of Transportation (PennDOT) District office when utilization of a PennDOT storm drainage system is proposed.

D. Stormwater Management Facilities

1. All stormwater management facilities must be located on a plan and described in detail.

2. When infiltration measures such as seepage pits, beds, or trenches are used, the locations of existing and proposed septic tank infiltration areas and wells must be shown.

3. All calculations, assumptions, loading ratios (guidelines presented in the PA BMP Manual), and criteria used in the design of the stormwater management facilities must be shown.

Section 403. Plan Submission

The Municipality shall require receipt of a complete SWM site plan, as specified in this Ordinance.

A. Proof of application or documentation of required permit(s) or approvals for the programs listed below shall be part of the plan, if applicable:

1. NPDES Permit for Stormwater Discharges from Construction Activities

2. PADEP permits as needed

a. PADEP Joint Permit Application

b. Chapter 105 (Dam Safety and Waterway Management)

c. Chapter 106 (Floodplain Management)

3. PennDOT Highway Occupancy Permit

4. Any other permit under applicable state or federal regulations

B. The plan shall be coordinated with the state and federal permit process and the municipal SALDO review process. The process implementing the provisions in this Ordinance is illustrated in Appendices D-1 and D-2.

C. For projects that require SALDO approval, the SWM site plan shall be submitted by the Applicant as part of the preliminary plan submission where applicable for the regulated activity.

D. For regulated activities that do not require SALDO approval, see Section 301, General Requirements.

E. Five (5) copies of the SWM site plan shall be submitted by the applicant for review in accordance with established criteria and procedures:

1. Two (2) copies to the Municipality accompanied by the requisite municipal review fee, as specified in this Ordinance.

2. Two (2) copies to the County Conservation District.

3. One (1) copy to the municipal Engineer.

F. Any submissions to the agencies listed above that are found to be incomplete shall not be accepted for review and shall be returned to the Applicant with a notification in writing of the specific manner in which the submission is incomplete.

Section 404. Stormwater Management (SWM) Site Plan Review

A. SWM plans shall be submitted to the municipality for review by the municipal engineer for consistency with this Ordinance and the respective Act 167 Stormwater Management Plan. Any plan found incomplete may not be accepted for review and may be returned to the Applicant. The municipal Engineer will review the SWM site plan for any subdivision or land development against the municipal SALDO provisions not otherwise superseded by this Ordinance.

B. The applicant shall respond to the Conservation District comments on the SWM site plan prior to being considered for final approval by the Municipality.

C. For activities regulated by this Ordinance (Section 105), the municipal Engineer will notify the Applicant and the Municipality in writing, with a copy to the Building Permit Officer, within [___] calendar days, whether the SWM site plan is consistent with the stormwater management plan.

1. If the municipal Engineer determines that the SWM site plan is consistent with the stormwater management ordinance, the municipal Engineer will forward a letter of consistency to the municipality, who will then forward a copy to the Applicant.

2. If the municipal Engineer determines that the SWM site plan is inconsistent or noncompliant with the stormwater management ordinance, the municipal Engineer will forward a letter to the municipality, with a copy to the Applicant citing the reason(s) and specific Ordinance sections for the inconsistency or noncompliance. Inconsistency or noncompliance may be due to inadequate information to make a reasonable judgment as to compliance with the stormwater management plan. Any SWM site plans that are inconsistent or noncompliant may be revised by the Applicant and resubmitted when consistent with this Ordinance.

D. For regulated activities under this Ordinance that require an NPDES Permit Application, the Applicant shall forward a copy of the municipal Engineer's letter stating that the SWM site plan is consistent with the stormwater management ordinance to the Conservation District. PADEP and the Conservation District may consider the municipal Engineer's review comments in determining whether to issue a permit.

E. The Municipality will not grant preliminary or final approval to any subdivision or land development for regulated activities specified in this Ordinance if the SWM site plan has been found by the municipal Engineer to be inconsistent with the stormwater management ordinance. All required permits from PADEP must be obtained prior to approval of any subdivision or land development.

F. No building permits for any regulated activity specified in this Ordinance will be approved by the Municipality if the SWM site plan has been found to be inconsistent with the stormwater management ordinance, as determined by the municipal Engineer and Conservation District, or without considering the comments of the municipal Engineer and Conservation District. All required permits from PADEP must be obtained prior to issuance of a building permit.

G. The Applicant shall be responsible for completing record drawings of all stormwater management facilities included in the approved SWM site plan. The record drawings and an explanation of any discrepancies with the design plans shall be submitted to the municipal Engineer for final approval. In no case will the Municipality approve the record drawings until the Municipality receives a copy of an approved Declaration of Adequacy and/or Highway Occupancy Permit from the PennDOT District office, NPDES Permit, and any other applicable permits or approvals from PADEP or the Conservation District. The above permits and approvals must be based on the record drawings.

H. The Municipality's approval of a SWM site plan shall be valid for a period not to exceed [*recommended 5*] years commencing on the date that the Municipality signs the approved SWM site plan. If stormwater management facilities included in the approved SWM site plan have not been constructed, or if constructed, record drawings of these facilities have not been approved within this [____] year time period, then the Municipality may consider the SWM site plan inconsistent or noncompliant and may revoke any and all permits. SWM site plans that are determined to be inconsistent or noncompliant by the Municipality shall be resubmitted in accordance with Section 406 of this Ordinance.

Section 405. Revision of Plans

A. A revision to a submitted SWM site plan under review by the Municipality for a development site that involves the following shall require a resubmission to the Municipality of a revised SWM site plan consistent with Section 403 of this Ordinance and be subject to review as specified in Section 404 of this Ordinance:

1. Change in stormwater management facilities or techniques,

2. Relocation or redesign of stormwater management facilities, or

3. Is necessary because soil or other conditions are not as stated on the SWM site plan as determined by the municipal Engineer.

B. A revision to an already approved or inconsistent or noncompliant SWM site plan shall be submitted to the Municipality, accompanied by the applicable municipal review and inspection fee. A revision to a SWM site plan for which a formal action has not been taken by the Municipality shall be submitted to the Municipality accompanied by the applicable municipal review and inspection fee.

Section 406. Resubmission of Inconsistent or Noncompliant SWM Site Plans

An inconsistent or noncompliant SWM site plan may be resubmitted with the revisions addressing the municipal Engineer's concerns documented in writing. It must be addressed to the municipality in accordance with Section 403 of this Ordinance, distributed accordingly, and be subject to review as specified in Section 404 of this Ordinance. The applicable municipal review and inspection fee must accompany a resubmission of an inconsistent or noncompliant SWM site plan.

ARTICLE V – INSPECTIONS

Section 501. Inspections

A. The municipal Engineer or his municipal designee shall inspect all phases of the installation of the permanent BMPs and/or stormwater management facilities as deemed appropriate by the municipal Engineer.

B. During any stage of the work, if the municipal Engineer or his municipal designee determines that the permanent BMPs and/or stormwater management facilities are not being installed in accordance with the approved stormwater management plan, the Municipality may revoke any existing permits or other approvals and issue a cease and desist order until a revised SWM site plan is submitted and approved, as specified in this Ordinance, and until the deficiencies are corrected.

C. A final inspection of all BMPs and/or stormwater management facilities shall be conducted by the municipal Engineer or his municipal designee to confirm compliance with the approved SWM site plan prior to the issuance of any occupancy permit.

Section 502. As-built Plans, Completion Certificate, and Final Inspections

A. The developer shall be responsible for providing as-built plans of all SWM BMPs included in the approved SWM site plan for activities involving proposed impervious surfaces 1,000 sq. ft. or greater and for earth disturbances 5,000 sq. ft. or greater. [*Note: this section can be modified to also require as-built plans for small projects using the simplified approach.*] The as-built plans and all explanation of any discrepancies with the construction plans shall be submitted to the Municipality within three (3) months of the completion of construction of the SWM BMPs.

B. As-built plans shall show the location and as-built conditions of all SWM BMP structures and include the following information: impervious surfaces included in the approved SWM site plan; topographic contours; and existing, proposed, and built impervious surfaces shown in the as-built drawings.

C. The as-built submission shall include a certification of completion signed by a Design Professional verifying that all permanent SWM BMPs have been constructed according to the approved plans and specifications.

D. The municipality will review the as-built submission for consistency with the approved SWM site plan as well as actual conditions at the project site. After receipt of the completion certification by the Municipality, the Municipality may conduct a final inspection.

ARTICLE VI – FEES AND EXPENSES

Section 601. Municipality SWM Site Plan Review and Inspection Fee

Fees have been established by the Municipality to defray plan review and construction inspection costs incurred by the Municipality. All fees shall be paid by the Applicant at the time of SWM site plan submission. [*A review and inspection fee schedule has been be established by resolution of the municipal Governing Body based on the size of the regulated activity and based on the Municipality's costs for reviewing SWM site plans and conducting inspections pursuant to Section 501. Keep if a fee schedule is established*.] The Municipality shall periodically update the review and inspection fee schedule to ensure that review costs are adequately reimbursed.

Section 602. Expenses Covered by Fees

The fees required by this Ordinance shall at a minimum cover:

A. Administrative costs.

B. The review of the SWM site plan by the Municipality and the municipal Engineer.

C. The site inspections.

D. The inspection of stormwater management facilities and drainage improvements during construction.

E. The final inspection upon completion of the stormwater management facilities and drainage improvements presented in the SWM site plan.

F. Any additional work required to enforce any permit provisions regulated by this Ordinance, correct violations, and assure proper completion of stipulated remedial actions.

ARTICLE VII – MAINTENANCE RESPONSIBILITIES

Section 701. Performance Guarantee

A. For all activities requiring submittal of a SWM site plan, the Applicant shall provide a financial guarantee to the Municipality for the timely installation and proper construction of all stormwater management facilities as:

1. Required by the approved SWM site plan equal to or greater than the full construction cost of the required facilities, or

2. The amount and method of payment provided for in the SALDO.

B. For other regulated activities, the Municipality may require a financial guarantee from the Applicant.

Section 702. Responsibilities for Operations and Maintenance (O&M) of Stormwater Controls and BMPs

A. The SWM site plan shall include a BMP operations and maintenance plan that describes how the permanent (e.g., post-construction) stormwater controls and BMPs will be properly operated, inspected, and maintained.

B. Establish access easements that include all significant stormwater controls, conveyances, and BMPs, and indicate a 15-foot perimeter area surrounding these features that will provide the municipality sufficient ingress to and egress from a public right-of-way.

C. The following items shall be included in the stormwater control and BMP operations and maintenance plan, as applicable:

1. Map(s) of the project area, in a form that meets the requirements for recording at the offices of the Recorder of Deeds of [*Insert*] County, shall be submitted on [___]-inch x –[___]-inch sheets. The contents of the maps(s) shall include, but not be limited to:

   a. Clear identification of the location and nature of permanent stormwater controls and BMPs,

   b. The location of the project site relative to highways, municipal boundaries, or other identifiable landmarks,

   c. Existing and final contours at intervals of two (2) feet, or others as appropriate,

   d. Existing streams, lakes, ponds, or other bodies of water within the project site area,

e. Other physical features including flood hazard boundaries, sinkholes, streams, existing drainage courses, and areas of natural vegetation to be preserved,

f. The locations of all existing and proposed utilities, sanitary sewers, and water lines within fifty (50) feet of property lines of the project site,

g. Proposed final changes to the land surface and vegetative cover, including the type and amount of impervious area that would be added,

h. Proposed final structures, roads, paved areas, and buildings, and

i. Access easement boundaries

2. A description of how each permanent stormwater control and BMP will be operated and maintained,

3. The identity and contact information associated with the person(s) responsible for operations and maintenance,

4. The name of the project site, the name and address of the owner of the property, and the name of the individual or firm preparing the plan, and

5. A statement, signed by the landowner, acknowledging that the stormwater controls and BMPs are fixtures that can be altered or removed only after approval by the Municipality.

D. The stormwater control and BMP operations and maintenance plan for the project site shall establish responsibilities for the continuing operation and maintenance of all permanent stormwater controls and BMPs, as follows:

1. If a plan includes structures or lots that are to be separately owned and in which streets, sewers, and other public improvements are to be dedicated to the Municipality, stormwater controls and BMPs may, at the Municipality's discretion, also be dedicated to and maintained by the Municipality;

2. If a plan includes operations and maintenance by a single owner or if sewers and other public improvements are to be privately owned and maintained, the operations and maintenance of stormwater controls and BMPs shall be the responsibility of the landowner.

E. The Municipality will make the final determination on the continuing operations and maintenance responsibilities. The Municipality reserves the right to accept or reject the operations and maintenance responsibility for any or all of the stormwater controls and BMPs.

Section 703. Municipal Review of a Stormwater Control and BMP Operations and Maintenance Plan

A. The Municipality will review the stormwater control and BMP operations and maintenance plan for consistency with this Ordinance and any permits issued by PADEP.

B. The Municipality will notify the Applicant in writing whether or not the stormwater control and BMP operations and maintenance plan is approved.

C. The Municipality will require an as-built plan per Section 502 showing all constructed stormwater controls and BMPs and an explanation of any discrepancies with the approved operations and maintenance plan.

Section 704. Adherence to an Approved Stormwater Control and BMP Operations and Maintenance Plan

It shall be unlawful to alter or remove any permanent stormwater control and BMP required by an approved stormwater control and BMP operations and maintenance plan or to allow the property to remain in a condition which does not conform to an approved stormwater control and BMP operations and maintenance plan.

Section 705. Operations and Maintenance Agreement for Privately Owned Stormwater Controls and BMPs

A. Prior to final approval of the site's SWM site plan (including plans for private facilities constructed under the simplified method), the Applicant shall sign and record an operations and maintenance agreement with the Municipality covering all stormwater controls and BMPs that are to be privately owned (refer to Appendix I). The maintenance agreement shall be transferred with transfer of ownership in perpetuity. The agreement shall be substantially the same as the agreement in Appendix I of this Ordinance.

B. Other items may be included in the agreement where determined necessary to guarantee the satisfactory operation and maintenance of all permanent stormwater controls and BMPs. The agreement shall be subject to the review and approval of the Municipality.

Section 706. Stormwater Management Easements

A. Stormwater management easements are required for all areas used for off-site stormwater control, unless a waiver is granted by the Municipality.

B. Stormwater management easements shall be provided to the municipality by the Applicant or property owner for access for inspections and maintenance, the preservation of stormwater runoff conveyance, infiltration, and detention areas, and for other stormwater controls. The purpose of the easement shall be specified in any agreement under Section 705.

Section 707. Recording of an Approved Stormwater Control and BMP Operations and Maintenance Plan and Related Agreements

A. The owner of any land upon which permanent stormwater controls and BMPs will be placed, constructed, implemented, or permanently maintained, as described in the stormwater control and BMP operations and maintenance plan, shall record the following documents in the Office of the Recorder of Deeds for *[insert]* County, within fifteen (15) days of approval of the stormwater control and BMP operations and maintenance plan by the Municipality:

1. The operations and maintenance plan, or a summary thereof,

2. Operations and maintenance agreements under Section 705, and

3. Easements under Section 706.

B. The Municipality may suspend or revoke any approvals granted for the project site upon discovery of failure on the part of the owner to comply with this section.

The following article provisions are optional. Please see box below.

Section 708. Municipal Stormwater Control and BMP Operation and Maintenance Fund

A. Persons installing stormwater controls or BMPs shall be required to pay a specified amount to the Municipal Stormwater Control and BMP Operation and Maintenance Fund to help defray costs of periodic inspections and maintenance expenses. The amount of the deposit shall be determined as follows:

1. If the stormwater control or BMP is to be privately owned and maintained, the deposit shall cover the cost of periodic inspections performed by the Municipality, as estimated by the municipal engineer, for a period of [*ten (10) or twenty five (25*)] years. This is to be paid in a manner specified by the municipality. After that period of time, inspections will be performed at the expense of the Municipality.

2. If the stormwater control or BMP is to be owned and maintained by the Municipality, the deposit shall cover the estimated costs for maintenance and inspections for [*ten (10) or twenty five (25)*] years. The municipality will establish the estimated costs utilizing information submitted by the Applicant.

3. The amount of the deposit to the fund shall be converted to present worth of the annual series values. The municipality shall determine the present worth equivalents, which shall be subject to the approval of the Governing Body.

B. If a stormwater control or BMP is proposed that also serves as a recreational facility (e.g., ball field or lake), the Municipality may reduce or waive the amount of the maintenance fund deposit based upon the value of the land for public recreational purpose.

C. If at some future time, a stormwater control or BMP (whether publicly or privately owned) is eliminated due to the installation of storm sewers or other storage facility, the unused portion of the maintenance fund deposit will be applied to the cost of abandoning or demolishing the facility and connecting to the storm sewer system or other facility. Any amount of the deposit remaining after the costs of abandonment or demolition will be used for inspection, maintenance, and operation of the receiving stormwater management system.

D. If stormwater controls or BMPs are accepted by the Municipality for dedication, the Municipality may require persons installing stormwater controls or BMPs to pay a specified amount to the Municipal Stormwater Control and BMP Operation and Maintenance Fund to help defray costs of operations and maintenance activities. The amount may be determined as follows:

1. The amount shall cover the estimated costs for operations and maintenance for ten (10) years, as determined by the Municipality.

2. The amount shall then be converted to present worth of the annual series values.

E. If a stormwater control or BMP is proposed that also serves as a recreational facility (e.g., ball field or lake), the Municipality may adjust the amount due accordingly.

F. The Municipality may require Applicants to pay a fee to the Municipal Stormwater Control and BMP Operation and Maintenance Fund to cover long-term maintenance of stormwater controls and BMPs.

G. The Municipality may require Applicants to pay a fee to the Municipal Stormwater Control and BMP Operation and Maintenance Fund to cover stormwater related problems which may arise from the land development and earth disturbance.

ARTICLE VIII – PROHIBITIONS

Section 801. Prohibited Discharges

The Municipality may want to consider developing and adopting a separate ordinance covering prohibited discharges from existing development.

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 this Commonwealth is prohibited.

B. No person shall allow, or cause to allow, stormwater discharges into the Municipality's separate storm sewer system that are not composed entirely of stormwater, except as provided in subsection C below, and 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:

1. Discharges from fire fighting activities;
2. Potable water sources including water line and fire hydrant flushings;
3. Irrigation drainage;
4. Routine external building washdown (which does not use detergents or other compounds);
5. Air conditioning condensate;
6. Water from individual residential car washing;
7. Springs and water from crawl space pumps;
8. Uncontaminated water from foundation or from footing drains;
9. Flows from riparian habitats and wetlands;
10. Lawn watering;
11. Pavement washwaters 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;
12. Uncontaminated groundwater;
13. Dechlorinated swimming pool discharges.

D. In the event that the Municipality determines that any of the discharges identified in Section 801.C significantly contribute to pollution of waters of the Commonwealth, or is so notified by PADEP, the Municipality will notify the responsible person to cease the discharge.

E. Upon notice provided by the Municipality under Section 801.D, the discharger will have a reasonable time, as determined by the Municipality, to cease the discharge consistent with the degree of pollution caused by the discharge.

F. Nothing in this section shall affect a discharger's responsibilities under state law.

Section 802. Prohibited Connections

The following connections are prohibited, except as provided in Section 801.C above:

A. Any drain or conveyance, whether on the surface or subsurface, that allows any non-stormwater discharge, including sewage, process wastewater, wash water entering the separate storm sewer system, and any connections to the storm drain system from indoor drains and sinks.

Section 803. Roof Drains and Sump Pumps

A. Roof drains and sump pumps shall not be connected to sanitary sewers.

B. Roof drains and sump pumps shall not be connected to streets, storm sewers, or roadside ditches except on a case by case basis as determined by the municipality.

