

Post Construction Stormwater Management Model Ordinance

Chester County Water Resources Authority

601 Westtown Road, Suite 260

P.O. Box 2747

West Chester, PA 19380-0990

610-344-5400

www.chesco.org/water

January 4, 2005

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Acknowledgements

The Chester County Water Resources Authority (CCWRA) greatly appreciates the extensive efforts and contributions provided by the members of the Chester County Water Resources Task Force in the development of this Model Ordinance. CCWRA is also grateful to Gaadt Perspectives, LLC, Chester County Planning Commission, and Chester County Conservation District for their assistance with this effort. Funding for this effort was provided by the Chester County Board of Commissioners.

POST CONSTRUCTION STORMWATER MANAGEMENT MODEL ORDINANCE

This Model Ordinance was prepared to demonstrate how the goals and objectives outlined for stormwater management in *Watersheds: An Integrated Water Resources Plan for Chester County, Pennsylvania and Its Watersheds* can be implemented through municipal ordinances. This Model Ordinance is provided as a courtesy of Chester County Water Resources Authority for voluntary consideration by municipal governments.

The Model Ordinance presents a comprehensive compilation of components necessary for effective stormwater management, and it reflects a moderate level of restrictions in its numeric standards. The components included are based on technically sound principles and represent the best and most responsive balance of inputs received from a wide range of technical resources and stakeholders. Municipalities who choose to use this Model Ordinance are encouraged to thoroughly review and, where desired, modify this ordinance to meet their local stormwater management needs and municipal interests. However, the Model Ordinance presents a holistic approach with numerous inter-related components that should be implemented collectively through the integrated design process outlined in the ordinance. Therefore, adopting only portions of this ordinance may undermine its principles and design practices and result in ineffective stormwater management. Other example and model ordinances are available to municipalities from other sources. This Model Ordinance can be used by municipalities as a basis to achieve effective and consistent stormwater management throughout Chester County and its watersheds.

Stormwater management is rapidly evolving. Advancements in the understanding of how precipitation, stormwater, nature, and the constructed environment inter-act as well as new design techniques continue to emerge. The Pennsylvania Department of Environmental Protection (PADEP) is well underway with the development of a statewide stormwater management design manual that is anticipated to be published in late 2005. During development of this new manual further improvements in design and regulatory approaches are being identified that can be taken into account in local ordinances after the manual is completed. This Model Ordinance reflects a compilation of existing techniques and approaches, and will be re-visited upon completion of the state's new stormwater manual.

The ultimate purpose of this comprehensive approach to stormwater management is to accommodate planned growth in a manner that protects public safety and public infrastructure, reduces erosion of private properties and stream channels, minimizes flooding, maintains ground water recharge and stream baseflows, and protects surface water and ground water quality. For these reasons, this ordinance focuses on reducing the volume of stormwater runoff. The ordinance also emphasizes infiltration and water quality design approaches that are preferable to the more traditional stormwater management practices (i.e., pipe and basin approach).

The stormwater management standards presented here are best used in conjunction with land use regulations that promote "conservation design principles". These principles (such as techniques for conserving natural resources, maintaining and/or restoring natural drainage patterns, minimizing grading and disturbance, and minimizing the extent of impervious cover) help reduce the volume of stormwater runoff and therefore help reduce the size of structural stormwater facilities. Additional information on "conservation design principles" is contained in the Chester County, Pennsylvania Water Resources Compendium (CCWRA, 2001).

PADEP has indicated that this Model Ordinance meets their Municipal Separate Storm Sewer System (MS4) National Pollution Discharge Elimination System (NPDES) Phase II post-construction stormwater management ordinance requirements. The Commonwealth of Pennsylvania has established regulations and guidance that also require other municipal stormwater management activities. Municipalities are encouraged to become thoroughly familiar with all requirements established under their MS4 NPDES Phase II permits prior to adopting any new or revised ordinances.

The Model Ordinance was also developed to help municipalities where PA Stormwater Management Act (Act 167) stormwater management plans have not been completed. This Model Ordinance addresses the components of stormwater management typically included in ordinances completed under Act 167, with the exception of regional release rates for stormwater detention basins which must be calculated based on watershed-wide computer modeling. This Model Ordinance should not be used to replace any existing ordinance adopted through an Act 167 Stormwater Management Plan process.