C. Roof drains and sump pumps shall discharge to infiltration areas or vegetative BMPs to the maximum extent practicable where advantageous to do so.

Section 804. Alteration of BMPs

A. No person shall modify, remove, fill, landscape, or alter any existing stormwater control or BMP unless it is part of an approved maintenance program without the written approval of the Municipality.

B. No person shall place any structure, fill, landscaping, or vegetation into a stormwater control or BMP or within a drainage easement that would limit or alter the functioning of the stormwater control or BMP without the written approval of the Municipality.

ARTICLE IX – ENFORCEMENT AND PENALTIES

Section 901. Right-of-Entry

A. Upon presentation of proper credentials, duly authorized representatives of the Municipality may enter at reasonable times upon any property within the Municipality to inspect the implementation, condition, or operation and maintenance of the stormwater controls or BMPs in regard to any aspect governed by this Ordinance.

B. Persons working on behalf of the Municipality shall have the right to temporarily locate on or in any stormwater control or BMP in the Municipality such devices as are necessary to conduct monitoring and/or sampling of the discharges from such stormwater control or BMP.

C. If the property owner or representative does not grant access to the Municipality within 24 hours of notification, it will be a violation of this Ordinance.

Section 902. Public Nuisance

A. The violation of any provision of this Ordinance is hereby deemed a public nuisance.

B. Each day that a violation continues shall constitute a separate violation.

Section 903. Enforcement Generally

A. Whenever the Municipality finds that a person has violated a prohibition or failed to meet a requirement of this Ordinance, the Municipality may order compliance by written notice to the responsible person. Such notice may, without limitation, require the following remedies:

1. Performance of monitoring, analyses, and reporting;

2. Elimination of prohibited connections or discharges;

3. Cessation of any violating discharges, practices, or operations;

4. Abatement or remediation of stormwater pollution or contamination hazards and the restoration of any affected property;

5. Payment of a fine to cover administrative and remediation costs;

6. Implementation of stormwater controls and BMPs; and

7. Operation and maintenance of stormwater controls and BMPs.

B. Such notification shall set forth the nature of the violation(s) and establish a time limit for correction of these violations(s). Said notice may further advise that, if applicable, should

the violator fail to take the required action within the established deadline, the work will be done by the Municipality or designee, and the expense thereof shall be charged to the violator.

C. Failure to comply within the time specified shall also subject such person to the penalty provisions of this Ordinance. All such penalties shall be deemed cumulative and shall not prevent the Municipality from pursuing any and all other remedies available in law or equity.

Section 904. Suspension and Revocation of Permits and Approvals

A. Any building, land development, or other permit or approval issued by the Municipality may be suspended or revoked by the Municipality for:

1. Noncompliance with or failure to implement any provision of the permit;

2. A violation of any provision of this Ordinance or any other law or regulation applicable to the regulated activity;

3. The creation of any condition or the commission of any act during construction or development that constitutes or creates a hazard or nuisance, pollution, or endangers the life, health, or property of others.

B. Prior to revocation or suspension of a permit and at the request of the Applicant, the Governing Body shall schedule a hearing to discuss the noncompliance if there is no immediate danger to life, public health, or property. The expense of a hearing shall be the Applicant's responsibility.

C. A suspended permit or approval may be reinstated by the Municipality when:

1. The municipal Engineer or designee has inspected and approved the corrections to the stormwater controls and BMPs or the elimination of the hazard or nuisance, and/or

2. The Municipality is satisfied that the violation has been corrected.

D. A permit or approval that has been revoked by the Municipality cannot be reinstated. The Applicant may apply for a new permit in accordance with this Ordinance.

Section 905. Penalties

A. Any person violating the provisions of this Ordinance shall be subject to a fine as established by the Municipality for each violation, recoverable with costs. Each day that the violation continues shall constitute a separate offense and the applicable fines are 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 906. Notification

In the event that a person fails to comply with the requirements of this Ordinance or fails to conform to the requirements of any permit issued hereunder, and the Municipality chooses to pursue enforcement action, the Municipality will provide written notification of the violation. Such notification will state the nature of the violation(s) and establish a time limit for correction of these violation(s). Failure to comply within the time specified will subject such person to the penalty provisions of this Ordinance. All such penalties will be deemed cumulative and shall not prevent the Municipality from pursuing any and all remedies. It shall be the responsibility of the owner of the real property on which any regulated activity is proposed to occur, is occurring, or has occurred to comply with the terms and conditions of this Ordinance.

Section 907. Enforcement

The municipal Governing Body is hereby authorized and directed to enforce all of the provisions of this Ordinance. All inspections regarding compliance with the SWM site plan shall be the responsibility of the municipality or its designee.

A. A set of design plans approved by the Municipality shall be on file and available for viewing at the site throughout the duration of the construction activity. Periodic inspections may be made by the Municipality or its designee during construction.

B. It shall be unlawful for any person, firm, or corporation to undertake any regulated activity under Section 105 on any property except as provided for in the approved SWM site plan and pursuant to the requirements of this Ordinance. It shall be unlawful to alter or remove any control structure required by the SWM site plan pursuant to this Ordinance or to allow the property to remain in a condition that does not conform to the approved SWM site plan.

C. At the completion of the project and as a prerequisite for the release of the performance guarantee, the owner or his representatives shall:

1. Provide a certification of completion from an engineer, architect, surveyor, or other qualified person verifying that all stormwater facilities have been constructed according to the plans and specifications and approved revisions thereto.

2. Provide a set of as-built (record) drawings per Section 502.

D After receipt of the certification by the Municipality, a final inspection shall be conducted by the municipality or its designee to certify compliance with this Ordinance.

E An occupancy permit will not be issued unless the certification of completion pursuant to Section 907.C.1 has been secured. The occupancy permit shall be required for each lot owner and/or Applicant for all subdivisions and land developments in the Municipality.

Section 908. Appeals

A. Any person aggrieved by any action of the *[Municipality]* or its designee relevant to the provision of this Ordinance may appeal to *[the Municipality's Governing Body]* within thirty (30) days of that action.

B. Any person aggrieved by any decision of *[the Municipality's Governing Body]* relevant to the provision of this Ordinance may appeal to the County Court of Common Pleas in the County where the activity has taken place within thirty (30) days of the municipal decision.

ENACTED and ORDAINED at a regular meeting of the _____ _____ on the _____ of _____, 20__. This Ordinance shall take effect immediately.

_____
[Name]

_____
[Title]

_____
[Name]

_____
[Title]

_____
[Name]

_____
[Title]

_____
[Name]

_____
[Title]

_____
[Name]

_____
[Title]

ATTEST:

_____
Secretary

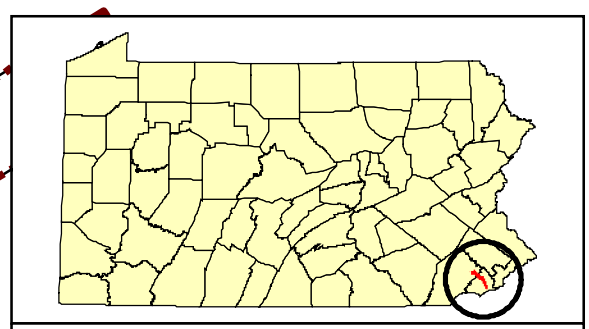
I hereby certify that the foregoing Ordinance was advertised in the _____ on _____, 20__, a newspaper of general circulation in the Municipality and was duly enacted and approved as set forth at a regular meeting of the Municipality's Governing Body held on _____, 20__.

_____
Secretary

ORDINANCE APPENDIX A

CRUM CREEK WATERSHED STORMWATER MANAGEMENT DISTRICT MAP

CRUM CREEK
PHASE II - ACT 167 STORMWATER MANAGEMENT PLAN



TREDYFFRIN
EASTTOWN
MALVERN
WILLISTOWN
NEWTOWN
EDGMONT
UPPER PROVIDENCE
MARPLE
SPRINGFIELD
MEDIA
MORTON
SWARTHMORE
RUTLEDGE
NETHER PROVIDENCE
RIDLEY
RIDLEY PARK
EDDYSTONE
MONTGOMERY COUNTY
DELAWARE COUNTY
CHESTER COUNTY
DELAWARE COUNTY
PENNSYLVANIA
NEW JERSEY
Delaware River
Crum Creek
Springton Reservoir
Lewis Run
Reese Run
Preston Run
Hunter Run
Trout Run
Hotland Run
Dicks Run
Little Crum Creek

A
B
A
B
A

50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79

30 252 3 252 1 420 320 476 252 13 95 291

Management District Legend

District	Design Storm Proposed Conditions		Design Storm Existing Conditions
A	2-Year 5-Year 10-Year 25-Year 50-Year 100-Year	Reduce To	1-Year 5-Year 10-Year 25-Year 50-Year 100-Year
B	2-Year 5-Year 10-Year 25-Year 50-Year 100-Year	Reduce To	1-Year 2-Year 5-Year 10-Year 25-Year 100-Year

1.25 0.625 0 1.25

1 Inch = 1.25 Miles

APPENDIX A
MANAGEMENT DISTRICTS

Prepared For:
Delaware County Planning Department
Courthouse and Government Center Bldg
201 West Front Street
Media, PA 19063
610-891-5200

Legend

- WATERSHED BOUNDARY
- SURFACE WATER
- STREAMS
- SUBAREAS
- COUNTY BOUNDARIES
- MUNICIPAL BOUNDARIES

Roads

- INTERSTATE
- US HIGHWAY
- PA HIGHWAY
- OTHER ROADS

NOTE:
Portions of this map were generated from existing data sources as listed below. These data are shown on the map for spatial reference only. These data did not enter into any computations or affect the reliability of the hydrologic analysis. Borton-Lawson Engineering has found some inaccuracies in some of these data and has corrected the data in locations where discrepancies were obvious; however, it was not a part of this Act 167 Plan to correct all of the mapping data.

DATA SOURCES:
Watershed Boundary - PADEP
State Roads - PennDOT, 2004
Local Roads - PennDOT, 2001
Counties - PennDOT, 2002
Municipalities - PennDOT, 2001
Streams - PaDEP/ERRI, 2001
Lakes - Aqua America, 2001
Delaware River - USFWS (derived from NWI coverages)
Management Districts/ Subareas - Delineated by Borton-Lawson, 2006

Borton Lawson ENGINEERING

Northeast Pennsylvania
613 Baltimore Drive
Wilkes-Barre, PA 18702
Tel: 570-821-1999

Lehigh Valley
3893 Adler Place
Bethlehem, PA 18017
Tel: 484-821-0470

PREPARED BY: WSB CHECKED BY: SJD
Date: 10/08/2008 PROJECT #: 2004-1553-00

FILE: \\Athens\dProjects\2004\1553\00\DATA\GIS\FINAL_REPORT_MAPS\ArcMap\AppendixA_Crum_Mgmt_Districts.mxd

ORDINANCE APPENDIX B

Simplified Approach to Stormwater Management for Small Projects

Applicability: Stormwater management procedures for projects with between five hundred (500) square feet and (999) square feet of proposed impervious area.

SIMPLIFIED APPROACH TO STORMWATER MANAGEMENT FOR SMALL PROJECTS

Introduction

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

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

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

The Simplified Approach requires:

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

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

What needs to be sent to the Municipality?

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

B.1 Determination of Simplified Approach Volume Requirements

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

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

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

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

For Rain Barrels/Cisterns

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

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

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

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

[1]The typical volume of a rain barrel is between 50-200 gallons, so more than 1 rain barrel may be needed. Larger volumes may require a cistern.
[2]Assume that the rain barrel/cistern is 25% full

For Rain Gardens/Bioretention or Dry Well #1:

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

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

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

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

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

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

[1]Assume that the rain garden/bioretention or the dry well #1 are 0% full

For Infiltration Trench or Dry Well #2:

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

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

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

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

STEP 5 - Sketch a simple site plan as shown in Figure B-1 that includes:

- Name and address of the owner of the property, and or name and address of the individual preparing the plan, along with the date of submission.

- Location of proposed structures, driveways, or other paved areas with approximate size in square feet.

- Location, orientation, and dimensions of all proposed BMPs. For all rain gardens/bioretention, infiltration trenches, and dry wells, the length, width, and depth must be included on the plan. For rain barrels or cisterns the volume must be included.

- Location of any existing or proposed on-site septic system and/or potable water wells showing rough proximity to infiltration facilities.

- Location of any existing waterbodies such as; streams, lakes, ponds, wetlands, or other waters of the Commonwealth within fifty (50) feet of the project site, and the distance to the project site and/or BMPs. The project or BMPs cannot be located less than fifty (50) feet away from a perennial or intermittent stream. If an existing buffer is legally prescribed (i.e., deed, convenant, easement, etc.) and it exceeds the requirements of this Ordinance, the existing buffer shall be maintained.

- Location of all existing structures including buildings, driveways, and roads within fifty (50) feet of the project site.

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

Table B-3: Simplified Method - Calculating Infiltration Trench and Dry Well #2 Storage Volume and Surface Area for 1" Rainfall

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

[1]Assume a void ratio of 40%

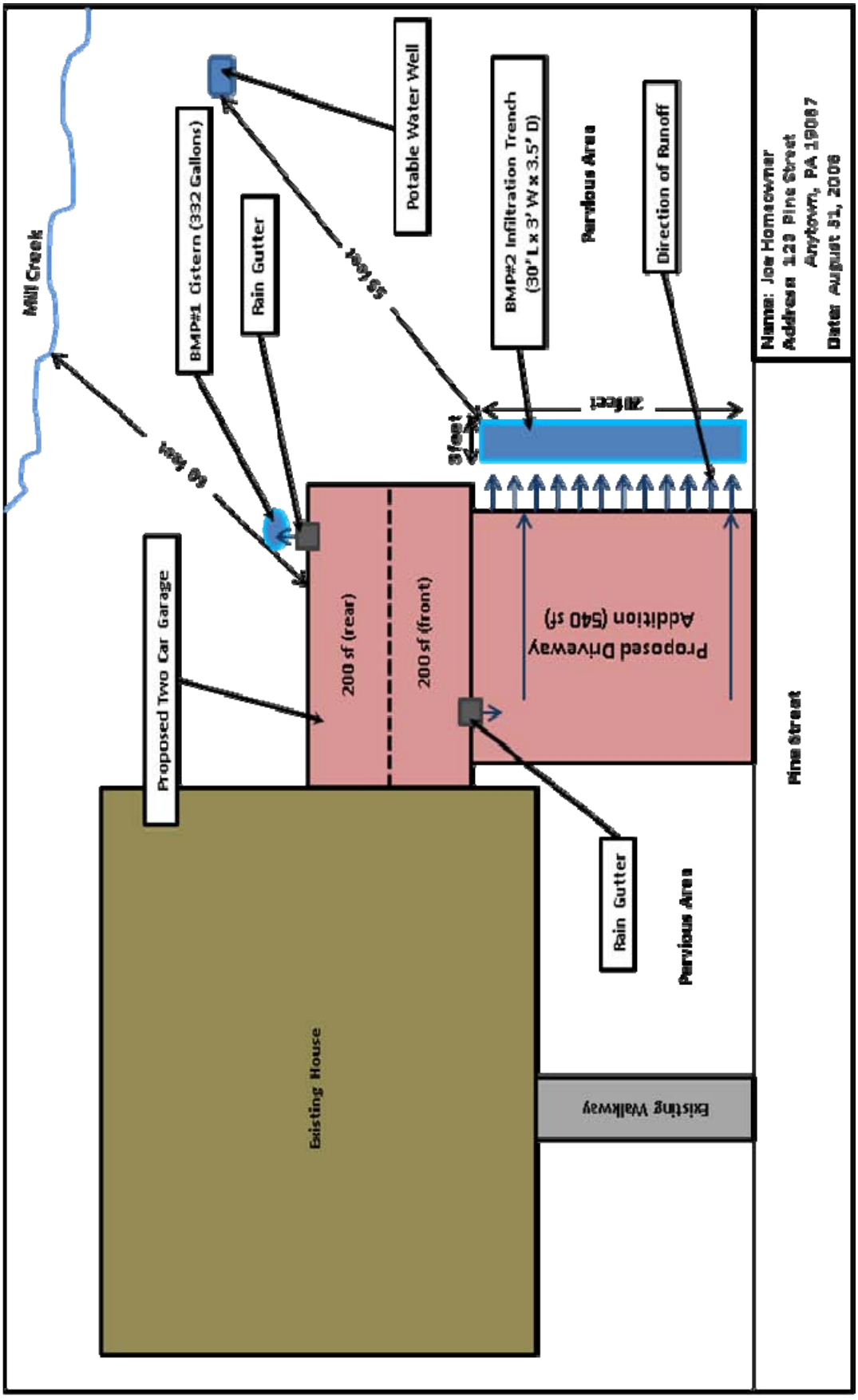


Figure B-1: Typical Dry Well Configuration filled with Stone Fill (Left) and Structural Prefabricated Chamber (Right)

Table B-4: Simplified Method Worksheet

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

Note: For additional BMPs, use additional sheets

B.2 Definitions

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

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

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

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

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

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

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

Pervious Surface - Any surface that is not impervious.

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

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

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

B.3 Description of BMPs

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

Rain Barrels/Cisterns

Rain barrels are large containers that collect drainage from roof leaders and temporarily store water to be released to lawns, gardens, and other landscaped areas after the rainfall has ended. Rain barrels are typically between 50 and 200 gallons in size. The stored water can also be used as a non-potable water supply. Cisterns are larger than rain barrels having volumes of 200 gallons or more, and can be placed on the surface or underground. Figures B-2 and B-3 show examples of rain barrels and cisterns, respectively, that could be used. Rain barrels and cisterns are manufactured in a variety of shapes and sizes. All of these facilities must make provisions for the following items:

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

Figure B-2: Rain Barrels

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

Figure B-3: Cisterns

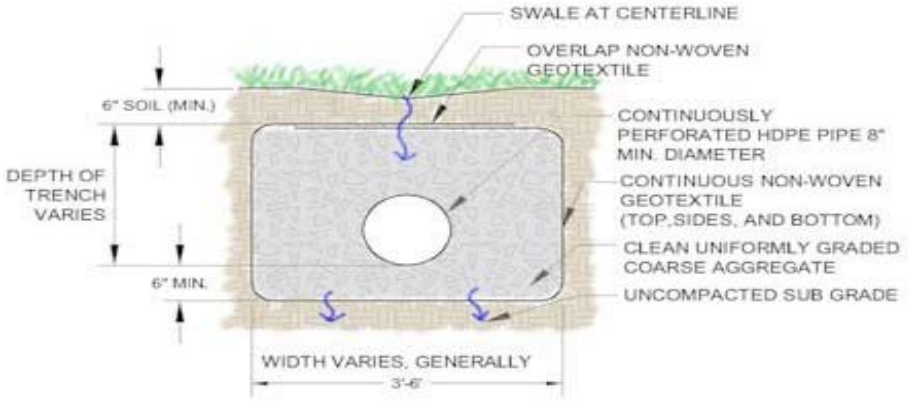
Source (for both pics): Pennsylvania Stormwater BMP Manual (2006)

Infiltration Trench

An infiltration trench is a long, narrow, rock-filled trench with or without a perforated pipe that receives stormwater runoff and has no outlet. Runoff is stored in the void space between the stones and in the pipe and infiltrates through the bottom and into the underlying soil matrix. Infiltration trenches perform well for removal of fine sediment and associated pollutants. Figure B-4 shows a typical infiltration trench configuration. Infiltration trenches shall incorporate or make provisions for the following elements:

- Perforated pipe is to be set level.
- The width is limited to between **3 and 8 feet**, and the depth ranges from **2 to 6 feet**.
- Trench should be wrapped in nonwoven geotextile (see definition in Section B.2) on the top, sides, and bottom.
- There should be a positive overflow that allows stormwater that cannot be stored or infiltrated to be discharged into a nearby vegetated area.
- Roof downspouts may be connected to infiltration trenches, but should contain a cleanout to collect sediment and debris before entering the infiltration area.
- Infiltration testing is recommended to ensure that the soil is capable of infiltrating stormwater. A description of how an infiltration test is performed is found in Appendix C of the PA BMP Manual.
- It is recommended that there be a 2-foot clearance above the regularly occurring seasonal high water table and a minimum depth to bedrock of 2 feet.
- The infiltration trench should be at least 50 feet from individual water supply wells, 100 feet from community or municipal water supply wells, and 50 feet from any septic system component. It should not be located near hotspots (see definition in Section B.2).
- The infiltration trench should be located so that it presents no threat to sub-surface structures such as building foundations and basements.
- Protect infiltration areas from compaction.
- The ratio of the collected area to the footprint of the facility should be as small as possible with a ratio of less than 5:1 preferred.

Figure B-4: Typical Infiltration Trench



Source: Pennsylvania Stormwater BMP Manual (2006)

Rain Garden/Bioretention Area

A rain garden (bioretention area) is an excavated depression area on the surface of the land in which native vegetation is planted to filter and use stormwater runoff. Runoff ponds on top of the surface of the rain garden and then infiltrates into an enhanced soil below the surface where plants can use the water to grow. Bioretention also improves water quality, vegetation filters the water, and the root systems encourage or promote infiltration. Figure B-5 shows a typical rain garden. Key elements of a rain garden include:

- Ponding depths of **1 foot** or less (recommended).
- Native vegetation that can tolerate dry and wet weather.
- An overflow area where, if the bioretention area were to overflow, the water would flow over pervious area (i.e., grass, meadow), and would not cause harm to property, or;
- An overflow such as a domed riser to allow excess flow from large storms to travel to other substantial infiltration areas or pervious areas.
- Typical side slopes of 3:1 are recommended, with 2:1 being the maximum.
- The soil/planting mix depth should be between 1.5 feet and 6 feet deep.

Figure B-5: Typical Rain Garden/Bioretention Area

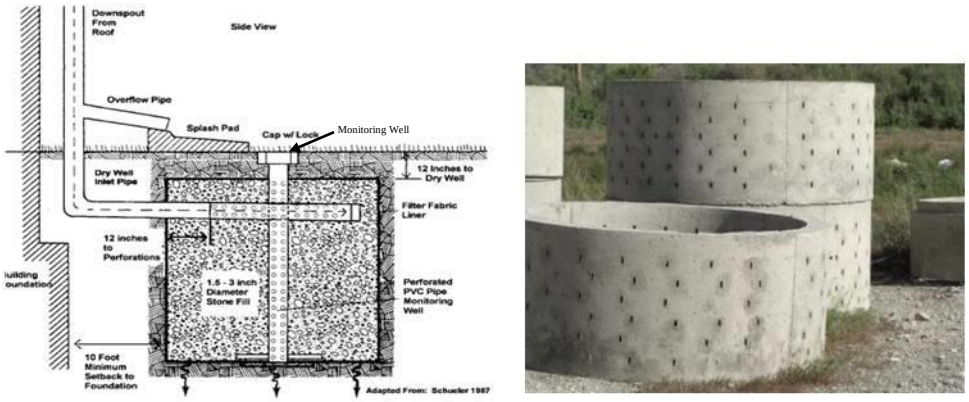
Source: Pennsylvania Stormwater BMP Manual (2006)

Dry Wells

A dry well, also referred to as a seepage pit is a subsurface storage facility that temporarily stores and infiltrates runoff from the roofs of buildings or other impervious surfaces. A dry well can be either a structural prefabricated chamber (Dry Well #1) or an excavated pit filled with stone fill (Dry Well #2). Dry wells discharge the stored runoff via infiltration into the surrounding or underlying soils. Figure B-6 shows a typical prefabricated dry well and a typical dry well configuration with stone fill. The following elements shall be incorporated into all dry well designs:

- These facilities should be located a minimum of ten (10) feet from the building foundation to avoid foundation seepage problems and are not recommended if their installation would create a risk for basement flooding.
- Construction of a dry well should be performed after surface soils in all other areas of the site are stabilized to avoid clogging.
- During construction, compaction of the subgrade soil in the bottom of the dry well should be avoided, and construction should be performed only with light machinery.
- Depth of a dry well should be between **1.5 feet and 4 feet**. Gravel fill should consist of stone of an average of one and one half to three (1.5 – 3.0) inches in diameter with the gravel fill wrapped in a nonwoven geotextile that separates the stone fill from the surrounding soil.
- At least 1 foot of soil needs to be placed over the top of the dry well.
- Dry wells should be inspected at least four (4) times annually as well as after large storm events.
- Dry wells should have overflow pipes to allow high volumes of runoff to connect to other on-site substantial infiltration areas or pervious areas.
- Every dry well needs to have at least one monitoring well.
- Infiltration testing is recommended to ensure that the underlying soil is capable of infiltrating the needed volume of stormwater.

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



Source (for pic on left): https://seagrant.sunysb.edu/marina/pdfs/BMPsForMarinas.htm

B.4 Example

Simplified Approach Volume Determination:

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

STEP 1 - Determine the total area of all proposed impervious surfaces to drain to each BMP:

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

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

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

Select a BMP or combination of BMPs from Section B.3 to be used to satisfy the volume requirement. Determine the length, width, depth and other requirements for the BMPs in Section B.3. A BMP needs to be placed to catch runoff from the back of the garage, and a BMP needs to be placed to capture runoff from the front of the garage and the driveway. Figure B-7 shows the direction the runoff flows and the locations where the BMPs are to be placed.

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

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

STEP 2 - Select the proposed impervious area value for BMP #1, the rain barrel or cistern, in Column 1 that is closest to, but not less than 200 in Table B-5:

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

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

The volume in gallons of the rain barrel/cistern to be used as BMP #1, assuming the rain barrel/cistern is 25% full, is determined by finding the row in Column 3 that corresponds to the impervious area value determined in Step 1. Therefore, the volume of BMP #1, the rain barrel/cistern must be ≥ 166 gallons. A combination of rain barrels could be used in succession as shown in Figure B-2, or a cistern could be used.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

2 → **3** → **4**

*Assume a void ratio of 40%

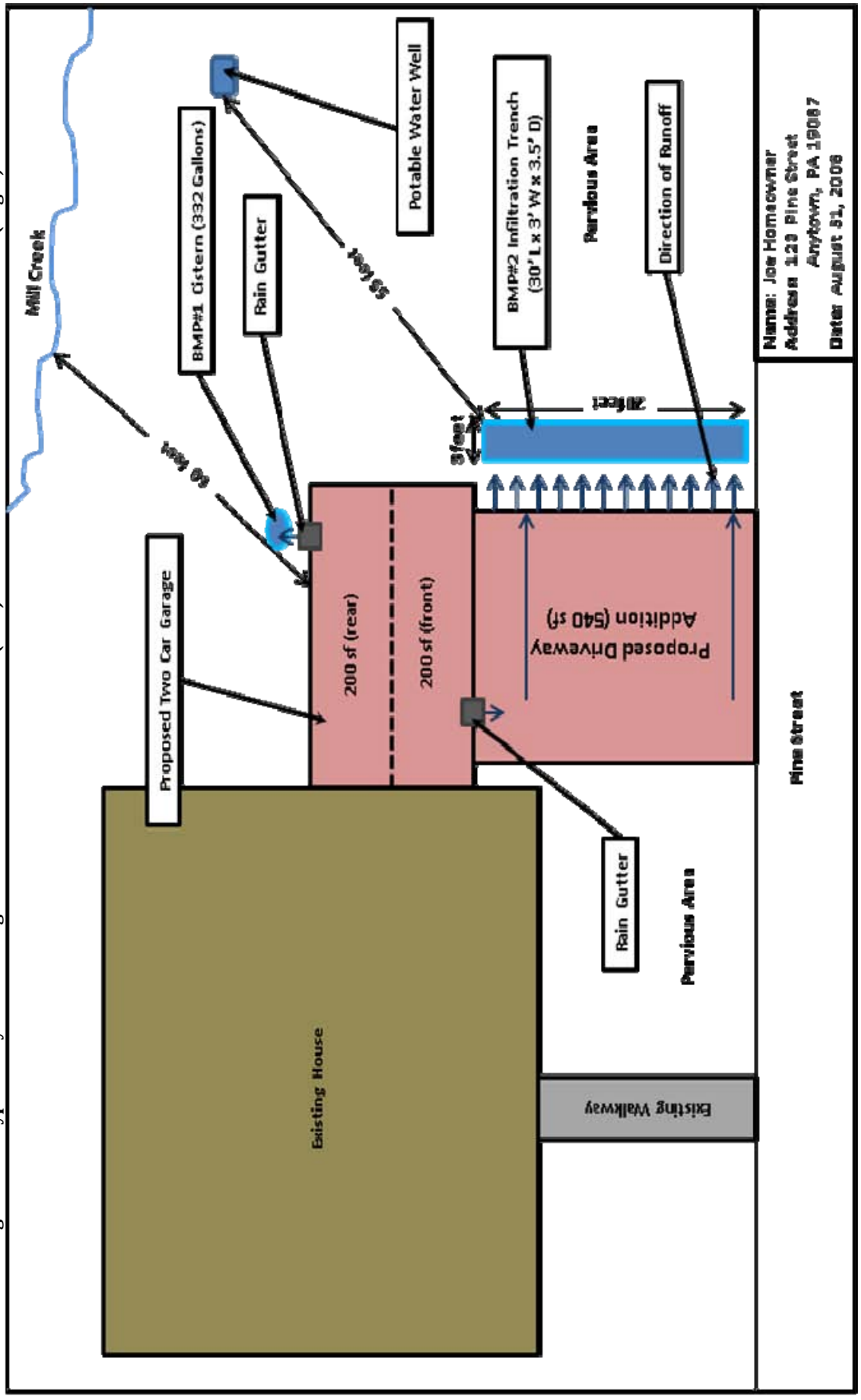


Figure B-7: Typical Dry Well Configuration filled with Stone Fill (Left) and Structural Prefabricated Chamber (Right)

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

Simplified Method Worksheet				
STEP 1				
Proposed Impervious Surface for BMP #1	**Proposed Impervious Surface for BMP #2**	**Proposed Impervious Surface for BMP #3**		
200	740			
STEPS 2&3				
Rain Barrel or Cistern				
Proposed Impervious Surface from Column 1 in Table B-5	**Volume from Column 2 or 3 in Table B-5**			
200	166 gallons			
Rain Garden/Bioretention or Dry Well #1				
Proposed Impervious Surface from Column 2 in Table B-2	**Volume of BMP from Column 2 in Table B-2**	**Area of BMP from Column 3 in Table B-2**	**Depth of BMP from Column 3 in Table B-2**	**Types of Material to Be Used**
Infiltration Trench or Dry Well #2				
Proposed Impervious Surface from Column 2 in Table B-6	**Volume of BMP from Column 2 in Table B-6**	**Area of BMP from Column 3 in Table B-6**	**Depth of BMP from Column 3 in Table B-6**	**Types of Material to Be Used**
740	156	52	3	Infiltration Trench, Uniformly Graded Aggregate, HDPE 8" pipe, geotextile material, grass planted on top
Note: For additional BMPs, use additional sheets				

B.5 Simplified Operation, Inspection, and Maintenance Plan

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

STORMWATER BEST MANAGEMENT PRACTICES
OPERATIONS, MAINTENANCE, AND INSPECTION AGREEMENT

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

WITNESSETH

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

WHEREAS, the Landowner _____

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

_____, located at _____

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

WHEREAS, the Municipality and the Landowner, its administrators, executors, successors, heirs, or assigns, agree that the health, safety, and welfare of the residents of the Municipality and the protection and maintenance of water quality require that on-site stormwater Best Management Practices be constructed and maintained on the property; and,

WHEREAS, the Landowner is required to inform future buyers of the property about the function of, operation, and maintenance requirements of the BMP or BMPs prior to the purchase of the property by said future buyer, and upon purchase of the property the future buyer assumes all responsibilities as Landowner and must comply with all components of this agreement.

WHEREAS, for the purposes of this agreement, the following definition shall apply:

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

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

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

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

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

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

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

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

2. The Landowner shall operate and maintain the BMP(s) as shown on the Plan in good working order acceptable to the Municipality and in accordance with the specific maintenance requirements outlined in this agreement.

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

4. In the event that the Landowner fails to operate and maintain the BMP(s) as shown on the Plan in good working order acceptable to the Municipality, the Municipality or its representatives may enter upon the property and take whatever action is deemed necessary to maintain said BMP(s). This provision shall not be construed to allow the Municipality to erect any permanent structure on the land of the Landowner. It is expressly understood and agreed that the Municipality is under no obligation to maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the Municipality.

5. In the event that the Municipality, pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner shall reimburse the Municipality for all expenses (direct and indirect) incurred within ten days of receipt of an invoice from the Municipality.

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

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

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

ATTEST:

WITNESS the following signatures and seals:

(SEAL) For the Municipality:

_____

(SEAL) For the Landowner:

_____

ATTEST:

_____ (City, Borough, Township)

County of _____, Pennsylvania

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

GIVEN UNDER MY HAND THIS _____ day of _____, 200_.

_____ _____

NOTARY PUBLIC **(SEAL)**

ORDINANCE APPENDIX C – 1

SAMPLE SWM SITE PLAN APPLICATION

SAMPLE SWM SITE PLAN APPLICATION

(To be attached to the "land subdivision plan or development plan review application" or "minor land subdivision plan review application")

Application is hereby made for review of the SWM Site Plan and related data as submitted herewith in accordance with the _____ Stormwater Management Ordinance.

_____Final Plan _____Preliminary Plan _____Sketch Plan

Date of Submission _____Submission No._____

1. Name of subdivision or development_____

2. Name of Applicant _____ Telephone No._____

   (if corporation, list the corporation's name and the names of two officers of the corporation)
   _____Officer 1
   _____Officer 2

   Address_____
   Zip code_____

   Applicant's interest in subdivision or development
   (if other than property owner, give owner's name and address)

3. Name of property owner _____Telephone No._____

   Address_____
   Zip code_____

4. Name of engineer or surveyor _____Telephone No._____

   Address_____
   Zip code_____

5. Type of subdivision or development proposed:

____ Single-family Lots	____ Townhouses	____ Commercial (Multi-lot)
____ Two-family Lots	____ Garden Apartments	____ Commercial (One Lot)
____ Multi-family Lots	____ Mobile Home Park	____ Industrial (Multi-lot)
____ Cluster Type Lots	____ Campground	____ Industrial (One Lot)
____ Planned Residential Development	____ Other (_____)	

6. Linear feet of new road proposed _____ L.F.

7. Area of proposed and existing impervious area on the entire tract.

   a. Existing (to remain) _____ S.F. _____% of property
   b. Proposed _____ S.F. _____% of property

8. Stormwater

   a. Does the peak rate of runoff from proposed conditions exceed that flow which occurred for existing conditions for the designated design storm?_____

   b. Design storm utilized (on-site conveyance systems) (24 hr.)_____
      No. of Subarea_____
      Watershed Name_____

      Explain:_____
      _____
      _____

   c. Does the submission and/or district meet the criteria for the applicable management district?_____

   d. Subarea number(s) from Ordinance Appendix A of the Crum Creek Watershed Stormwater Management Plan or other subareas identified in other watershed stormwater management plans _____

   e. Type of proposed runoff control_____

   f. Does the proposed stormwater control criteria meet the requirements/guidelines of the Stormwater Ordinance?_____

      If not, what variances/waivers are requested?_____
      _____

      Reasons_____

   g. Does the plan meet the requirements of Article III of the Stormwater Ordinance?_____

      If not, what variances/waivers are requested?_____

      Reasons why _____
      _____

   h. Was TR-55, June 1986, utilized in determining the time of concentration?_____
      _____

i. What hydrologic method was used in the stormwater computations?_____

_____

j. Is a hydraulic routing through the stormwater control structure submitted?_____

_____

k. Is a construction schedule or staging attached?_____

l. Is a recommended maintenance program attached?_____

9. Erosion and Sediment Pollution Control (E&S):

a. Have the SWM site plan and E&S plan, supporting documentation, and narrative been submitted to the [*County Name*] County Conservation District?_____

b. Total area of earth disturbance _____S.F.

10. Wetlands

a. Have the wetlands been delineated by someone trained in wetland delineation?_____

b. Have the wetland lines been verified by a state or federal permitting authority?_____

c. Have the wetland lines been surveyed?_____

d. Total acreage of wetland within the property _____

e. Total acreage of wetland disturbed_____

f. Supporting documentation_____

11. Filing

a. Has the required fee been submitted?_____

Amount_____

b. Has the proposed schedule of construction inspection to be performed by the Applicant's engineer been submitted?_____

c. Name of individual who will be making the inspections_____

d. General comments about stormwater management at the development_____

_____

_____

CERTIFICATE OF OWNERSHIP AND ACKNOWLEDGMENT OF APPLICATION:

COMMONWEALTH OF PENNSYLVANIA
COUNTY OF [*County Name*] .

On this the _____ day of _____, 20_____, before me, the undersigned officer, personally appeared _____who, being duly sworn according to law, deposes and says that _____are owners of the property described in this application and that the application was made with _____ knowledge and/or direction and does hereby agree with the said application and to the submission of the same.

_____Property Owner

My Commission Expires_____20_____
Notary Public_____

THE UNDERSIGNED HEREBY CERTIFIES THAT TO THE BEST OF HIS KNOWLEDGE AND BELIEF, THE INFORMATION AND STATEMENTS GIVEN ABOVE ARE TRUE AND CORRECT.

SIGNATURE OF APPLICANT_____

//

(Information Below This Line To Be Completed By The Municipality)

_____ (Name of) Municipality official submission receipt:

Date complete application received _____plan number_____

Fees _____ date fees paid _____ received by_____

Official submission receipt date _____

Received by_____

_____
Municipality

PROPOSED SCHEDULE OF FEES

[Note: It is recommended that Municipalities adopt a fee schedule independent of the Ordinance so that fee schedules can be adjusted as need arises without having to go through the Ordinance revision public hearing process. This schedule of fees is to be submitted by the applicant with the land development plan]

Subdivision name_____ Submittal No._____

Owner _____ Date_____

Engineer_____

1. Filing fee $_____

2. Proposed land use
   - 2a. Subdivision, campgrounds, mobile home parks, and multi-family dwelling where the units are located in the same local watershed $_____
   - 2b. Multi-family dwelling where the designated open space is located in a different local watershed from the proposed units $_____
   - 2c. Commercial/industrial $_____
   - 2d. Other $_____

3. Relative amount of earth disturbance
   - 3a. Residential
     - road <500 l.f. $_____
     - road 500-2,640 l.f. $_____
     - road >2,640 l.f. $_____
   - 3b. Commercial/industrial and other
     - impervious area <3,500 s.f. $_____
     - impervious area 3,500-43,560 s.f. $_____
     - impervious area >43,560 s.f. $_____

4. Relative size of project
   - 4a. Total tract area <1 ac. $_____
     - 1-5 ac. $_____
     - 5-25 ac. $_____
     - 25-100 ac. $_____
     - 100-200 ac. $_____
     - >200 ac. $_____

5. Stormwater control measures
   - 5a. Detention basins and other controls which require a review of hydraulic routings ($ per control) $_____

5b. Other control facilities which require storage volume calculations but no hydraulic routings ($ per control)	$_____
6. Site inspection ($ per inspection)	$_____
Total	$_____

All subsequent reviews shall be 25% of the amount of the initial review fee unless a new application is required as per Section 406 of the Stormwater Ordinance. A new fee shall be submitted with each revision in accordance with this schedule.