The components of this Model Ordinance are individually and collectively focused on reducing the volume of stormwater runoff and pollutant loadings from newly developed and redeveloped sites. This is accomplished by requirements to (among others): reduce the magnitude and extent of impervious cover and site disturbance; capture and remove from runoff a sufficient volume of stormwater to protect stream channels and reduce flooding; establish a minimum volume of infiltration to protect ground water recharge; manage the peak rate of stormwater runoff to reduce flooding and erosion of stream channels; remove pollutants from runoff prior to the release of stormwater to streams; and ensuring effective operation and maintenance of all stormwater facilities.

Municipalities should consider adopting separate soil erosion and sediment pollution control standards that specifically address issues of site disturbance, as these are not included within the Model Ordinance. Each municipality will also need to add complementary and/or additional language (with appropriate cross-references) to completely describe the municipality's design standards for collection and conveyance components of stormwater management systems, which may already be adopted and in practice. Municipalities may also consider adding specific design standards for other best management practices (BMPs) in addition to those that are included in this Model Ordinance. The Pennsylvania Handbook of Best Management Practices for Developing Areas (PACD, 1998) (latest edition or the PA stormwater management design manual when published), or the 2000 Maryland Stormwater Design Manual (MDE, 2000), among others, can be referenced for guidance and design methodology for additional BMPs. Corresponding standards for maintenance, applicability, and enforcement, etc. should also be included for any BMPs added to the ordinance.

For municipalities with existing stormwater ordinances, this Model Ordinance can be used as a reference or framework for revising or rewriting the existing ordinance, or (with appropriate modifications) as a replacement ordinance. When used for the latter option, it is recommended that this Model Ordinance be adopted as a separate (stand alone) component of a municipal code (with appropriate cross-referencing to zoning and subdivision ordinances).

Please direct any questions regarding the Model Ordinance to the Chester County Water Resources Authority, 601 Westtown Road, Suite 260, P.O. Box 2747, West Chester, PA 19380-0990 (610-344-5400). The Model Ordinance is available in electronic format at www.chesco.org/water/.

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POST CONSTRUCTION STORMWATER MANAGEMENT

Section 1.0 PURPOSE

In order to protect the health, safety, and general welfare of the residents of [*municipality*], as well as to protect, sustain, and enhance the surface and ground water resources of [*municipality*], drainage and stormwater management practices shall be utilized as directed herein to achieve the following objectives:

- 1.1 Accommodate site development and redevelopment in a manner that protects public safety and that is consistent with (or re-establishes) the natural hydrologic characteristics of each watershed (refer to Appendix A for watershed delineations) and sustains ground water recharge, stream baseflows, stable stream channel (geomorphology) conditions, the carrying capacity of streams and their floodplains, ground water and surface water quality, and aquatic living resources and their habitats.
- 1.2 Reduce and minimize the volume of stormwater generated.
- 1.3 Protect natural infiltration and ground water recharge rates in order to sustain ground water supplies and stream baseflows.
- 1.4 Maintain runoff characteristics of the site after completion of development that are consistent with the carrying capacity and stable channel conditions of the receiving streams.
- 1.5 Protect water quality by removing and/or treating pollutants prior to discharge to ground and surface waters throughout [*municipality*], and to protect, restore, and maintain the chemical, physical, and biological quality of ground and surface waters.
- 1.6 Protect instream channels and geomorphology conditions of the receiving streams; protect their flood carrying capacity and aquatic habitats and to reduce instream erosion and sedimentation.
- 1.7 Reduce flooding impacts and prevent a significant increase in surface runoff rates and volumes, predevelopment to post-development, which could worsen flooding downstream in the watershed, (refer to Appendix A for watershed delineations) enlarge floodplains, erode stream banks and create other flood-related health-welfare-property losses; in general, to preserve and restore the natural flood-carrying capacity of streams and their floodplains.
- 1.8 Protect adjacent lands from adverse impacts of direct stormwater discharges.
- 1.9 Ensure effective long-term operation and maintenance of all permanent stormwater management facilities.
- 1.10 Maintain natural drainage patterns and encourage the use of natural drainage systems.
- 1.11 Treat and release stormwater as close to the source of runoff as possible using a minimum of structures and maximizing reliance on natural processes.
- 1.12 Maintain the existing water balance in all watersheds, subwatersheds, and streams in [*municipality*], and protect and/or restore natural hydrologic characteristics and habitats wherever possible throughout the watershed systems. (Refer to Appendix A for watershed delineations.)