ORDINANCE APPENDIX C – 2

SWM SITE PLAN CHECKLIST

Chester County Conservation District
688 Unionville Road, Suite 200
Kennett Square, PA 19348
Phone: 610-925-4920
Fax: 610-925-4925

Project: _____
Municipality: _____
Engineer: _____
Submittal No: _____
Date: _____
Project ID: _____ (for County use ONLY)

ARTICLE I: GENERAL PROVISIONS

Reference: Section 105 Applicability/Regulated Activities

1. List all watersheds within which the proposed project is to take place:
   _____
2. Does the Proposed Project meet the definition of a "Regulated Activity" in any of the Stormwater Management Plans? ☐ Yes ☐ No

STOP – If you have checked NO for either of the above questions, you are not required to submit a SWM plan under the watershed's respective Stormwater Management Ordinance.

ARTICLE I: GENERAL PROVISIONS

Reference: Section 106 Exemptions

Note: Parent tract refers to the total parcel configuration on [*Insert date of ordinance adoption]* ,and includes any subdivision of lands which may have occurred after the date.

Parent Tract Area: _____ acres

Total Existing Impervious Area (as of [*Insert date of ordinance adoption*]): _____ acres
Total New Impervious Area (all Phases): _____ acres

Parcel IS Exempt ☐ Parcel IS NOT Exempt ☐

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 304 Nonstructural Project Design

1. Has an Existing Resource and Site Analysis Map (ERSAM) been prepared?

   ☐ Yes ☐ No, Explain _____
   _____
   _____

ARTICLE III: STORMWATER MANAGEMENT (continued)

2. Are any of the following Environmentally Sensitive areas identified on site?

Steep Slopes	☐ Yes	☐ No	☐ Unknown
Ponds / Lakes / Vernal Pools	☐ Yes	☐ No	☐ Unknown
Streams	☐ Yes	☐ No	☐ Unknown
Wetlands	☐ Yes	☐ No	☐ Unknown
Hydric Soils	☐ Yes	☐ No	☐ Unknown
Floodplains	☐ Yes	☐ No	☐ Unknown
Stream Buffer Zones	☐ Yes	☐ No	☐ Unknown
Hydrologic Soil Groups A or B	☐ Yes	☐ No	☐ Unknown
Recharge Areas	☐ Yes	☐ No	☐ Unknown
Others: _____	☐ Yes	☐ No	☐ Unknown

3. Does the site layout plan avoid Environmentally Sensitive Areas identified on site?

☐ Yes ☐ No, Explain _____

_____

_____

4. Has a stream buffer been established per Section 306.C.?

☐ Yes ☐ No, Explain _____

_____

_____

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 305 Infiltration

1. Is the proposed activity considered a "Stormwater Hotspot"? (refer to Section 301.T) ☐ Yes ☐ No

2. Have provisions been installed to promote infiltration on site?

☐ Yes ☐ No, Explain _____

_____

_____

3. Total Recharge Volume Required:_____cubic feet (using: ☐ Modified CG-1; ☐ Modified CG-2)

4. How is the Required Recharge Volume being addressed?

☐ Infiltration Trench ☐ Dry Swales
☐ Infiltration Basin ☐ Other: _____
☐ Bioretention

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 306 Water Quality Requirements

1. Have provisions been installed to address stormwater runoff water quality on site?

   ☐ Yes ☐ No, Explain _____

   _____

   _____

2. Total Water Quality Volume Required: _____ acre feet

3. Is the site in a Special Protection watershed which includes Exceptional Value (EV) or High Quality (HQ) waters? ☐ Yes ☐ No

4. How is the Required Water Quality Volume being addressed?

   ☐ Wet Detention Basin
   ☐ Extended Dry Detention Basin
   ☐ Bioretention
   ☐ Sand Filter
   ☐ Constructed Wetlands
   ☐ Other: _____

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 307 Stream Bank Erosion Requirements

1. Has the 2- year proposed conditions flow been reduced to the 1- year existing conditions flow?

   ☐ Yes ☐ No, Explain _____

   _____

   _____

2. Does the proposed conditions 1- year storm drain over a minimum 24- hour period?

   ☐ Yes ☐ No, Explain _____

   _____

   _____

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 308 Stormwater Peak Rate Control and Management Districts

1. In which of the following Stormwater Management District(s) is the site located?

   ☐ A
   ☐ B
   ☐ Other _____

ARTICLE III: STORMWATER MANAGEMENT (continued)

2. Does the Proposed Conditions Runoff meet the Criteria established in Table 308.1?

☐ Yes ☐ No If you answered Yes, proceed. If you answered No, consult with Municipality.

a. Are you claiming "Hardship," as described in Section 308.G in lieu of meeting the requirements of this District?

☐ Yes ☐ No, Explain _____

_____

_____

b. If you are claiming "Hardship," has a Downstream Impacts Evaluation been prepared in accordance with Section 308.H?

☐ Yes ☐ No, Explain _____

_____

_____

_____

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 309 Calculation Methodology

1. Which method(s) are utilized in the SWM site plan for computing stormwater runoff rates and volumes?

☐ TR-20
☐ TR-55 ☐ Rational Method
☐ HEC-1 / HEC-HMS ☐ Other: _____

2. Was NOAA Atlas 14 utilized in rainfall determination?

☐ Yes ☐ No, Explain _____

_____

_____

3. Was Table F-1 (Runoff Curve Numbers) or Table F-2 (Rational Runoff Coefficients) in Appendix F utilized in calculations for runoff?

☐ Yes ☐ No, Explain _____

_____

_____

4. For any proposed stormwater detention facility, were the appropriate design storms routed through the facility using the Storage-Indication Method?

☐ Yes ☐ No, Explain _____

_____

_____

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 310 Other Requirements

1. Is this project subject to PENNDOT approval?

   ☐ Yes ☐ No

   a. If "YES," have these plans been forwarded to PENNDOT for review?

      ☐ Yes ☐ No, Explain _____

      _____

2. Have proposed wet detention basins incorporated biologic control consistent with the West Nile Guidelines presented in Appendix H?

   ☐ Yes ☐ No ☐ Not Applicable

3. Are any proposed stormwater facilities subject to PADEP Chapter 105 permitting?

   ☐ Yes ☐ No

   a. If "YES," have these plans been forwarded to PADEP for review?

      ☐ Yes ☐ No, Explain _____

      _____

ARTICLE VII: MAINTENANCE RESPONSIBILITIES

Reference: Section 702 Responsibilities for Operations and Maintenance of Stormwater Controls/BMPs

1. Has a Stormwater Control and BMP Operations and Maintenance Plan been approved by the Municipality?

   ☐ Yes ☐ No, Explain _____

   _____

2. Who shall assume responsibility for implementing the Stormwater Control and BMP Operations and Maintenance Plan?

   ☐ Municipality ☐ Homeowner Association

   ☐ Private Owner ☐ Other _____

Delaware County Conservation District
Rose Tree Park – Hunt Club
1521 N. Providence Rd.
Media, PA 19063
Phone: 610-892-9484
Fax: 610-892-9489
Email: Info@delcocd.org

Project: _____
Municipality: _____
Engineer: _____
Submittal No:_____
Date:_____
Project ID: _____ (for County use ONLY)

ARTICLE I: GENERAL PROVISIONS

Reference: Section 105 Applicability/Regulated Activities

1. List all watersheds within which the proposed project is to take place:
   _____
2. Does the Proposed Project meet the definition of a "Regulated Activity" in any of the Stormwater Management Plans? ☐ Yes ☐ No

STOP – If you have checked NO for either of the above questions, you are not required to submit a SWM plan under the watershed's respective Stormwater Management Ordinance.

ARTICLE I: GENERAL PROVISIONS

Reference: Section 106 Exemptions

Note: Parent tract refers to the total parcel configuration on [*Insert date of ordinance adoption*], and includes any subdivision of lands which may have occurred after that date.

Parent Tract Area: _____ acres

Total Existing Impervious Area (as of [*Insert date of ordinance adoption*]): _____ acres
Total New Impervious Area (all Phases): _____ acres

Parcel IS Exempt ☐ Parcel IS NOT Exempt ☐

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 304 Nonstructural Project Design

1. Has an Existing Resource and Site Analysis Map (ERSAM) been prepared?

   ☐ Yes ☐ No, Explain _____
   _____
   _____

ARTICLE III: STORMWATER MANAGEMENT (continued)

2. Are any of the following Environmentally Sensitive areas identified on site?

Steep Slopes	☐ Yes	☐ No	☐ Unknown
Ponds / Lakes / Vernal Pools	☐ Yes	☐ No	☐ Unknown
Streams	☐ Yes	☐ No	☐ Unknown
Wetlands	☐ Yes	☐ No	☐ Unknown
Hydric Soils	☐ Yes	☐ No	☐ Unknown
Floodplains	☐ Yes	☐ No	☐ Unknown
Stream Buffer Zones	☐ Yes	☐ No	☐ Unknown
Hydrologic Soil Groups A or B	☐ Yes	☐ No	☐ Unknown
Recharge Areas	☐ Yes	☐ No	☐ Unknown
Others: _____	☐ Yes	☐ No	☐ Unknown

3. Does the site layout plan avoid Environmentally Sensitive Areas identified on site?

☐ Yes ☐ No, Explain _____

_____

_____

4. Has a stream buffer been established per Section 306.C.?

☐ Yes ☐ No, Explain _____

_____

_____

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 305 Infiltration

1. Is the proposed activity considered a "Stormwater Hotspot"? (Refer to Section 301.T) ☐ Yes ☐ No

2. Have provisions been installed to promote infiltration on site?

☐ Yes ☐ No, Explain _____

_____

_____

3. Total Recharge Volume Required:_____cubic feet (using: ☐ Modified CG-1; ☐ Modified CG-2)

4. How is the Required Recharge Volume being addressed?

☐ Infiltration Trench ☐ Dry Swales
☐ Infiltration Basin ☐ Other: _____
☐ Bioretention

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 306 Water Quality Requirements

1. Have provisions been installed to address stormwater runoff water quality on site?

   ☐ Yes ☐ No, Explain _____

   _____

   _____

2. Total Water Quality Volume Required: _____ acre feet

3. Is the site in a Special Protection watershed which includes Exceptional Value (EV) or High Quality (HQ) waters? ☐ Yes ☐ No

4. How is the Required Water Quality Volume being addressed?

   ☐ Wet Detention Basin
   ☐ Extended Dry Detention Basin
   ☐ Bioretention
   ☐ Sand Filter
   ☐ Constructed Wetlands
   ☐ Other: _____

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 307 Stream Bank Erosion Requirements

1. Has the 2- year proposed conditions flow been reduced to the 1- year existing conditions flow?

   ☐ Yes ☐ No, Explain _____

   _____

   _____

2. Does the proposed conditions 1- year storm drain over a minimum 24- hour period?

   ☐ Yes ☐ No, Explain _____

   _____

   _____

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 308 Stormwater Peak Rate Control and Management Districts

1. In which of the following Stormwater Management District(s) is the site located?

   ☐ A
   ☐ B
   ☐ Other _____

ARTICLE III: STORMWATER MANAGEMENT (continued)

2. Does the Proposed Conditions Runoff meet the Criteria established in Table 308.1?

☐ Yes ☐ No If you answered Yes, proceed. If you answered No, consult with Municipality.

b. Are you claiming "Hardship," as described in Section 308.G in lieu of meeting the requirements of this District?

☐ Yes ☐ No, Explain _____

_____

_____

b. If you are claiming "Hardship," has a Downstream Impacts Evaluation been prepared in accordance with Section 308.H?

☐ Yes ☐ No, Explain _____

_____

_____

_____

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 309 Calculation Methodology

1. Which method(s) are utilized in the SWM site plan for computing stormwater runoff rates and volumes?

☐ TR-20
☐ TR-55 ☐ Rational Method
☐ HEC-1 / HEC-HMS ☐ Other: _____

2. Was NOAA Atlas 14 utilized in rainfall determination?

☐ Yes ☐ No, Explain _____

_____

_____

3. Was Table F-1 (Runoff Curve Numbers) or Table F-2 (Rational Runoff Coefficients) in Appendix F utilized in calculations for runoff?

☐ Yes ☐ No, Explain _____

_____

_____

4. For any proposed stormwater detention facility, were the appropriate design storms routed through the facility using the Storage-Indication Method?

☐ Yes ☐ No, Explain _____

_____

_____

ARTICLE III: STORMWATER MANAGEMENT (Continued)

Reference: Section 310 Other Requirements

1. Is this project subject to PENNDOT approval?

   ☐ Yes ☐ No

   b. If "YES," have these plans been forwarded to PENNDOT for review?

      ☐ Yes ☐ No, Explain _____
      _____

2. Have proposed wet detention basins incorporated biologic control consistent with the West Nile Guidelines presented in Appendix H?

   ☐ Yes ☐ No ☐ Not Applicable

3. Are any proposed stormwater facilities subject to PADEP Chapter 105 permitting?

   ☐ Yes ☐ No

   c. If "YES," have these plans been forwarded to PADEP for review?

      ☐ Yes ☐ No, Explain _____
      _____

ARTICLE VII: MAINTENANCE RESPONSIBILITIES

Reference: Section 702 Responsibilities for Operations and Maintenance of Stormwater Controls/BMPs

1. Has a Stormwater Control and BMP Operations and Maintenance Plan been approved by the Municipality?

   ☐ Yes ☐ No, Explain _____
   _____

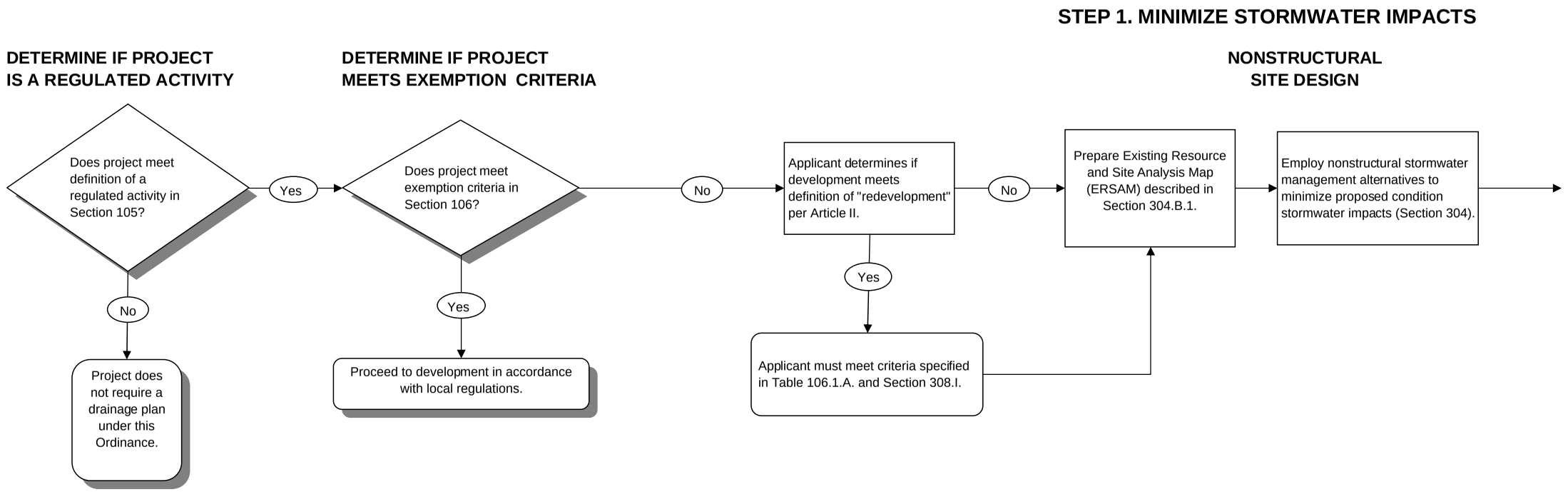
2. Who shall assume responsibility for implementing the Stormwater Control and BMP Operations and Maintenance Plan?

   ☐ Municipality ☐ Homeowner Association
   ☐ Private Owner ☐ Other _____

ORDINANCE APPENDIX D

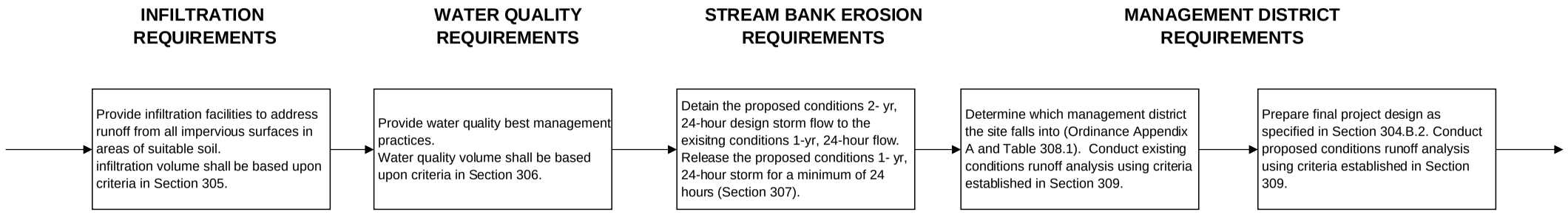
IMPLEMENTATION FLOW CHARTS

CRUM CREEK WATERSHED
STORMWATER MANAGEMENT
Water Quality and Quantity Control Drainage Plan
Applicant Plan Preparation Procedure

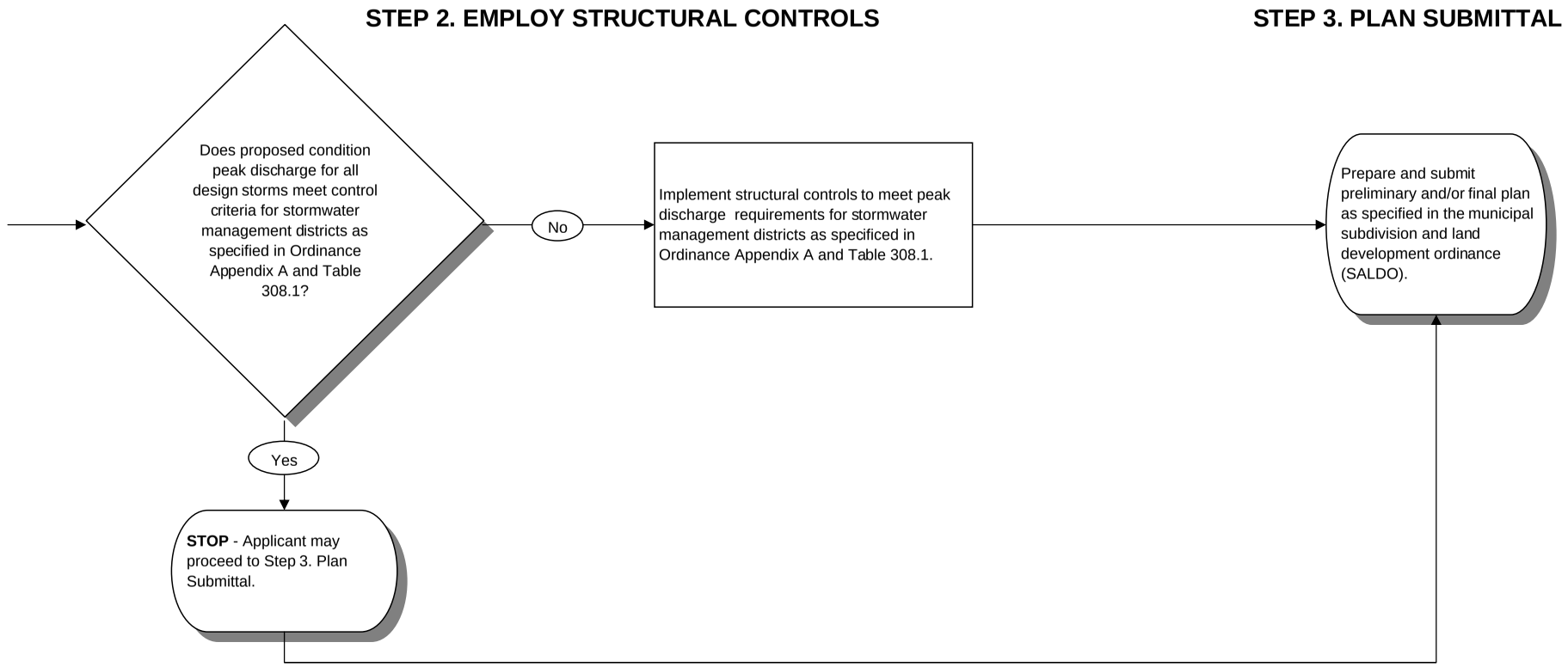


CRUM CREEK WATERSHED
STORMWATER MANAGEMENT
Water Quality and Quantity Control Drainage Plan
Applicant Plan Preparation Procedure