- 1.13 Address certain requirements of the Municipal Separate Storm Sewer System (MS4) National Pollution Discharge Elimination System (NPDES) Phase II Stormwater Regulations.
- 1.14 Reduce the impacts of runoff from existing developed sites undergoing redevelopment while encouraging development and redevelopment in urban areas and areas designated for growth.
- 1.15 Meet legal water quality requirements under state law, including regulations at 25 Pa. Code Chapter 93.4a to protect and maintain “existing uses” and maintain the level of water quality to support those uses in all streams, and to protect and maintain water quality in “special protection” streams.

Note: Purpose statement 1.15 applies to MS4 municipalities; other municipalities should consult with their solicitor for applicability.

Section 2.0 GENERAL PROVISIONS

2.1 Statutory Authority

Note: The applicable statutory authority in any given jurisdiction may vary. Municipalities should consult with their attorney or solicitor and edit or amend Section 2.1 Statutory Authority as deemed appropriate.

[Municipality] is empowered to regulate land use activities that affect stormwater runoff by the authority of the Pennsylvania Municipalities Planning Code, Act 247, as amended, and Pennsylvania’s Stormwater Management Act, Act 167, as amended. [Municipality] as a Municipal Separate Storm Sewer System under Phase II of the National Pollution Discharge Elimination System (NPDES) Storm Water Program of the Environmental Protection Agency (EPA) is empowered to regulate stormwater by the authority of the Clean Streams Law, 35 P.S. §691.1, et seq. and The Clean Water Act, 33 U.S.C. §1251, et seq.

Note: Only municipalities regulated under the PA NPDES Phase II stormwater regulations should include the references to NPDES related statutes.

2.2 Applicability

The standards contained herein shall apply to all areas within [municipality]. These standards shall only apply to permanent stormwater management facilities. Stormwater management and erosion and sedimentation control during construction activities are specifically not regulated by this Ordinance.

Note: municipalities should have separate ordinances for erosion and sedimentation pollution control.

Local stormwater management design criteria (e.g., inlet spacing, inlet type, collection system design and details, outlet structure design, culvert design and capacity, material specifications etc.) shall continue to be regulated by the applicable Municipal Ordinances.

Note: municipalities should review their current ordinances for stormwater related standards and cross-reference or incorporate those that still apply into this model.

2.2.1 The following activities shall be regulated by this Ordinance for land disturbances of greater than five thousand (5,000) square feet except as otherwise provided per Section 2.3 of this ordinance:

- A. Land development and redevelopment.
- B. Subdivision.
- C. Construction of new or additional impervious or semi-pervious surfaces (driveways, parking lots, etc.).
- D. Construction of new buildings or additions to existing buildings.
- E. Diversion or piping of any natural or man-made stream channel.
- F. Installation of stormwater management facilities or appurtenances thereto.

2.3 Exemptions

2.3.1 With the approval of [*municipal governing body*], the following activities may be exempted from on-site stormwater runoff control. An exemption shall apply only to the requirement for on-site stormwater facilities and the preparation of a Stormwater Management Plan. All other stormwater management design elements, such as a storm sewer system, road culverts, erosion and sedimentation control, and runoff quality, shall be required. All exemption requests must be filed with the [*municipal*] zoning officer.

- A. 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.
- B. Maintenance Exemption. Any maintenance to an existing stormwater management system made in accordance with plans and specifications approved by the municipal engineer or [*municipality*].
- C. Gardening. Use of land for gardening for home consumption.
- D. Agricultural Activities. Agriculture when operated in accordance with a conservation plan, nutrient management plan or erosion and sedimentation control plan approved by the Chester County Conservation District, including activities such as growing crops, rotating crops, tilling of soil and grazing animals. 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 greater than one thousand (1,000) square feet shall be subject to the provisions of this ordinance.