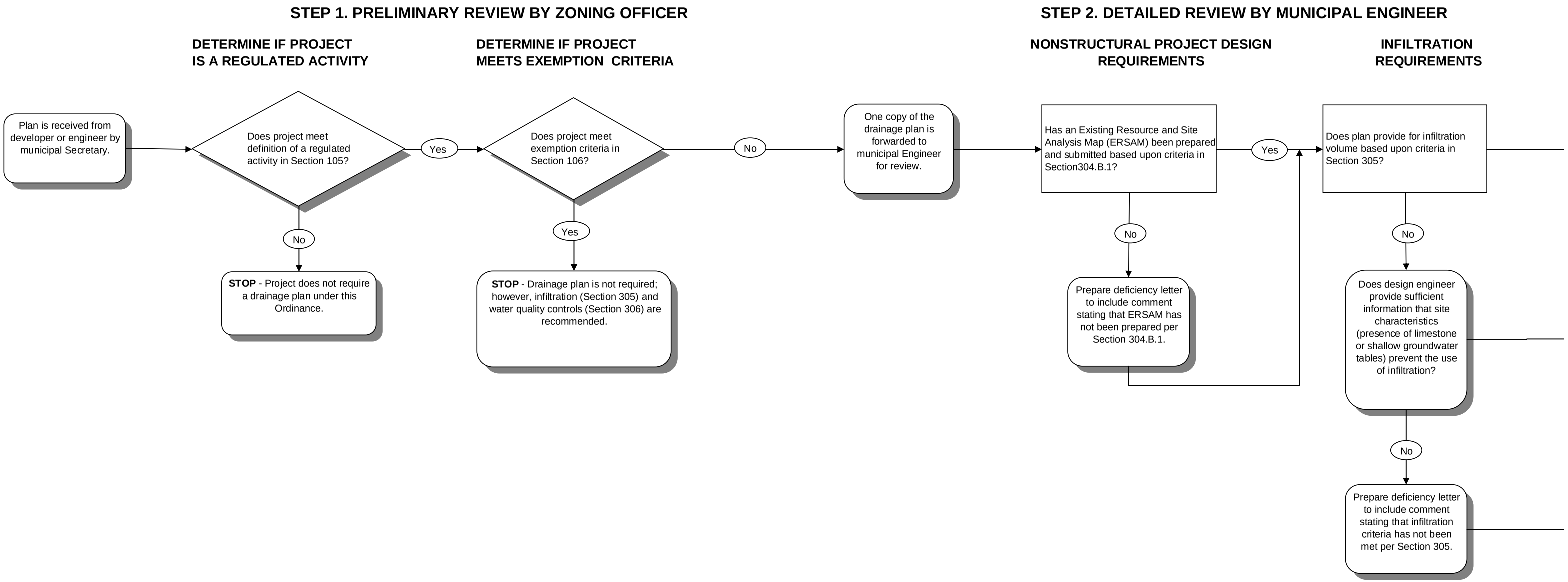
STEP 1. MINIMIZE STORMWATER IMPACTS (CONT.)



CRUM CREEK WATERSHED
STORMWATER MANAGEMENT
Water Quality and Quantity Control Drainage Plan
Applicant Plan Preparation Procedure

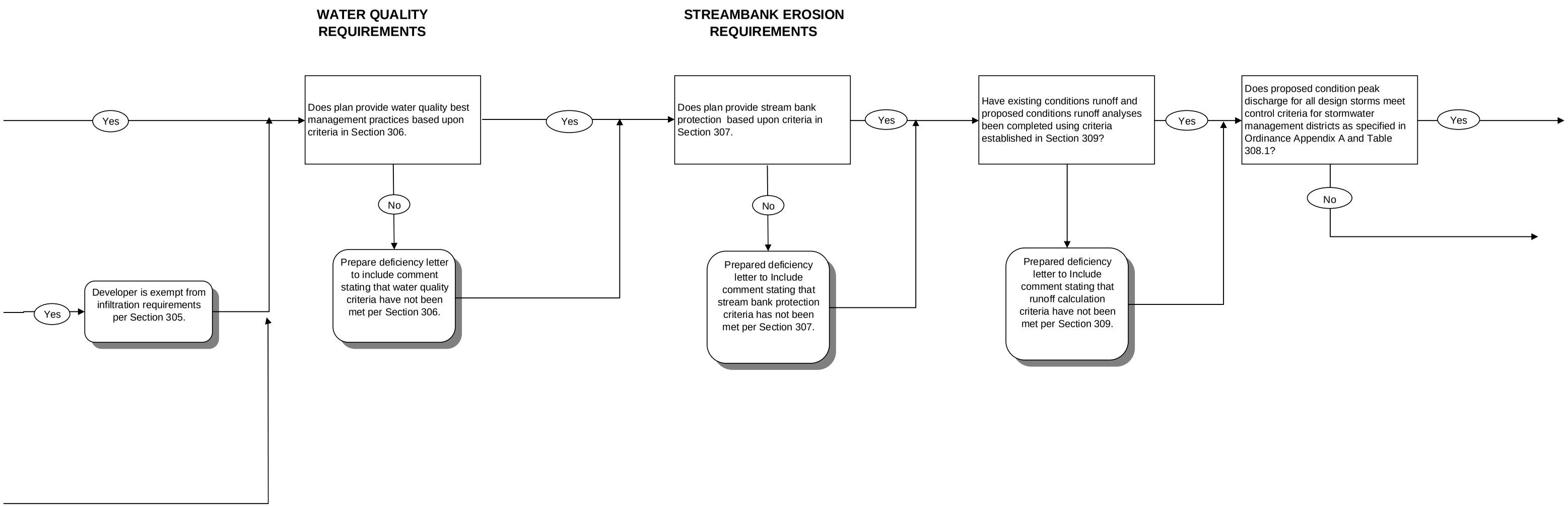


CRUM CREEK WATERSHED
STORMWATER MANAGEMENT
Water Quality and Quantity Control Drainage Plan
Municipal Review Procedure



CRUM CREEK WATERSHED
STORMWATER MANAGEMENT
Water Quality and Quantity Control Drainage Plan
Municipal Review Procedure

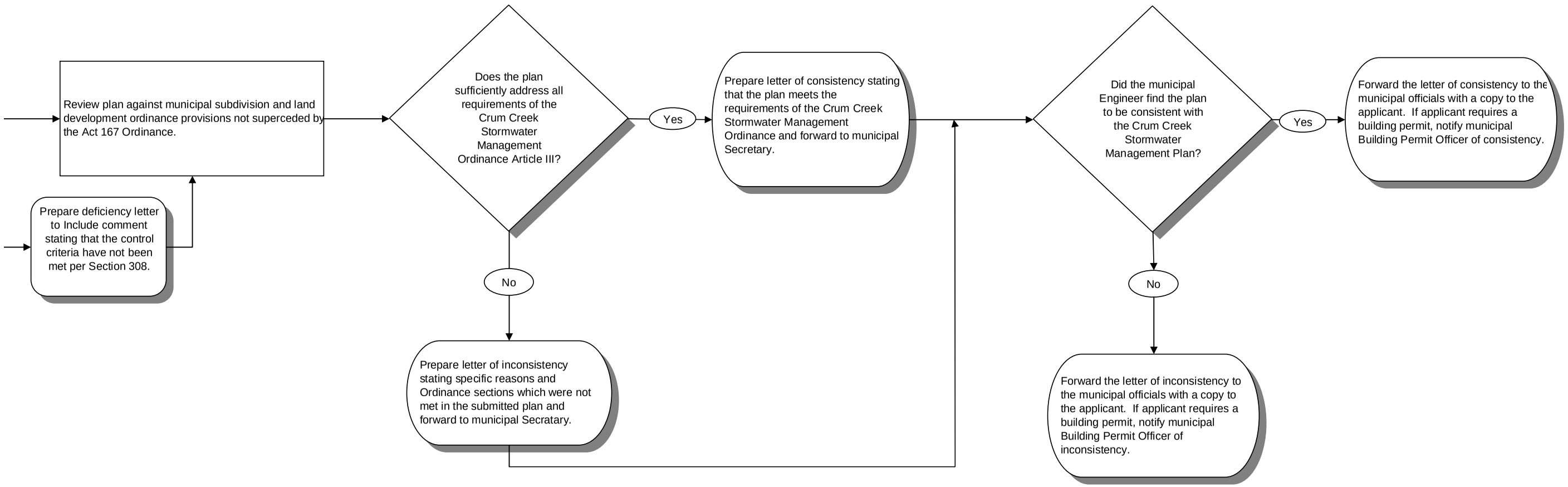
STEP 2. DETAILED REVIEW BY MUNICIPAL ENGINEER (CONT.)



CRUM CREEK WATERSHED
STORMWATER MANAGEMENT
Water Quality and Quantity Control Drainage Plan
Municipal Review Procedure

STEP 2. DETAILED REVIEW BY MUNICIPAL ENGINEER (CONT.)

STEP 3. MUNICIPAL ACTION



ORDINANCE APPENDIX E

LOW IMPACT DEVELOPMENT (LID) PRACTICES

LOW IMPACT DEVELOPMENT (LID) PRACTICES

ALTERNATIVE APPROACH FOR MANAGING STORMWATER RUNOFF

Natural hydrologic conditions can be altered radically by poorly planned development practices such as introducing unnecessary impervious surfaces, destroying existing drainage swales, constructing unnecessary storm sewers, and changing local topography. A traditional drainage approach of development has been to remove runoff from a site as quickly as possible and capture it in a detention basin. This approach leads ultimately to the degradation of water quality as well as expenditure of additional resources for detaining and managing concentrated runoff at some downstream location.

The recommended alternative approach is to promote practices that will minimize proposed conditions runoff rates and volumes, which will minimize needs for artificial conveyance and storage facilities. To simulate pre-development hydrologic conditions, infiltration is often necessary to offset the loss of infiltration by creation of impervious surfaces. The ability of the ground to infiltrate depends upon the soil types and its conditions.

Preserving natural hydrologic conditions requires careful alternative site design considerations. Site design practices include preserving natural drainage features, minimizing impervious surface area, reducing the hydraulic connectivity of impervious surfaces, and protecting natural depression storage. A well-designed site will contain a mix of all of those features. The following describes various techniques to achieve the alternative approach:

- **Preserving Natural Drainage Features**. Protecting natural drainage features, particularly vegetated drainage swales and channels, is desirable because of their ability to infiltrate and attenuate flows and to filter pollutants. However, this objective is often not accomplished in land development. In fact, commonly held drainage philosophy encourages just the opposite pattern – streets and adjacent storm sewers are typically located in the natural headwater valleys and swales, thereby replacing natural drainage functions with a completely impervious system. As a result, runoff and pollutants generated from impervious surfaces flow directly into storm sewers with no opportunity for attenuation, infiltration, or filtration. Developments designed to fit site topography also minimize the amount of grading on site.

- **Protecting Natural Depression Storage Areas**. Depressional storage areas either have no surface outlet or drain very slowly following a storm event. They can be commonly seen as ponded areas in farm fields during the wet season or after large runoff events. Traditional development practices eliminate these depressions by filling or draining, thereby obliterating their ability to reduce surface runoff volumes and trap pollutants. The volume and release rate characteristics of depressions should be protected in the design of the development site. The depressions can be protected by simply avoiding the depression or by incorporating its storage as additional capacity in required detention facilities.

- **Avoiding Introduction of Impervious Areas**. Careful site planning should consider reducing impervious coverage to the maximum extent possible. Building footprints, sidewalks, driveways, and other features producing impervious surfaces should be evaluated to minimize impacts on runoff.

- **Reducing the Hydraulic Connectivity of Impervious Surfaces**. Impervious surfaces are significantly less of a problem if they are not directly connected to an impervious conveyance system (such as a storm sewer). Two basic ways to reduce hydraulic connectivity are routing of roof runoff over lawns and reducing the use of storm sewers. Site grading should promote increasing travel time of stormwater runoff and should help reduce concentration of runoff to a single point in the development.

- **Routing Roof Runoff Over Lawns**. Roof runoff can be easily routed over lawns in most site designs. The practice discourages direct connection of downspouts to storm sewers or parking lots. The practice also discourages sloping driveways and parking lots to the street. By routing roof drains and crowning the driveway to run off to the lawn, the lawn is essentially used as a filter strip.

- **Reducing the Use of Storm Sewers**. By reducing use of storm sewers for draining streets, parking lots, and back yards, the potential for accelerating runoff from the development can be greatly reduced. The practice requires greater use of swales and may not be practical for some development sites, especially if there are concerns for areas that do not drain in a "reasonable" time. The practice requires educating local citizens and public works officials who expect runoff to disappear shortly after a rainfall event.

- **Reducing Street Widths**. Street widths can be reduced by either eliminating on-street parking or by reducing roadway widths. Municipal planners and traffic designers should encourage narrower neighborhood streets which ultimately could lower maintenance.

- **Limiting Sidewalks to One Side of the Street**. A sidewalk on one side of the street may suffice in low-traffic neighborhoods. The lost sidewalk could be replaced with bicycle/recreational trails that follow back-of-lot lines. Where appropriate, backyard trails should be constructed using pervious materials.

- **Using Permeable Paving Materials**. These materials include permeable interlocking concrete paving blocks or porous bituminous concrete. Such materials should be considered as alternatives to conventional pavement surfaces, especially for low use surfaces such as driveways, overflow parking lots, and emergency access roads.

- **Reducing Building Setbacks**. Reducing building setbacks reduces impervious cover associated with driveway and entry walks and is most readily accomplished along low-traffic streets where traffic noise is not a problem.

- **Constructing Cluster Developments**. Cluster developments can also reduce the amount of impervious area for a given number of lots. The biggest savings occurs with street length, which also will reduce costs of the development. Cluster development groups the

construction activity in less-sensitive areas without substantially affecting the gross density of development.

In summary, a careful consideration of the existing topography and implementation of a combination of the above mentioned techniques may avoid construction of costly stormwater control measures. Benefits include reduced potential for downstream flooding and water quality degradation of receiving streams/water bodies, enhancement of aesthetics, and reduction of development costs. Other benefits include more stable baseflows in receiving streams, improved infiltration, reduced flood flows, reduced pollutant loads, and reduced costs for conveyance and storage.

ORDINANCE APPENDIX F

STORMWATER MANAGEMENT DESIGN CRITERIA

TABLE F-1
RUNOFF CURVE NUMBERS

TABLE F-2
RATIONAL RUNOFF COEFFICIENTS

TABLE F-3
MANNING ROUGHNESS COEFFICIENTS

TABLE F-1

RUNOFF CURVE NUMBERS

LAND USE DESCRIPTION	Hydrologic Condition	HYDROLOGIC SOIL GROUP A	B	C	D
Open Space					
Grass cover < 50%	Poor	68	79	86	89
Grass cover 50% to 75%	Fair	49	69	79	84
Grass cover > 75%	Good	39	61	74	80
Meadow		30	58	71	78
Agricultural					
Pasture, grassland, or range – Continuous forage for grazing	Poor	68	79	86	89
Pasture, grassland, or range – Continuous forage for grazing	Fair	49	69	79	84
Pasture, grassland, or range – Continuous forage for grazing	Good	39	61	74	80
Brush—brush-weed-grass mixture with brush the major element	Poor	48	67	77	83
Brush—brush-weed-grass mixture with brush the major element	Fair	35	56	70	77
Brush—brush-weed-grass mixture with brush the major element	Good	30	48	65	73
Fallow Bare soil	-------	77	86	91	94
Crop residue cover (CR)	Poor	76	85	90	93
	Good	74	83	88	90
Woods – grass combination (orchard or tree farm)	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30	55	70	77

Commercial	(85% impervious)	89	92	94	95
Industrial	(72% impervious)	81	88	91	93
Institutional	(50% impervious)	71	82	88	90

Residential districts by average lot size:

	% Impervious				
1/8 acre or less * (townhouses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Farmstead		59	74	82	86
Smooth surfaces (concrete, asphalt, gravel, or bare compacted soil)		98	98	98	98
Water		98	98	98	98
Mining/newly graded areas (pervious areas only)		77	86	91	94

* Includes multi-family housing unless justified lower density can be provided.

Note: Existing site conditions of bare earth or fallow ground shall be considered as meadow when choosing a CN value.

Source: NRCS (SCS) TR-55

TABLE F-2

RATIONAL RUNOFF COEFFICIENTS

		HYDROLOGIC SOIL GROUP			
LAND USE DESCRIPTION		A	B	C	D
Cultivated land : without conservation treatment		.49	.67	.81	.88
: with conservation treatment		.27	.43	.61	.67
Pasture or range land: poor condition		.38	.63	.78	.84
: good condition		---*	.25	.51	.65
Meadow: good condition		---*	---*	.44	.61
Woods: thin stand, poor cover, no mulch		---*	.34	.59	.70
: good cover		---*	---*	.45	.59
Open spaces, lawns, parks, golf courses, cemeteries					
Good condition: grass cover on 75% or more of the area		---*	.25	.51	.65
Fair condition: grass cover on 50% to 75% of the area		---*	.45	.63	.74
Commercial and business areas (85% impervious)		.84	.90	.93	.96
Industrial districts (72% impervious)		.67	.81	.88	.92
Residential:					
Average lot size	Average % impervious				
1/8 acre or less	65	.59	.76	.86	.90
1/4 acre	38	.25	.49	.67	.78
1/3 acre	30	---*	.49	.67	.78
1/2 acre	25	---*	.45	.65	.76
1 acre	20	---*	.41	.63	.74
Paved parking lots, roofs, driveways, etc.		.99	.99	.99	.99
Streets and roads:					
Paved with curbs and storm sewers		.99	.99	.99	.99
Gravel		.57	.76	.84	.88
Dirt		.49	.69	.80	.84

Notes: Values are based on SCS definitions and are average values**.**
Values indicated by ---* should be determined by the design engineer based on site characteristics.