- E. Forest Management. Forest management operations, which are consistent with a sound forest management plan as filed with the [*municipal*] zoning officer and which follow the Pennsylvania Department of Environmental Protection's management practices contained in its publication "Soil Erosion and Sedimentation Control Guidelines for Forestry." Such operations are required to have an erosion and sedimentation control plan.

- F. Improvement-related Exemption. Stormwater management facilities will not be required for any net increase of impervious surface of less than one thousand (1,000) square feet where the cumulative total square feet of all impervious surfaces does not exceed the impervious surface standards of the applicable zoning district. However, where the net increase in impervious surface exceeds one thousand (1,000) square feet but the total disturbed area is less than five thousand (5,000) square feet pursuant to a soil erosion and sediment pollution control plan and/or a grading plan, the Applicant shall demonstrate compliance with Section 1.2, 1.8 and 1.10 of this ordinance to the municipal engineer for the increased impervious surface.

Note: The municipality may want to consider including a provision for waivers specifically within the post construction stormwater ordinance. If so, the municipality should consider using the model language presented below as Section 2.3.2 "Waivers". Section 2.3.2 is intended to provide a procedure to achieve the purposes, goals and principles of this ordinance while providing reasonable flexibility for difficult site conditions and innovative site design approaches. The standards within this Ordinance are essential and should be strictly adhered to. Requests for waivers or modifications of these standards should be granted only where the requirement of strict adherence would be unreasonable, cause undue hardship, or an alternative standard can be demonstrated to provide equal or better results. The intent of this provision is to provide a procedure for a waiver that takes into consideration the importance of the purposes, goals, and principles of this ordinance, the importance of comprehensive stormwater management, and the comments of the Chester County Conservation District. If this section is to be incorporated into the ordinance, it should undergo a thorough legal review.

2.3.2 Waivers

- A. The provisions of this Ordinance are the minimum standards for the protection of the public welfare.*
- B. If an Applicant demonstrates to the satisfaction of the Board of Supervisors that any mandatory provision of this Ordinance is unreasonable or causes unique or undue unreasonableness or hardship as it applies to the proposed Project, or that an alternate design may result in a superior result within the context of Section 1.0, 4.1.1 and 4.1.2 of this Ordinance, the Board of Supervisors upon obtaining the comments and recommendations of the Township Engineer and Chester County Conservation District may grant a waiver or relief so that substantial justice may be done and the public interest is secured; provided that such waiver will not have the effect of nullifying the intent and purpose of this Ordinance.*
- C. The Applicant shall submit all requests for waivers in writing and shall include such requests as a part of the Application for Development, or during the plan review and approval process. The Applicant shall state in full the facts of unreasonableness or hardship on which the request is based, the provision or provisions of the Ordinance that are involved, and the minimum waiver or relief that is necessary. The Applicant shall state how the requested waiver and how the Applicant's proposal shall result in an equal or better means of complying with the intent of Section 1.0 "Purpose", 4.1.1 "Design Goals" and 4.1.2 "General Principles" of this Ordinance.*
- D. The Applicant shall submit all waiver requests to the Chester County Conservation District for review and comment. The Applicant shall allow at least 30 days for the Chester County Conservation District review prior to submission of the waiver request to the Board of Supervisors. The Applicant shall submit the Chester County Conservation District comments to the Board of Supervisors prior to the Board of Supervisors decision on the waiver request.*
- E. The Board of Supervisors shall keep a written record of all actions on waiver requests.*

- F. *The Board of Supervisors may charge a fee for each waiver request, which shall be used to offset the administrative costs of reviewing the waiver request. The applicant shall also agree to reimburse the Township for reasonable and necessary fees that may be incurred by the Township Engineer in any review of a waiver request.*

- G. *In granting waivers, the Board of Supervisors may impose reasonable conditions as will, in its judgment, secure substantially the objectives of the standards or requirements that are to be modified.*

- H. *The Board of Supervisors may grant applications for waivers when the following findings are made, as relevant:*
 - 1. *That the waiver shall result in an equal or better means of complying with the intent of Section 1.0, 4.1.1 and 4.1.2 of this Ordinance.*
 - 2. *That the waiver is the minimum necessary to provide relief.*
 - 3. *That the applicant is not requesting a waiver based on cost considerations.*
 - 4. *That existing off-site stormwater problems will not be exacerbated.*
 - 5. *That runoff is not being diverted to a different drainage area.*
 - 6. *That increased flooding or ponding on off-site properties or roadways will not occur.*
 - 7. *That potential icing conditions will not occur.*
 - 8. *That increase of peak flow or volume from the site will not occur.*
 - 9. *That erosive conditions due to increased peak flows or volume will not occur.*
 - 10. *That adverse impact to water quality will not result.*
 - 11. *That increased 100-Year Floodplain levels will not result.*
 - 12. *That increased or unusual municipal maintenance expenses will not result from the waiver.*
 - 13. *That the amount of stormwater generated has been minimized to the greatest extent allowed.*
 - 14. *That infiltration of runoff throughout the proposed site has been provided where practicable and pre-development ground water recharge protected at a minimum.*
 - 15. *That peak flow attenuation of runoff has been provided.*
 - 16. *That long term operation and maintenance activities are established.*
 - 17. *That the receiving streams and/or water bodies will not be adversely impacted in flood carrying capacity, aquatic habitat, channel stability and erosion and sedimentation.*

2.4 General Requirements

- 2.4.1 The management of stormwater on site, both during and upon completion of the disturbances associated with activities permitted under Section 2.2.1, shall be accomplished in accordance with the standards and criteria of this Ordinance. The design of any temporary or permanent facilities and structures and the utilization of any natural drainage systems shall be in full compliance with this article.

The intent of these design standards is to encourage environmentally sound stormwater management practices that provide necessary drainage facilities while protecting the

hydrologic characteristics and water quality of the site and watershed. Developments shall be required to incorporate infiltration and stormwater management controls. Stormwater management design shall blend into the natural environment and be aesthetically integrated into the site design.

- 2.4.2 Applicants shall refer to the Pennsylvania Handbook of Best Management Practices for Developing Areas (PACD, 1998), (latest edition or the PA stormwater management design manual when published), the 2000 Maryland Stormwater Design Manual (MDE, 2000) or other appropriate references for guidance in the design of stormwater management facilities most appropriate to individual site conditions. Objectives for design are to reduce the volume of stormwater generated, infiltrate runoff at its source to the maximum extent possible, achieve water quality improvement at the source or during conveyance, and provide for peak flow attenuation. Applicants shall examine design alternatives by viewing them in a series. In addition, Applicants are strongly encouraged to use structural and nonstructural stormwater management practices that reduce or eliminate the need for detention basins.
- 2.4.3 All development activity within a Special Flood Hazard Area designated by the Federal Emergency Management Agency (FEMA) shall comply with Chapter [reference applicable local ordinance] of the Zoning Ordinance [i.e., local floodplain ordinance] and this paragraph. All development shall be designed to maintain the flood carrying capacity of the floodway such that the base flood elevations are not increased, either upstream or downstream. The natural conveyance characteristics of the site and the receiving floodplain shall be incorporated into the stormwater management practices proposed for the site.
- 2.4.4 The stormwater management system shall not create an adverse impact on stormwater quantity or quality in either upstream or downstream areas. Offsite areas which discharge to or across a site proposed for development shall be addressed in the stormwater management plan prepared for the development. No stormwater management plan shall be approved until it is demonstrated that the runoff from the project shall not adversely impact downstream areas.
- 2.4.5 Wetlands shall not be used to meet the minimum design requirements for stormwater management or stormwater runoff quality treatment, except when used as part of a treatment train that incorporates a portion of the outer zone (filter strip) of the wetland's riparian buffer as a stormwater outfall (Refer to Section 4.1.3.A.9).
- 2.4.6 All proposed stormwater management systems shall be designed to prevent the pollution of ground water resources by stormwater, promote safety, minimize health hazards, preserve natural features and provide infiltration and ground water recharge where appropriate. Neither submission of a plan under the provision herein nor compliance with the provisions of these Regulations shall relieve any person from responsibility for damage to any person or property otherwise imposed by law.
- 2.4.7 Where deemed necessary by the municipal engineer, or as addressed in an approved Act 167 stormwater management plan, the Applicant shall construct storm drains to handle on-site runoff; to the maximum extent permitted under the Municipalities Planning Code and Act 167, or any amendments thereto, provide on-site/off-site drainage easements; and

provide for the conveyance of off-site runoff to an acceptable outlet in the same watershed.