Source : New Jersey Department of Environmental Protection, Technical Manual for Stream Encroachment, August 1984

TABLE F-3

MANNING'S ROUGHNESS COEFFICIENTS

Roughness Coefficients (Manning's "n") for Overland Flow

Surface Description	n		
Dense growth	0.4	-	0.5
Pasture	0.3	-	0.4
Lawns	0.2	-	0.3
Bluegrass sod	0.2	-	0.5
Short grass prairie	0.1	-	0.2
Sparse vegetation	0.05	-	0.13
Bare clay-loam soil (eroded)	0.01	-	0.03
Concrete/asphalt - very shallow depths (less than 1/4 inch)	0.10	-	0.15
- small depths (1/4 inch to several inches)	0.05	-	0.10

Roughness Coefficients (Manning's "n") for Channel Flow

Reach Description	n
Natural stream, clean, straight, no rifts or pools	0.03
Natural stream, clean, winding, some pools or shoals	0.04
Natural stream, winding, pools, shoals, stony with some weeds	0.05
Natural stream, sluggish deep pools and weeds	0.07
Natural stream or swale, very weedy or with timber underbrush	0.10
Concrete pipe, culvert, or channel	0.012
Corrugated metal pipe	0.012-0.027(1)
High density polyethylene (HDPE) pipe	
Corrugated	0.021-0.029(2)
Smooth lined	0.012-0.020(2)

(1) Depending upon type, coating, and diameter

(2) Values recommended by the American Concrete Pipe Association, check manufacturer's recommended value

Source: U.S. Army Corps of Engineers, HEC-1 Users Manual

ORDINANCE APPENDIX G

REFERENCES

REFERENCES

BMP Manuals

California
California Stormwater BMP Handbook: New Development and Redevelopment (January 2003) – separate file available at https://www.casqa.org/resources/bmp-handbooks

Georgia
Georgia Stormwater Management Manual Volume 2: Technical Handbook (August 2001)-separate file **(http://www.georgiastormwater.com/)**

Maryland
2000 Maryland Stormwater Design Manual –
https://mde.maryland.gov/programs/water/stormwatermanagementprogram/pages/stormwater_design.aspx

Massachusetts
Stormwater Management, Volume Two: Stormwater Technical Handbook (Massachusetts, 1997) – separate file available at **http://www.state.ma.us/dep/brp/stormwtr/stormpub.htm**

Minnesota
Minnesota Urban Small Sites BMP Manual: Stormwater Best Management Practices for Cold Climates (July 2001) –
https://www.pca.state.mn.us/water/stormwater-best-management-practices-manual

New Jersey
Revised Manual for New Jersey: Best Management Practices for Control of Nonpoint Source Pollution from Stormwater (Fifth Draft May 2000) –
NJDEP New Jersey Department of Environmental Protection (state.nj.us)

New York
New York State Stormwater Management Design Manual (2001) –
http://www.dec.ny.gov/chemical/29072.html

Pennsylvania

Pennsylvania Department of Environmental Protection ***Pennsylvania Stormwater Best Management Practices Manual,*** Pub. No. 363-0300-002, December 30, 2006

Washington
Stormwater Management Manual for Western Washington (August 2001) – **http://www.ecy.wa.gov/programs/wq/stormwater/manual.html**

Federal
Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring (FHWA) – **http://www.fhwa.dot.gov/environment/ultraurb/3fs1.htm**

USEPA Infiltration Trench Fact Sheet (September 1999) –
Document Display | NEPIS | US EPA

Riparian Buffer References

Alliance for the Chesapeake Bay, Pennsylvania Department of Environmental Protection, September 2000. *Forest Buffer Toolkit*, Stream ReLeaf Program.

Penn State College of Agricultural Sciences, 1996. *Establishing Vegetative Buffer Strips Along Streams to Improve Water Quality*. Publication # AGRS-67.

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ORDINANCE APPENDIX H

WEST NILE VIRUS GUIDANCE

WEST NILE VIRUS GUIDANCE

(This source is from the Monroe County, PA Conservation District that researched the potential of West Nile Virus problems from BMPs due to a number of calls they were receiving)

Monroe County Conservation District Guidance: Stormwater Management and West Nile Virus

Source: Brodhead McMichaels Creeks Watershed Act 167 Stormwater Management Ordinance Final Draft 2/23/04

The Monroe County Conservation District recognizes the need to address the problem of nonpoint source pollution impacts caused by runoff from impervious surfaces. The new stormwater policy being integrated into Act 167 stormwater management regulations by the PA Department of Environmental Protection (PADEP) will make nonpoint pollution controls an important component of all future plans and updates to existing plans. In addition, to meet post-construction anti-degradation standards under the state National Pollutant Discharge Elimination System (NPDES) permitting program, applicants will be required to employ Best Management Practices (BMPs) to address nonpoint pollution concerns.

Studies conducted throughout the United States have shown that wet basins and in particular constructed wetlands are effective in traditional stormwater management areas such as channel stability and flood control and are one of the most effective ways to remove stormwater pollutants (United States Environmental Protection Agency 1991, Center for Watershed Protection 2000). From Maryland to Oregon, studies have shown that as urbanization and impervious surfaces increase in a watershed, the streams in those watersheds become degraded (CWP 2000). Although there is debate over the threshold of impervious cover when degradation becomes apparent (some studies show as little as 6% while others show closer to 20%), there is agreement that impervious surfaces cause nonpoint pollution in urban and urbanizing watersheds and that degradation is ensured if stormwater BMPs are not implemented.

Although constructed wetlands and ponds are desirable from a water quality perspective, there may be concerns about the possibility of these stormwater management structures becoming breeding grounds for mosquitoes. The Conservation District feels that although it may be a valid concern, **municipalities should not adopt ordinance provisions prohibiting wet basins for stormwater management.**

Mosquitoes

The questions surrounding mosquito production in wetlands and ponds have intensified in recent years by the outbreak of the mosquito-borne West Nile Virus. As is the case with all vector-borne maladies, the life cycle of West Nile Virus is complicated, traveling from mosquito to bird, back to mosquito, and then to other animals including humans. *Culex pipiens* was identified as the vector species in the first documented cases from New York in 1999. This species is still considered the primary transmitter of the disease across its range. Today there are some 60 species of mosquitoes that inhabit Pennsylvania. Along with *C. pipiens*, three other

species have been identified as vectors of West Nile Virus while four more have been identified as potential vectors.

The four known vectors in NE Pennsylvania are *Culex pipiens, C. restuans, C. salinarius*, and *Ochlerotatus japonicus*. All four of these species prefer, and almost exclusively use, artificial containers (old tires, rain gutters, birdbaths, etc.) as larval habitats. In the case of *C. pipiens*, the most notorious of the vector mosquitoes, the dirtier the water, the better they like it. The important factor is that these species do not thrive in functioning wetlands where competition for resources and predation by larger aquatic and terrestrial organisms is high.

The remaining four species, *Aedes vexans*, *Ochlerotatus Canadensis*, *O. triseriatus*, and *O. trivittatus*, are currently considered potential vectors due to laboratory tests (except the *O. trivittatus*, which did have one confirmed vector pool for West Nile Virus in PA during 2002). All four of these species prefer vernal habitats and ponded woodland areas following heavy summer rains. These species may be the greatest threat of disease transmission around stormwater basins that pond water for more than four days. This can be mitigated, however, by establishing ecologically functioning wetlands.

Stormwater Facilities

If a stormwater wetland or pond is constructed properly and a diverse ecological community develops, mosquitoes should not become a problem. Wet basins and wetlands constructed as stormwater management facilities should be designed to attract a diverse wildlife community. If a wetland is planned, proper hydrologic soil conditions and the establishment of hydrophytic vegetation will promote the population of the wetland by amphibians and other mosquito predators. In natural wetlands, predatory insects and amphibians are effective at keeping mosquito populations in check during the larval stage of development while birds and bats prey on adult mosquitoes.

The design of a stormwater wetland must include the selection of hydrophytic plant species for their pollutant uptake capabilities and for not contributing to the potential for vector mosquito breeding. In particular, species of emergent vegetation with little submerged growth are preferable. By limiting the vegetation growing below the water surface, larvae lose protective cover, and there is less chance of anaerobic conditions occurring in the water.

Stormwater ponds can be designed for multiple purposes. When incorporated into an open space design, a pond can serve as a stormwater management facility and a community amenity. Aeration fountains and stocked fish should be added to keep larval mosquito populations in check.

Publications from the PA Department of Health and the Penn State Cooperative Extension concerning West Nile Virus identify aggressive public education about the risks posed by standing water in artificial containers (tires, trash cans, rain gutters, bird baths) as the most effective method to control vector mosquitoes.

Conclusion

The Conservation District understands the pressure faced by municipalities when dealing with multifaceted issues such as stormwater management and encourages the incorporation of water quality management techniques into stormwater designs. As Monroe County continues to grow, conservation design, infiltration, and constructed wetlands and ponds should be among the preferred design options to reduce the impacts of increases in impervious surfaces. When designed and constructed appropriately, the runoff mitigation benefits to the community from these design options will far outweigh their potential to become breeding grounds for mosquitoes.

ORDINANCE APPENDIX I

STORMWATER CONTROLS AND BEST MANAGEMENT PRACTICES
OPERATIONS AND MAINTENANCE AGREEMENT

STORMWATER CONTROLS AND BEST MANAGEMENT PRACTICES OPERATIONS AND MAINTENANCE AGREEMENT

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

WITNESSETH

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

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

WHEREAS, the Stormwater Controls and BMP Operations and Maintenance Plan approved by the Municipality (hereinafter referred to as the "Plan") for the Property identified herein, which is attached hereto as Appendix A and made part hereof, provides for management of stormwater within the confines of the Property through the use of Best Management Practices (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 stormwater BMPs be constructed and maintained on the Property; and

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

BMP – "Best Management Practice"-activities, facilities, designs, measures, or procedures used to manage stormwater impacts from land development, to protect and maintain water quality and infiltration, and to otherwise meet the purposes of the municipal Stormwater Management Ordinance, including but not limited to infiltration trenches, seepage pits, filter strips, bioretention, wet ponds, permeable paving, rain gardens, grassed swales, forested buffers, sand filters, and detention basins.

- Infiltration Trench – A BMP surface structure designed, constructed, and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or groundwater aquifer,

- Seepage Pit – An underground BMP structure designed, constructed, and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or groundwater aquifer,

- Rain Garden – A BMP overlain with appropriate mulch and suitable vegetation designed, constructed, and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or underground aquifer, and

WHEREAS, the Municipality requires, through the implementation of the Plan, that stormwater management BMPs as required by said Plan and the municipal Stormwater Management Ordinance be constructed and adequately operated and maintained by the Landowner, his 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 BMPs shall be constructed by the Landowner in accordance with the plans and specifications identified in the Plan.

2. The Landowner shall operate and maintain the BMP(s) as shown on the Plan in good working order acceptable to the Municipality and in accordance with the specific maintenance requirements noted on the 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 identification, to inspect the BMP(s) whenever it deems necessary. Whenever possible, the Municipality shall notify the Landowner prior to entering the Property.

4. In the event that the Landowner fails to operate and maintain the BMP(s) as shown on the Plan in good working order acceptable to the Municipality, the Municipality or its representatives may enter upon the Property and take whatever action is deemed necessary to maintain said BMP(s). This provision shall not be construed to allow the Municipality to erect any permanent structure on the land of the Landowner. It is expressly understood and agreed that the Municipality is under no obligation to maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the Municipality.

5. In the event that the Municipality, pursuant to this Agreement, performs work of any nature or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner shall reimburse the Municipality for all expenses (direct and indirect) incurred within ten (10) days of receipt of an invoice from the Municipality.

6. The intent and purpose of this Agreement is to ensure the proper maintenance of the on-site BMP(s) by the Landowner; provided, however, that this Agreement shall not be deemed to create or affect any additional liability on 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 interest shall release the Municipality's employees and designated representatives from all damages, accidents, casualties, occurrences, or claims which might arise or be asserted against said employees and representatives from the construction, presence, existence, or maintenance of the BMP(s) by the Landowner or Municipality. In the event that a claim is asserted against the Municipality, its designated representatives, or employees, the Municipality shall

promptly notify the Landowner, and the Landowner shall defend, at his own expense, any suit based on the claim. If any judgment or claims against the Municipality's employees or designated representatives shall be allowed, the Landowner shall pay all costs and expenses regarding said judgment or claim.

8. The Municipality shall inspect the BMP(s) 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 _____ 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 interest, in perpetuity.

ATTEST:

WITNESS the following signatures and seals:

(SEAL) For the Municipality:

_____

(SEAL) For the Landowner:

_____

ATTEST:

_____ (City, Borough, Township)

County of _____, Pennsylvania

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

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

_____ _____

NOTARY PUBLIC **(SEAL)**

ORDINANCE APPENDIX J

RIPARIAN BUFFER TRAIL GUIDELINES

Riparian Buffer Trail Guidelines

[Note to Municipality: The following riparian buffer trail guidelines may be modified provided that the buffer meets all minimum width and vegetation requirements detailed in Section 306 of the ordinance as well as all federal, state and local, stormwater, floodplain, and other requirements and regulations.]

Introduction

Riparian buffers are used as non-structural best management practices (BMPs) for protecting and enhancing water quality. Depending on their size, location, and design, riparian buffers often supply additional environmental, economic, aesthetic, and recreational value. Passive recreational trails can be a compatible use within riparian buffers if the trails are sized and placed appropriately. The trail guidelines below are meant to supplement Section 306, Water Quality Requirements, and do not alter or modify the regulations set forth in Section 301 General Requirements. All other applicable rules and requirements should be followed, including all federal, state, permitting, and local stormwater and floodplain ordinances.

Installing a trail does not relieve a developer or municipality of the minimum buffer and vegetation requirements described in Section 306-C, or infiltration and peak rate controls in Sections 305 and 308. Effort shall be made to mitigate water quality and peak rate adjacent the trail structure to avoid collecting runoff in a large facility and creating a point discharge. This can be accomplished by trail-side stone filtration trenches, vegetative filter strips, small bio-retention facilities, and other mechanisms subject to site constraints and municipal engineer approval. See Figure J-1. In situations where site constraints negate the feasibility of trail-side mitigation methods, effort shall be made to collect runoff in multiple stormwater facilities for segmented portions of the trail, in place of detaining stormwater in one large facility. Level spreaders shall be constructed at facility outlets to decrease point-source discharges.

As with all trails, adequate land acquisition, easements, and/or landowner permission should be obtained in advance of any trail placement. Care should be given when designing and installing trails so as not to compromise the buffer's ability to protect water quality. Many factors such as slope, vegetation, and soil type will determine the type, size, and placement of the trail within the riparian buffer. Heavily used trails and trails with wide impervious surfaces should be set back farther from the stream edge to help mitigate the effects of any associated increase in runoff. Note: failure to comply with these guidelines (Installing a trail with inadequate setback from the stream bank) could result in increased stormwater runoff, decreased water quality, stream bank degradation, and damage to the buffer or trail.

Trail Recommendations

Location, Size, and Orientation

All trails should be a reasonable width appropriate for the site conditions. It is not recommended that the width of any paved trail exceed twenty five (25) percent of the total buffer width. All trail designs and specifications are subject to approval by the municipality.

Natural vegetation must be present throughout the buffer as described in Section 306 of the ordinance. Grassy areas should be managed as meadows or be reforested and should not be mowed as lawn in any part of the buffer. Where existing vegetation is insufficient to protect water quality, additional native species should be planted to enhance the buffer.

Paved trails, if appropriate to the site, are permitted and must be located at least twenty-five (25) feet from the top of the stream bank. In limited instances, paved trails be placed closer to a stream due to topography, or in order to accommodate passive educational and recreational activities, but must always be at least ten (10) feet from the top of the stream bank. Although this can be achieved by diverting the entire trail closer to the stream, more conservative methods should be considered, such as smaller spur trails or loop trails. These smaller trails provide access to the stream, but reduce the total traffic along the sensitive stream bank.

In rare instances where the buffer width is reduced due to zoning setback or geographical constraints, the municipality should strongly consider whether the benefits of a trail outweigh the benefits of a wider buffer.

Signage

The installation of interpretive and educational signage is strongly encouraged along the trail. Signs should point out local natural resources and educate the public on how riparian buffers protect the watershed. There should be minimum disturbance in the vegetated buffer between the trail and the stream. Therefore, all appurtenances (e.g. benches, educational signs, kiosks, fountains, etc.) should be installed on the landward side of the trail, if possible. All appurtenances shall be installed in compliance with federal, state, local, stormwater, floodplain, and other regulations and permitting requirements (e.g. anchoring, etc.)

Parking Areas

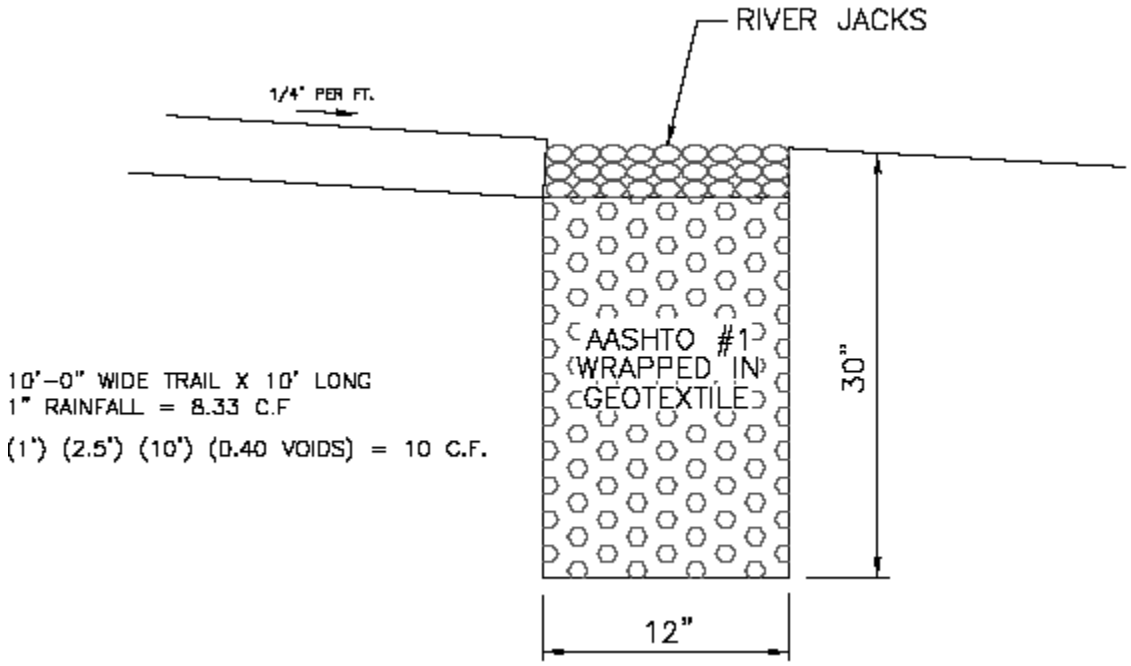
New trailheads and trail parking areas shall meet all the infiltration, rate control, and minimum setback requirements of this ordinance. Every effort should be made to coordinate trail access with existing parking areas. Any new parking areas and trailhead clearings should not encroach on the riparian buffer in any way.

Trail Maintenance

The installation and maintenance of all trails should be performed in a manner that minimizes site disturbance and prevents runoff and erosion. Soil disturbance should be avoided if possible. The removal of native trees and other native vegetation should also be kept to a minimum. If large or heavy equipment is required for trail installation, special care should be given not to damage existing trees and tree roots.

FIGURE J-1

EXAMPLE DESIGN OF A TRAIL-SIDE STONE FILTRATION TRENCH



Source:
James MacCombie, Herbert E. MacCombie Jr. P.E. Consulting Engineers & Surveyors Inc.

PLAN APPENDIX 2

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PHASE II REQUIREMENTS

What is NPDES Phase II?

Polluted stormwater runoff has been determined to be the leading cause of impairment threatening our nation's surface waters. Mandated by Congress under the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) Stormwater Program is a comprehensive two-phased approach to addressing sources of stormwater pollution that affect the quality of the nation's waters.

In Pennsylvania, the Department of Environmental Protection (PADEP) has implemented Phase I of this program which affects certain industrial sites, construction sites over 5 acres, and municipalities with populations over 100,000, which includes Philadelphia, Pittsburgh, Allentown, and Erie. NPDES permits that were issued under this program were the State's first step in addressing the affects of nonpoint source pollution in our lakes and streams.

Building upon the success of this program, Phase II of Pennsylvania's NPDES program will require permitting of over 700 municipal separate storm sewer systems (MS4s) in Pennsylvania. Operators of these regulated MS4s are required to apply for NPDES permit coverage by March 10, 2003. Phase II also requires permitting of all construction sites, regardless of location, with over 1 acre of disturbance.

Am I an MS4 Municipality?

The over 700 MS4s are located in 20 designated Urban Areas (UAs) and 17 potential UAs in Pennsylvania. An Urban Area is defined by the U.S. Census Bureau as "a place and the adjacent densely settled surrounding territory that together have a minimum population of 50,000 people and a density of 1,000 persons/square mile." The list of MS4 municipalities can be obtained from DEP's website, DEP ID 385-2000-012.

Even if your municipality is not a designated MS4, it may be beneficial to adopt some or all of the requirements under Phase II of the NPDES program to address existing stormwater pollution problems within your municipality. Although not mandated by federal or state law, non-MS4 municipalities should consider the goals of the program and the overall return it may provide in improving overall water quality in the community.

What Are the Minimum Stormwater Management Requirements Under Phase II?

The Phase II stormwater regulations specify six program elements that must be addressed by designated MS4 municipalities. The regulations also imply that additional things will need to be done, but the lack of specific requirements gives permit holders a great deal of flexibility, if not a lot of guidance, about what to do about some aspects of stormwater management, chiefly monitoring.

The six required stormwater program elements include:

1. Public Education and Outreach
2. Public Involvement and Participation
3. Illicit Discharge Detection and Elimination
4. Construction Site Runoff Control
5. Post-Construction Runoff Management
6. Pollution Prevention/Good Housekeeping Practices for All Municipal Operations

1. Public Education and Outreach

Awareness of stormwater related environmental issues and problems is generally low. A variety of surveys suggest that public awareness of the fact that storm drains are usually not connected to the sewers or that individual actions around our homes cause significant environmental impact to urban streams is not high! Many citizens do not know that our urban streams and watersheds are being damaged by the effects of urbanization and by the pollutants found in urban environments. Support for stormwater or urban watershed management will not be strong, particularly if new resources are needed, unless citizens are aware of the condition of urban watersheds and stream segments.

In some Phase II communities, the presence of 303d list streams (streams listed by U.S. EPA as impaired streams) and the TMDL (Total Maximum Daily Load) process for reducing pollution and restoring water quality in these streams may help to increase awareness. Nonetheless, a strong, well-designed and ongoing, or at least periodic, educational program will be needed both to build support for the stormwater program and to make citizens aware of changes they can and need to make to reduce unnecessary stormwater impacts. A strong, effective community education program will include general public awareness education as well as more technical education that targets specific groups such as developers, construction contractors, landscapers, lawn care services, and a variety of small businesses. It is important to address specific sectors of the community due to special concerns about pollution or other impacts associated with that activity as well as general things that homeowners and property owners can do to address needless or avoidable pollution.

In many communities there may already be an educator or educators involved in environmental education in the classroom who would be happy to assist the community by developing a stormwater education unit for delivery at appropriate grade levels. Likewise, local scouting organizations or student conservation organizations would probably be willing to conduct educational activities in the neighborhood using activities like the stream walk or storm drain activity. *Hands-on activity and involvement is critical to learning at all ages. Stormwater programs should utilize these existing resources whenever possibl*e.

2. Public Involvement and Participation

It is absolutely vital to involve the public as early as possible in the design and implementation of the stormwater or urban watershed management program. A diverse cross-section of the community representing all of the different stakeholder groups should be represented. This should include the regulated community (developers, builders, business owners or managers, etc.), the taxpayers who will be paying the tab, the property owners who have been impacted by flooding in the past, environmental groups and environmental activists, landowners, educators, volunteer citizen monitors, and others. These are the people who will pay the bills, work with you to reduce pollution from their activities *(or oppose you at every turn if they are not informed and do not buy into the progra*m), work with you to implement school and community education programs, work on clean-ups and assist with monitoring through citizen monitoring programs.

The Phase II U.S. EPA requirements include public involvement, and there is probably no better way to do this than to form a citizen advisory committee. This should not be a committee appointed from political insiders. It should be composed of stakeholders who come to the table and are interested enough to stay with the process and who are in basic agreement that the community or stormwater management area organization is responsible for and must develop a stormwater management program. Truly open public involvement can avoid expensive and time-consuming controversies that often lead to legal actions. They can also reduce the potential of citizen lawsuits from groups or individuals critical of the progress toward addressing stormwater management. As parties involved from the beginning in designing, implementing, and evaluating the program, it is likely that the concerns of all groups will be addressed sufficiently to avoid serious controversy that can be resolved only through legal remedies. Citizen groups and persons fully involved in a meaningful way in the process will not choose expensive legal action to resolve disputes. Furthermore, most Phase II communities are not going to find it easy to fund stormwater management efforts.

Volunteer involvement will probably be a critical component of many successful programs. Volunteers can contribute a lot, whether it is scout troops interested in helping with neighborhood education through activities like storm drain stenciling, educators willing to help design educational materials, citizens interested in working to help via involvement in volunteer water monitoring, or businesses willing to contribute to the support of these citizen efforts or other forms of volunteerism.

3. Illicit Discharge Detection and Elimination

In some areas, pollutants from illicit or illegal discharges may be a significant contribution to pollutant loadings. These may be intentional or unintentional. In older areas they may be discharges that were never rerouted to the sewer system as regulations for discharges were put in place. They may also be things like floor drains that were never properly connected to the sewer system. The task facing permit holders is to develop strategies and methods for detecting these illicit/illegal discharges so that they

can be eliminated. A strategy for addressing this problem should first employ education of business owners and operators and homeowners and involve the public in detecting and correcting these problems voluntarily. Addressing the problem will also require a monitoring strategy. Monitoring for illicit/illegal discharges should be kept as simple as possible given resource realities and should progress from simpler, cheaper methods to more complex and more expensive methods as needed. Some techniques for detecting these discharges include:

- Visual inspection along water courses for pipes and unusual discharges (at the same time a check can be made for leaking or broken sewer pipes)
- Visual inspections of business and industrial sites
- Smoke or dye testing to detect or confirm suspected illicit/illegal connections
- Dry weather sampling of suspicious discharges for substances indicative of domestic or industrial wastewater (detergent, optical brighteners, caffeine, or high conductivity)
- Inspection, visual or remote camera, inside stormwater conveyances
- Reconnaissance sampling upstream of where contamination hotspots are found

4. Construction Site Runoff Control

Perhaps one of the most damaging and preventable forms of pollution in rapidly growing urban areas is the excessive sediment loads that can be contributed to streams due to erosion and transport of sediments from construction sites. Communities must have in place measures to control polluted runoff from construction sites. The Phase II rule requires permitting of construction sites down to 1 acre. Also, a robust and effective program for erosion and sediment control from construction sites will require education and enforcement. Since it is the permit holder that will be the most likely target of any clean water suits filed by local citizens or by environmental groups representing citizens who feel that enforcement is inadequate, permit holders should have their own program for enforcement. This means that the community or (in cases of a watershed authority with multiple jurisdictions), the authority, will need to have an erosion and sediment control program. Some suggestions for doing this include:

- ✓ adopt and implement a strong erosion and sediment control ordinance
- ✓ provide education and training for municipal personnel who are involved in municipal construction projects from supervisors to equipment operators
- ✓ encourage erosion and sediment control training for construction contractors and homebuilders or if possible work with others to provide training locally
- ✓ require that at least one appropriate individual (an engineer, landscaper, engineering technician, etc.) become certified as a Certified Professional in Erosion and Sediment Control Specialist (CPESC) and assist that person with the costs associated with certification
- ✓ create a process for review and approval of construction site erosion and sediment control plans and provide for review of significant projects by the CPESC

- ✓ cross-train building inspectors to do initial inspections of construction sites
- ✓ as necessary, have the CPESC conduct more detailed inspections
- ✓ determine whether you wish to develop a local enforcement program

Having an effective erosion and sediment control ordinance and program is a critical part of an effective stormwater management program. An effective erosion and sediment control program coupled with effective public involvement in the stormwater program provides insurance against costly legal actions.

5. Post-Construction Runoff Management

The Phase II minimum requirements also include management of runoff after the active construction period. These requirements assure that a responsible party will take care of maintaining best management practices (BMPs) until the site is stabilized for erosion control practices and that maintenance of detention and retention basins and other structural BMPs will be funded and taken care of in the future. If the permit holder can, through incentives (fee structures, etc.), induce developers to utilize nonstructural BMPs, the potential and actual future obligations of the permit holder or community will be lessened. Even then, it is desirable to have some sort of bonding mechanism in place or some sort of recurring fee so that funds for maintenance will be available when needed. The permit holder or community should research the positive and negative aspects of different mechanisms for post-construction maintenance before choosing an approach that it believes best suits the needs of the community or area.

6. Pollution Prevention and Good Housekeeping for Municipal Operations

The final requirement for stormwater Phase II permit holders is for the municipality or municipalities regulated under the permit to develop and implement pollution reduction and good housekeeping procedures for prevention of pollution from stormwater runoff. This means that a program for prevention of stormwater impacts from municipal facilities and municipal operations will have to be developed or perhaps strengthened if such a program already exists. Elements of such a program might include structural components or such things as fuel and materials storage and handling safeguard improvements, erosion and sediment control on municipal projects, protection or restoration of riparian corridors on municipal property, use of design elements to prevent stormwater runoff and pollution on new projects or redevelopment projects, flow and pollution control BMPs for municipal parking areas, and other actions for prevention or reduction of polluted stormwater runoff. Since careless or thoughtless actions of individuals often contribute to stormwater pollution, a pollution prevention and housekeeping improvement program should include an educational component for appropriate municipal employees and contractors. This public sector pollution prevention and housekeeping component of the stormwater management program can be important, particularly so when a community or permit holder is going to implement voluntary or even regulatory programs for reducing stormwater pollution. The public pollution prevention and housekeeping improvements can be used to demonstrate improvements and, thus, serve as educational activities for private sector businesses and industries in the community.

When Should a Community Do More than the Minimum?

Clearly these six activities represent the minimum requirements for Phase II communities or permit holders. Every community is different, and every community may have issues, concerns, or problems a little different from those in other communities. For example, some communities may have concerns about streams or water bodies that are special, very high quality resources that the community places special value on or which have important economic value. A community may have a Total Maximum Daily Load (TMDL) stream for which special additional actions are needed or required to restore water quality in order to avoid growth restrictions or other possible sanctions. A community might have a specific problem like bacteriological contamination from waterfowl that threatens a public beach, flooding problems, or something else that is a special concern in the community that causes it to desire to do more. Communities should pursue everything that makes sense to do for which there is a public consensus and adequate funding to complete. However, permit holders ***should not*** list anything in their plan or permit (if they are applying for an individual permit) that they do not definitely plan and know that they can and will complete. EPA will hold permit holders to those things that they say they will do as part of the permit. *It is safer for permit holders to do more than they indicated than to list something tenuous and not be able to accomplish it*.

PLAN APPENDIX 3

MUNICIPAL ORDINANCE MATRIX

CRUM CREEK WATERSHED

MUNICIPAL ORDINANCE MATRIX

(WATERSHED STORM MANAGEMENT)

			Within the Subdivision and Land Development Ordinance					
Township/Borough	**Zoning**	**Subdivision & Land Development**	**Stormwater***	**Floodplain**	**Road**	**Grading**	**Erosion and Sedimentation**	**Other**
Eddystone Borough	Yes, 1997	County Ord., 1981	Sec. 309	County Ord. 77-5 1977	Sec. 403, 506, 605, 704, 805	Sec. 403.6, 605.4, 805.6	Sec. 811	
Edgmont Township	Yes, 2002	Yes, 2002	Sec. 810	Ord. 61 (Zoning Ord.)	Sec. 802	Sec. 816/Ord. 151-1999	Sec. 810	
Marple Township	Yes, 1999	Yes, 1954	Ch. 257, Ord. 2005-4+	Ord. 77.14 Sec. 74-28	Sec. 74.14	Sec. 74.26	- - -	- - -
Media Borough	Yes, 2005	County Ord., 1981	Ch. 251, Ord. 992+	Ch. 171, Ord. 743				Steep Slopes Ch. 257, Ord. 940
Morton Borough	Yes, 1995	County Ord., 1981	Ord. 651+	Ord. 579	Sec. 403, 506, 605, 704, 805	Sec. 403.6, 605.4, 805.6	Sec 811	- - -
Nether Providence Twp.	Yes, 1996	Yes, 199,Chapt. 289	Ch. 281	chapt. 269	chapt. 289-7	Ch 269; Ch 281, Ch 289; Ch 300-58	Ch. 281	
Newtown Township	Yes, 1995	Yes, 1995	Ch. 143 Ord. 2005-2+	Chapt. 91	Ch. 148 sec. 27-33	Ch. 134 Sec. 9	Ch. 138	Art. 1713 Steep Slope Cons. Dist.
Ridley Township	Yes, 1990	Yes, 1982	Ord. 1881	Ord. 1714	Ch 268-22	Ch 268-32	Ch 124, Ord. 1689	ardous Materials: Ch 151, Ord 16
Ridley Park Borough	Yes, 1990	Yes, 1989	Ord. 1157	Ch. 109	Sec. 602-611	Sec. 606	Sec. 618A	- - -
Rutledge Borough	Yes, 1997	Yes, 1976	Ord. 451+	Ord. 337 Ch 8	- - -	- - -	- - -	- - -
Springfield Township	Yes, 1997	Yes, 1995	Ch. 119, Ord. 1429+	Art. 13, Sect. 143	Sec. 123-28	Sec. 123-25 A.2, B&C	Sec. 123-37	- - -
Swarthmore Borough	Yes, 1996	Yes, 2001	Ord. 2002-963, Art. 3	---	Zoning Ord. Ch. 1288	Ord. 2001-963 sec. 403, Zoning, Ch. 1292	Ord. 2001-963 Art. 4.	
Upper Providence Twp.	Yes, 1998	Yes, 1992	Ch. 1054, Ord. 394+	Ch. 1270 (Zoning)	Ch. 1230 sec. 03-14	Ch. 1230 sec. 19	Ch. 1230 sec. 19	
Easttown Township	Yes, 1997	Yes, 1997	Sect. 625	Art. 15, Sect. 1501-05 (Zoning)	Sect. 602-612	- - -	Sect. 626	- - -
Malvern Borough	Yes, 2003**	Yes, 1973***	Art. 6, Sect. 604 E	Art. 22, Sect. 2201 (Zoning)**	Art. 6, Sect. 603-605	Art. 6, Sect. 604 C	Art. 6, Sect. 611	t. 22, Sect. 2202 Steep Slope Re
Tredyffrin Township	Yes, 1998	Yes, 1998	Sec. 181-53	Sec. 208-15, 208-16 (Zoning)	Sec. 181-46	- - -	Sec. 181-40	- - -
Willistown Township	Yes, 1991	Yes, 1984	Ch. 73, Art. 8	Ch. 73, Art. 6	Ch. 123, Art. 6, Sect. 23-35	Ch. 73, Art. 9, Sect 49-50	Ch. 73, Art. 9	Ch. 73, Art. 7 Steep Slopes

PLAN APPENDIX 4

PUBLIC COMMENT AND RESPONSES
PUBLIC HEARING

PA ACT 167
STORMWATER MANAGEMENT PLAN
FOR THE CRUM CREEK WATERSHED

Delaware County Planning Department
Government Center Building
201 West Front Street
Media, PA 19063-2751
(610) 891-5200

Chester County Planning Commission
601 Westtown Road
P.O. Box 2747
West Chester, PA 19380-0990
(610) 344-6285

TO : CRUM CREEK WATERSHED MANAGERS/SECRETARIES
NON-MUNICIPAL WATERSHED PLAN ADVISORY COMMITTEE (WPAC) MEMBERS

FROM : CRUM CREEK ACT 167 STORMWATER MANAGEMENT PLAN – PLANNING TEAM

SUBJECT : FINAL DRAFT CRUM CREEK ACT 167 STORMWATER MANAGEMENT PLAN

DATE : JULY 11, 2011

CC: : CRUM CREEK WPAC MEMBERS (letter only)
MUNICIPAL ENGINEERS (letter only)
PADEP

After many years of hard work and a great deal of input from the Watershed Plan Advisory Committee (WPAC), the municipal engineers, and the Pennsylvania Department of Environmental Protection (PADEP), the Project Team is pleased to transmit the final draft Act 167 Stormwater Management Plan for the Crum Creek Watershed. Enclosed for your review are one hard copy and one CD of the final draft. **Municipalities, please share this document with your WPAC representative and engineer**. Non-municipal WPAC members will receive their own copies. The plan will also be posted on the Delaware County website at www.co.delaware.pa.us/planning and the Chester County website at www.chesco.org/planning.

Please note that the plan and the model ordinance contained within it were developed in strict conformance with the Pennsylvania Act 167 Stormwater Management Act. Additionally, it is our current understanding that the ordinance will meet the requirements of the pending NPDES II MS4 Stormwater Permit (PAG-13) Program (MCM5, Post-Construction Stormwater Management).

Transmittal of this document begins a municipal comment period which will also include a two-week public comment period, ending with public hearing at the Delaware County Government Center Building:

Date: Thursday, August 11, 2011
Time: 7:00 p.m.
(directions enclosed)

-over-

Shortly after the public hearing, Delaware and Chester Counties will each adopt the plan by resolution. The final plan containing the resolution will be transmitted to PADEP for formal approval. As required by Act 167, the municipalities will then have six months from the date of the PADEP approval letter to adopt the standards and criteria of the plan, which are reflected in the ordinance.

As many reviewers may remember, a great deal of back and forth discussion and compromise between the County, the municipalities, and most importantly, DEP, went into the development of the plan and ordinance. Our goal is to complete the plan adoption and approval processes before the end of the year so that the ordinance can be used to satisfy upcoming MS4 permitting requirements. Therefore, the Project Team is requesting that your comments **do not revisit the technical standards and criteria** that have already received technical approval from DEP. Rather, please try to limit your comments to non-technical items (typos, inaccuracies, etc.) that do not require us to go back through the WPAC and PADEP review processes.

Please send your comments to Karen Holm at the Delaware County Planning Department (DCPD) no later than August 12, which is the official close of the comment period.

If you have any questions, please do not hesitate to contact Karen Holm at DCPD by calling 610-891-5213 or via email at holmk@co.delaware.pa.us; or Carrie Conwell at the Chester County Planning Commission by calling 610-344-6285 or via email at cconwell@chesco.org.

RESPONSES TO COMMENTS

PADEP Comments

Comment:

From: Mease, Ronald
Sent: Tuesday, July 19, 2011 1:44 PM
To: Kehler, Jennifer
Subject: RE: Crum Creek Act 167 Plan Public Hearing

Jennifer,

On page III-43 of the draft report, Table III-7, the maximum storage volumes listed for both dams are substantially different than our DEP records. Our records show the following:

Dam	Acre-Feet at Normal Pool	Acre-Feet at Top of Dam	Acre-Feet above Normal Pool
Springton Reservoir	10,740	13,600	2,860 (= 13600 - 10740)
Crum Creek	282	670	388 (= 670 – 282)

The plan developers of the Act 167 plan seem to be using significantly higher volumes for flood storage volume at these dams. The accuracy of this data and its impact on the hydrologic model should be checked.