- 2.4.8 Where watercourses traverse a development site, drainage easements shall be provided conforming to the line of such watercourses. The terms of the easements shall prohibit excavation, the placing of fill or structures, any alterations that may adversely affect the flow of stormwater within any portions of the easement, and require the establishment and protection of riparian buffers.
- 2.4.9 Any stormwater management facilities regulated by this Ordinance that would be located in or adjacent to Waters of the Commonwealth or wetlands shall be subject to approval by the PADEP through the Joint Permit Application process, or the General Permit Process, as required by PADEP regulations. When there is a question whether wetlands may be involved, it is the responsibility of the Applicant or his agent to demonstrate that the land in question is not classified as wetlands. Otherwise approval to work in the area shall be obtained from PADEP as determined through the jurisdictional determination process.
- 2.4.10 Any stormwater management facility or part thereof regulated by this Ordinance that will be located in State highway rights-of-way shall be subject to approval by the Pennsylvania Department of Transportation (Penn DOT).
- 2.4.11 At the time of application for a building permit for any approved lot created by a subdivision and/or improved as a land development project, issuance of the permit shall be conditioned upon adherence to the terms of this Ordinance.
- 2.4.12 Stormwater discharges to critical areas with sensitive resources (e.g., special protection waters, cold water fisheries, recharge areas, water supply reservoirs, etc.) may be subject to additional performance criteria or may need to utilize or restrict certain stormwater management practices.

2.5 Repealer

Any Ordinance or Ordinance provision of the [*municipality*] inconsistent with any of the provisions of this Ordinance is hereby repealed to the extent of the inconsistency only; provided, however, that this repeal shall in no manner be construed as a waiver, release or relinquishment of the right to initiate, pursue or prosecute, as the case may be, any proceeding at law or in equity pertaining to any act done which would have constituted a violation of such prior ordinance or ordinance provision. All of said ordinance or ordinance provisions shall remain in full force and effect and are not repealed hereby as they pertain to such acts and to the processing of such plans filed prior to the effective date of this ordinance, which are protected from the effect of intervening ordinances by Section 508(4) of the Pennsylvania Municipalities Planning Code.

2.6 Severability

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

2.7 Compatibility with Other Ordinance Requirements

Permits and approvals issued pursuant to this Ordinance shall not relieve the Applicant of the responsibility to comply with or to secure other required permits or approvals for activities regulated by any other applicable code, rule, act, statute or ordinance. This Ordinance shall not preclude the inclusion in such other permit of more stringent requirements concerning regulation of stormwater and erosion. Where a conflict exists between a provision within this ordinance and that of the PADEP Phase II NPDES regulations, as amended, the PADEP requirements shall govern.

2.8 Enforcement and Penalties

The standards contained herein shall be administered, enforced and penalties ascribed pursuant to the [*municipal*] Zoning Ordinance or Subdivision and Land Development Ordinance.

Section 3.0 STORMWATER MANAGEMENT PLAN

For all activities regulated by this Ordinance in accordance with Section 2.2.1, the Applicant shall submit a stormwater management plan and report prepared by a Professional Engineer licensed in the Commonwealth of Pennsylvania, which shall contain, but not be limited to, the following:

- 3.1 A suitable map of the watershed for any and all named streams within which the project is proposed (a United States Geological Survey quadrangle map is usually sufficient) with existing and proposed development areas presented on the map.
- 3.2 Suitable maps and drawings showing all existing natural and constructed drainage facilities affecting the subject property.
- 3.3 Hydrologic (watershed) and water feature boundaries, including all areas flowing to the proposed project, existing streams (including first order and intermittent streams), springs, lakes, ponds, or other bodies of water within the project area.
- 3.4 Sufficient topographical information with elevations to verify the location of all ridges, streams, etc. (two-foot contour intervals within the project's boundaries and for proposed offsite improvements; for slopes greater than fifteen percent (15%), five (5)-foot contours are acceptable).
- 3.5 Notes pertaining to and locations of existing standing water, areas of heavy seepage, springs, wetlands, streams, and hydrologically sensitive areas.
- 3.6 General type of soils with Hydrologic Soil Group noted, estimated permeabilities in inches per hour, and location and results of all soil tests and borings.
- 3.7 100-year flood elevations for any Special Flood Hazard Areas on or within one hundred (100) feet of the property. For redevelopment sites, also show the ten (10) and twenty-five (25)-year flood elevations for any Special Flood Hazard Areas on or within one hundred (100) feet of the property. The source of these elevations shall also be shown on the plans.