Ronald C. Mease, P.E. | Civil Engineering Consultant
Department of Environmental Protection
Rachel Carson State Office Building
400 Market Street | Harrisburg, PA 17101
Phone: 717.772.5947 | Fax: 717.772.0409
www.depweb@.state.pa.us

Response:

DEP data was used in the modeling process. However, the way the information was portrayed in the table created confusion. Therefore, the table was removed from the report.

Comment:

From: Davis, Jeremy
Sent: Wednesday, July 20, 2011 1:25 PM
To: Conville, Jonathan
Subject: Crum Creek Act 167 review

We have reviewed the plan titled “Crum Creek Watershed Act 167 Stormwater Management Plan”, dated July 2011, and find it to be consistent with our programs. The Act 167 plan does not include any mention of increasing flood discharges in the watershed. The Plan includes a section on “Existing and Proposed State, Federal, and Local Flood Control Projects” in Section III, Page 38 (Page 57 of 273 in PDF form). While several flood protections measures are detailed, none mentioned are State or Federal projects.

The Bureau has no flood protection projects constructed in the watershed and has no projects currently proposed. Based on our review, we see no reason why the plan should not be approved as written. If you need more information, please contact Jake Kernoschak at jkernoscha@state.pa.us or 717-783-7723.

Jeremy A. Davis, E.I.T. | Project Specialist
Pennsylvania Department of Environmental Protection
Bureau of Waterways Engineering
Rachel Carson State Office Building
400 Market Street | P.O. Box 8460
Harrisburg, PA 17105-8460
Phone: 717.772.5952 | Fax: 717.772.0409
jeremdavis@state.pa.us

Response:

No changes were made to the document per this comment.

Municipal Comment

Comment:

From: Flaharty, Brady [Brady.Flaharty@TheARROGroup.Com]
Sent: Wednesday, August 03, 2011 11:53 AM
To: Holm, Karen
Cc: Barner, Zachary M.; mbrown@easttown.org
Subject: RE: Crum Creek Act 167 Plan
Karen,

Thank you for the information. Attached as a memorandum are Easttown Township's non-technical comments on the Crum draft model ordinance. Please feel free to contact me with any questions. Thank you.

Brady L. Flaharty, P.E.
Vice President
P 610.495.2118
F 610.495.5855
www.thearrogroup.com

ENGINEERING &
ENVIRONMENTAL CONSULTANTS

OUT IN FRONT

(Refer to email attachment from Easttown Township.)

Response:

We agree that there should be some guidance in the Model Ordinance regarding as-built plans. As such, we have added Section 502 “As-builts, Completion Certificate, and Final Inspections,” which specifies the threshold for submittal of an as-built plan, when it is due, and review and approval procedures. We also amended Sections 703 and 907 to specifically reference the requirements in Section 502. We didn’t want to get more detailed, as each municipality may want slightly different information in the as-built or wish to follow a different procedure. It should be noted that individual municipalities can amend the ordinance with any additional requirements may desire.

Citizen Comment

Comment:

From: John [mailto:jbutler@bellatlantic.net]
Sent: Wednesday, August 03, 2011 10:29 PM
To: Pickett, John
Cc: 'James Schmid'; 'william brainerd'; mayer.associates@comcast.net
Subject: Crum Watershed Plan

John

A fast review of the plan I have the following items

Marple already has a meadow lands standard for baseline storm water runoff when there is at least a 2000 sq foot disturbance. This seems to cut into that and doesn't take into the need to reduce what is already out there causing problems like the Wal Mart parking lot that has to have high temperature and contamination that needs to be controlled. Maybe there should be a requirement to spend a % of construction/remodel costs for storm water. There also needs to be a definition on redevelopment vs..remodel. There has to be a watershed overview of township waivers so we stop passing the problem downstream.

You allow a municipality to waiver a buffer down to 10 feet with a statement about down stream. Downstream to Marple is the township line so there has to be some higher power like the county to also review wavers. Marple continues to give wavers in the Darby watershed and we all know there are problems downstream.

Also you have a new manager in Ridley Park.

John Butler

ps

I also have asked DEP to look at their minimum review of over 1 acre with redevelopment on storm water since they are missing many opportunities to correct problems.

Response:

The comment relates primarily to a specific land development in Marple Township. The County does not have the legal authority to control waivers from municipal ordinances. The model ordinance contained in the plan was developed over a number of years for the entire watershed, and was reviewed and critiqued by each of the municipalities as well as PADEP. It is consistent with, and contains the minimum standards necessary to meet, the requirements of Act 167 and the MS4 program. If a municipality would like to make its own ordinance more stringent then it may do so. Therefore, the Plan and the Model Ordinance will not be revised to reflect the comments in the email.

ENGINEERING & ENVIRONMENTAL CONSULTANTS
OUT IN FRONT

649 North Lewis Road
Suite 100
Limerick, PA 19468
T 610.495.0303
F 610.495.5855

MEMORANDUM

TO: Karen L. Holm, Manager, Environmental Planning Section – Delaware County Planning Department

CC: Michael J. Brown, Assistant Township Manager – Easttown Township

FROM: Brady L. Flaharty, P.E., Township Engineer

RE: Easttown Township
Comments on Draft Crum Creek Watershed Act 167 Plan

PROJ. NO.: 10204.58

DATE: 08/03/11

In accordance with your July 11, 2011 memorandum, we reviewed the draft model ordinance from a non-technical standpoint on behalf of our client, Easttown Township. Our only issue with the draft model ordinance pertains to as-built plans, and stems from our experience in implementing the Township's current stormwater management ordinance (which is the Darby-Cobbs model ordinance), which is quite similar to the Crum draft model ordinance.

Section 907.C.2 of both the model ordinance and Darby-Cobbs ordinance requires the submission of as-built (record) drawings, but neither ordinance establishes the informational requirements for the as-built drawings, or an approval process. We have found that lack of these items in the Darby-Cobbs ordinance limits the ability of the municipality to force compliance, especially in situations where facilities were clearly not constructed as per approved plan and the project did not involve the issuance of an occupancy permit.

Following are our recommendations in regard to these issues, presented in numerical order relative to the model ordinance section numbering:

- Article II: Add definition for "Municipal Inspector": "The Municipal Engineer or his designee who conducts the inspections and reviews the As-Built Drawings as described in Article V."
- Article V: Change title from "Inspections" to "Inspections and As-Built Drawings".
- Article V: In §501, change all references to "municipal Engineer" and "municipal Engineer or his municipal designee" to "Municipal Inspector".
- Article V: Add subsection D to §501 as follows: "Applicant shall provide the Municipal Inspector with minimum advance notice for all inspections as established from time to time by the municipality's regulations."
- Article V: Add §502 entitled "As-Built Drawings", with the following subsections:
  A. Within 3 months of the completion of construction of the permanent BMPs and/or stormwater management facilities, As-Built Drawings shall be submitted to the Township for review and approval. A note to this effect shall be included on the SWM or Modified SWM Site Plan.
  B. As-Built Drawings shall show the as-built condition of all permanent BMPs and/or stormwater management facilities, as well as structures and impervious surfaces included in the approved SWM or Modified SWM Site Plan, and shall include topographic contours of the same interval as shown on the SWM or Modified SWM Site Plan. Impervious surfaces, as shown on the As-Built Drawings, shall be categorized into Pre-Existing (the impervious surfaces that existed prior to approval of the SWM or Modified SWM Site Plan), As-Approved (the impervious surfaces identified on the approved SWM or Modified SWM Site Plan), and As-Built (impervious surfaces as constructed). For all projects not exempted by §106 and designed in accordance with Appendix B, As-Built Drawings shall be signed and sealed by a Professional Engineer licensed in the Commonwealth of Pennsylvania, and shall be certified (via signed statement on the As-Built Drawings) to be in accordance with actual construction.
  C. The Municipal Inspector shall review the As-Built Drawings for consistency with the approved SWM or Modified SWM Site Plan, as well as actual conditions at the project site. If the Municipal Inspector disapproves the As-Built Drawings, the As-Built Drawings shall be revised and resubmitted until such time as the Municipal Inspector approves the As-Built Drawings. If the Municipal Inspector determines that the as-built condition of constructed BMPs and/or stormwater management facilities is not as per the approved SWM or Modified SWM Site Plan, the Applicant shall make the appropriate site modifications within a time period specified by the Municipal Engineer, and shall revise and resubmit the As-Built Drawings accordingly. Failure of the Applicant to obtain As-Built Plan approval in the manner specified in Section 502 shall subject the Applicant to the Enforcement and Penalties provisions of this Ordinance.
- Article VI: Add subsection G to §602 to cover the As-Built Drawings review process.

<u>Planning Commission Presentation</u> – July 15, 2010

Karen Holm gave a brief presentation on the Act 167 Stormwater Management Plan for the Crum Creek Watershed and the associated stormwater management ordinance that will be provided to all County municipalities for the purpose of compliance with the NPDES II/MS4 stormwater management program.

NPDES II/MS4 Program Refresher

- How the program affects developers (sites over 1 acre) – must be handled on site
- How the program affects municipalities – permit requiring 6 MCMs (program) [handout]
- New 5-year permit effective next March, NOI due in September
- **The NOI will declare what each municipality's program will contain for each of the MCMs; it specifically asks if an Act 167 ordinance or the DEP generic model will be used to satisfy MCM5**

Other SWM Plans

- Ridley 1988, Chester 2002, Darby 2005, none for Brandywine, Namaans, Delaware Direct – municipalities in Ridley use Chester, Crum using Darby, no plan – using either Chester or Darby to satisfy the NPDES II requirement
- **None of the other existing plans/ordinances will meet the requirement for MCM 5 under the new permit, so all of the other municipalities in the County will need to adopt a new stormwater ordinance before March 2011.**
- Since Darby meets the 2005 or later requirement, the ordinance is grandfathered, and municipalities in Darby-Cobbs (only) can continue to use the ordinance..

Major Components of the Plan

- Characterization of the watershed [hold Darby up as example]
- Extensive mapping
- Computer modeling of the stream/stormwater flow through the watershed
- Extensive input from the municipalities and others (WPAC)
- **Model ordinance provides the mechanism for implementation of the plan's recommendations**
- DEP now requires that the ordinance reflect NPDES/MS4 requirements for post construction runoff control
- Act 167 requires municipal adoption of the ordinance within 6 months of DEP approval

The Ordinance

- Articles and (very generally) what they address
    - Article I - General Provisions [bring copies of Table 106.1]
        - Purpose
        - Statutory Authority
        - **Applicability**
        - **Exemptions**
    - Article II – Definitions
    - Article III – Stormwater Management
        - General Requirements
        - Other Requirements (e.g., E&S Control other permits)

        - **Nonstructural Project Design – work around environmentally sensitive features, streams, and soils, first (existing resource and site analysis map,** stream buffers); and try to minimize impervious surfaces
        - Infiltration Requirements
        - **Water Quality Requirements – requires a minimum 50 ft. buffer**
        - Stream Bank Protection
        - **Peak Rate Control**
    - Article IV – Site Plan Requirements
    - Article V – Inspections
    - Article VI – Fees
    - Article VII – Maintenance Responsibilities
    - Article VIII – Prohibitions (nothing but stormwater in storm drains, few exceptions)
- How it compares to the Darby Creek (grandfathered)
    - **Applicability and exemptions significantly more restrictive**
    - Reversed Articles III and IV for clarity
    - Slightly different calculation methodology for infiltration (explain?)
    - **Modification in buffer width requirement [update on new state buffer widths]**
    - **Modification for trails in the buffer**
- Several of the Crum municipalities straddle the Darby/Crum watershed boundary (Newtown, Marple, Springfield, etc.), and rather than two ordinances, will adopt the Crum ordinance municipality-wide (w/watershed specific peak rates)
- Other

Timing and Next Steps

- **The plan is written, but the chapter that discusses the ordinance needs to be revised to reflect recent revisions (per DEP).**
- We plan to quickly edit the plan to clean up any typos or other mistakes, and then make it available for viewing.
- Long story – due to DEP's repeated changes and funding problems in Harrisburg, we have no budget for printing, so we plan to utilize CDs and the County's website as much as we can to reduce the need for paper copies of the plan.
- The adoption procedure requires:
    - We provide the municipalities, DVRPC, and the Planning Commission with an opportunity to comment [**DCPC endorse**]
    - Advertise, make the plan available for public review, and hold a public hearing, and accept comments
    - We are not necessarily required to change the plan, just document the comments
    - Delco County Council/Chesco Commissioners adoption
    - Goes to DEP for approval – effective date of the plan
- **We hope to have a chance to hold a Countywide meeting late summer to offer the Crum ordinance for their use, so that they can indicate they will be adopting it by March – this info needs to be in the NOI due in September.**
- **As such, we're hoping for the Counties to adopt before the end of summer so that we can receive DEP approval ASAP.**
- **We also plan to prepare an "official" plan update to each of the existing plans (just a few pages long) to designate the Crum (with watershed-specific peak**

rates) as the official ordinance under the respective plans, and possibly to assign it to the areas without an Act 167 plan (e.g., Marcus Hook, Trainer, Lower Chi)

Ask for Planning Commission comment/recommendation that County Council approve the plan

PUBLIC HEARING on ACT 167

THURSDAY, AUGUST 11, 2011
DELAWARE COUNTY COUNCIL CHAMBERS
DELAWARE COUNTY BUILDING
SECOND AND ORANGE STREETS
MEDIA, PA 19063

CHAIRPERSON: KAREN HOLM,
DELAWARE COUNTY PLANNING DEPARTMENT

IN ATTENDANCE:

JOHN PICKETT, DIRECTOR,
DELAWARE COUNTY PLANNING DEPARTMENT

JENNIFER KEHLER,
PA DEP

ZACHARY BARNER,
DELAWARE COUNTY PLANNING DEPARTMENT

DENNIS O'NEIL,
MacCOMBIE ENGINEERING

STEPHEN BOONE,
BORTON-LAWSON ENGINEERING

LESLIE TRULUCK,
PATCH

JANET BOWERS,
CHESTER COUNTY WATER RESOURCES
AUTHORITY

CARRIE CONWELL,
CHESTER COUNTY PLANNING COMMISSION

APPEARANCE:
(Second part
Of hearing)

CARL WILLIAM EWALD, ESQUIRE
for SWARTHMORE BOROUGH

(The hearing commenced at 7:00 p.m.)

MRS. HOLM: All right. So we have here the planning team which includes our Delaware County staff, Chester County staff, and our consultant from Borton-Lawson Engineering. We also have John Pickett, Planning Director, in the back. Jennifer Kehler is here from DEP. This is a public hearing to solicit comments from all who are present. Normally, we just take comments. We will have a presentation with Q and A.

We have the plan's history. It was the plan developed under the Stormwater Management Act of 1978. It was a multi-year planning effort. It was overseen by a Watershed Planning Committee, comprised of the planning team, the municipalities, and some other representatives, including the Chester- Ridley-Crum Watersheds Association, AQUA Pennsylvania, and NRCS.

The plan had extensive DEP input. It's gone through a number of revisions, but at the end of the day we had concurrence from all the participants, and what we ended up with was a dual-purpose ordinance that will satisfy both the Act 167 and MS4 Program. We're also hoping to transfer the stormwater ordinance to other municipalities.

The plan contents are pretty basic. This is the

outline of the chapters. There is a description of the watershed, an explanation of the technical analysis and development of the standards and criteria for the control of stormwater. The big product is the model ordinance, which is an appendix.

There are also sections on plan implementation and plan review. The plan basically was designed to address the five main objectives that we had for the stormwater management plan. This is a flow chart of the whole process. It is essentially the five-phase approach; that reflects the objectives.

The model ordinance is highlighted here. It has standard ordinance language, general provisions, and definitions. Article III contains all of the technical provisions, site plan and inspection requirements, and other provisions of the ordinance; it has a lot of the appendices.

The ordinance basically regulates all development involving 500 square feet or more of new or replacement impervious cover. It doesn't exempt smaller development from erosion and sedimentation control. The full ordinance and all of its provisions, kick in at 1,000 square feet of new or replacement impervious cover and over 5,000 square feet of earth disturbance. We also have a simplified approach for 500 to 999 square feet of impervious cover and mom-and-

pop developments. It allows you to cookbook how you control your stormwater.

Some of the highlights in the ordinance include requirements to prepare environmental-resource plans. The ordinance calls for a three-tiered approach to infiltration, which is based on the PA Best Management Practices Manual. What's unique about the ordinance is that instead of recommending a 50-foot buffer and allowing the buffer to be modified, the minimum requirement is fifty feet, but we do have modifications built in there for small lots. We're also permitting installation of paving for a trail within the buffer.

We have the standard peak rate control requirements that are based on the modeling, and an associated rate control map showing us the different areas, A and B, with different requirements for control.

The comment period closes tomorrow. So, if you have any comments, send them to me by then. The planning team will consider the comments and see if we're going to make any changes. Then, the Delaware County Council and Chester County Commissioners will, after we compile our minutes and everything else, adopt the plan by resolution. We'll package it all up and send it DEP for approval. They have ninety days to respond. Hopefully, we will receive

an approval letter, and the municipalities will have six months from the date of the approval letter to adopt the model ordinance.

Does anybody have any questions?

(No response)

MRS. HOLM: No questions? Does anybody have any comments?

(No response)

MRS. HOLM: No comments.

I guess we can wait five, ten, or fifteen minutes, to see if anybody else shows up. They might be coming late or looking for parking. If no one comes, then we'll adjourn.

Now we'll go off the clock until somebody shows up.

(A short break followed.)

MRS. HOLM: Hi. We have a sign-in sheet. We

gave our quick presentation and talked about the plan.

We're at the stage where we have invited people to come and give us any comments on the plan. Now, would you tell us the organization you represent, and then you can give us your comments.

CARL EWALD, ESQUIRE: I was just told to come and pick everything up.

MRS. HOLM: We have nothing to hand out.

Do you have any comments or questions?

MR EWALD: No.

MRS. HOLM: Okay. And you're representing Swarthmore and Media?

MR. EWALD: No, I'm here just for Swarthmore Borough.

MRS. HOLM: Okay. Just as an informational item to recap while you're here, what we're going to do after this hearing is package up the notes from the hearing, any comments we've received. Then, Delaware County Council and the Chester County Commissioners will each sign a Resolution adopting the plan. We'll bind that in with all of the comments and ship it off to DEP and wait 90 days and hopefully have the approval letter. And, within six months of the date of that approval letter, each municipality will be required to adopt the ordinance and put it in place.

When a municipality straddles two watersheds, as an example with the Crum and Ridley Creek, what they're going to do administratively is just adopt that ordinance municipality-wide.

And the ordinance will comply with the upcoming MS4 permit requirement for the post-construction stormwater control. So, that's pretty much it.

Swarthmore is entirely in the Crum Creek watershed. The municipalities are welcome to adopt something more stringent or add additional provisions if they feel they need to do that. This is pretty much a one-stop shopping ordinance.

MR. EWALD: Okay.

MRS. HOLM: But we'll be giving the ordinance to everybody. What we've done in the past with the ordinance is ask municipalities to fill in their name or select the buffer width, now a minimum of 50 ft.

It's pretty easy, and the engineer could sit down with any other borough officials and say do we want to go here or do we want to put something else in?

MRS. JENNIFER KEHLER: Is the proposed ordinance online for us to access?

MRS. HOLM: Right now the plan, including the

ordinance, is on the County's website. And when we receive our approval, what I'm going to do is convene a meeting just to instruct everybody in how to personalize the ordinance. It's really straight forward. It goes quickly. That's it. That was my presentation.

MR. EWALD: Okay.

MRS. HOLM: So you didn't miss anything. If nobody walks in the door, we're ready to pack up.

I don't expect anybody else.

MRS. KEHLER: I would think they would be here by now.

MRS. HOLM: I guess we'll close it up. So long. Thank you, everybody, for coming out.

(The meeting adjourned at 7:24 p.m.)

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