- 3.8 Description of current and proposed ground cover and land use. The total area and percent impervious cover shall be noted.
- 3.9 A plan of the proposed stormwater drainage system attributable to the activity proposed, including runoff calculations, stormwater management practices to be applied both during and after development, and the expected project time schedule.
- 3.10 The design computations for all proposed stormwater drainage systems, including storm-drain pipes, inlets, runoff control measures and culverts, drainage channels, and other features, facilities, and stormwater management practices.
- 3.11 A grading plan, including all areas of disturbance, of the subject activity. The total area of disturbance shall be noted in square feet and acres.
- 3.12 A plan of the erosion and sedimentation procedures to be utilized as required under Section [*insert applicable municipal code section on sedimentation and erosion control*].
- 3.13 A delineation of the pathways of all concentrated flow (that is, flow other than overland sheet flow).
- 3.14 The effect of the project (in terms of runoff volumes and peak flows) on adjacent properties and on any other stormwater collection system that may receive runoff from the project site and specifics of how erosion and flooding impacts to adjacent properties will be avoided or otherwise mitigated.
- 3.15 An operation and maintenance plan consistent with the requirements of Section 5.0. Such a plan should clearly explain how the proposed facilities operate and the functions they serve.
- 3.16 The name of the development, the name and address of the property owner and Applicant, and the name and address of the individual or firm preparing the plan.
- 3.17 A north arrow, submission date, scale and revision dates as applicable shall be included on each page of all plans submitted.
- 3.18 Complete delineation of the flow paths used for calculating the time of concentration for the pre-developed and post-developed conditions.
- 3.19 Construction details sufficient to completely express the intended stormwater design components consistent with this ordinance.

Section 4.0 PERMANENT STORMWATER MANAGEMENT DESIGN STANDARDS

4.1 Design Goals, Principles and Standards

4.1.1 Design Goals

Applicants shall adhere to a holistic design process incorporating the goals listed below. The objective is to achieve post-development hydrologic conditions that are consistent with the predevelopment ground cover assumption for new development (refer to Section 4.2.2) and improve the runoff conditions for redevelopment (refer to Section 4.1.3.C). The design goals are:

- A. Minimize the volume of runoff that must be collected, conveyed, treated and released by stormwater management facilities;

Note: Minimization of runoff generated by a proposed site is directly related to the various land use and design standards for site improvements required under the municipal zoning, and subdivision and land development ordinances. The affect that these requirements have on generating stormwater should be taken into consideration. Site design should implement runoff reduction techniques such as those described in Appendix B.

- B. Maintain the natural infiltration process and rate, and infiltrate runoff at its source;
- C. Remove and/or treat pollutants at the source or during conveyance;
- D. Provide for peak flow attenuation, as needed; and
- E. Attenuate runoff to protect the instream channel of the receiving stream.

4.1.2 General Principles

The following general principles apply to all applicable activities pursuant to Section 2.2.1:

- A. Incorporate Conservation Design practices to minimize the amount of stormwater generated on a site, encourage the disconnection of impervious land cover, and maximize the use of pervious areas for stormwater treatment and on-site rainfall infiltration.

Note: Design standards in other sections of the municipal subdivision and land development ordinance should be evaluated for their impact on generating stormwater runoff. For example, standards for parking stall sizes, quantity of parking, roadway widths, yard and bulk area requirements for each zoning district can inadvertently work against the minimization of stormwater generated. Also, pervious areas such as recreation fields may be available for the installation of stormwater facilities thereby maximizing the use of pervious areas. A brief description of suggested site design practices is provided in Appendix B.

- B. Infiltration of surface water runoff at its source is to be the primary mechanism for stormwater management based on soil infiltration testing. Infiltration practices include, but are not limited to those referenced in Section 4.3.2.A and as outlined in the publications listed in Section 4.3. Infiltration practices shall adhere to the following criteria:
 - 1. In choosing methods of infiltration, preference shall be given to a combination of surface and subsurface infiltration methods.

2. Applicants shall first consider minimum disturbance/minimum maintenance techniques combined with site grading that distributes runoff to reduce concentration. Next, Applicants shall consider depression areas combined with subsurface infiltration practices, followed by other subsurface measures, including but not limited to porous paving and perforated pipe storage.
3. The use of multiple infiltration features and facilities that provide for the following is encouraged:
 - a. Discourage concentration of flows,
 - b. Encourage disconnection of flows,
 - c. Infiltrate as close to the source of runoff as possible, and
 - d. Reduce visual impact.

Note: An example of promoting the concepts listed in 4.1.2.B.3 is choosing a design method to address runoff collected from rooftops and conveyed to the surface by downspouts. The “disconnection of flows” can be accomplished by directing the downspouts over pervious surfaces rather than impervious surfaces. This can be taken one step further by directing the downspouts in to infiltration facilities close to the source of the runoff. This promotes the idea of infiltrating as close to the source of runoff as possible and discourages the concentration of flows.

4. Where high water tables, subsurface contamination, or other site constraints preclude achieving the required infiltration volume, additional Conservation Design practices and alternative stormwater management practices should be implemented to reduce to the maximum extent practicable the total volume of stormwater released to streams. Applicant shall follow the stormwater runoff hierarchy of Section 4.3.1.A.
 5. Infiltration areas should be designed to maintain any broad and even infiltration pattern, which existed prior to development. Such facilities should use the natural topography and vegetation in order to blend in with the site. Infiltration designs, which do not provide this may be used if the Applicant demonstrates to the [municipality's] satisfaction that alternative approaches would be more effective, more harmonious with their existing environment and as easily maintained.
 6. Aboveground stormwater infiltration facilities should be as shallow as possible while still achieving the requirements of this ordinance.
- C. Water quality improvement shall be achieved in conjunction with or as part of infiltration practices. Water quality improvements shall also be provided for drainage areas not otherwise addressed by infiltration practices either at the source of runoff and/or during conveyance away from the source of runoff.
- D. To reduce the need for large retention and/or detention basins designed to satisfy the peak flow attenuation requirements, other innovative stormwater management practices located close to the source of runoff generation shall be considered, including a combination of practices (e.g., rooftop storage, open

vegetated channels, bioretention and infiltration trenches). Where basins are necessary, retention basins shall be considered first, then detention basins.

- E. When designing the stormwater management facility(ies) to satisfy the peak flow attenuation requirement (refer to Section 4.1.3.B.2), the effect of structural and non-structural stormwater management practices implemented as part of the overall site design may be taken into consideration when calculating total storage volume and release rates.
- F. Site hydrology and natural infiltration patterns shall guide site design, construction and vegetation decisions. All channels, drainage ways, swales, natural streams and other surface water concentrations shall be maintained and incorporated into design decisions unless changes can be justified to enhance natural runoff and/or infiltration patterns or reduce health/safety issues on the basis of other design objectives of this Ordinance.
- G. Stormwater management facilities that provide for reduction in volume of runoff are encouraged and may be taken into account in meeting the standards of this ordinance.

4.1.3 Minimum Performance Standards

- A. The following minimum performance standards shall apply to all applicable activities, **whether they are new development or redevelopment**, pursuant to Section 2.2.1.
 - 1. Structural and non-structural stormwater management practices that provide, promote or otherwise make best possible use of infiltration on-site shall be considered first and foremost in all site designs.
 - 2. Infiltration into areas underlain by karst and/or carbonate geology is encouraged but only where the design, supporting calculations, and soils investigations are provided which determine that the potential or likelihood of subsidence or sinkholes is minimal (refer to Section 4.3.2.L). Concentrated flows and points of discharge are discouraged in limestone areas; measures should be taken to convert such flows to uniform, shallow sheet flow. Appropriate on-site testing and evaluation should support any design of infiltration practices in carbonate geology. Relevant guidance and practices are discussed in Technical Best Management Practice Manual & Feasibility Report: Infiltration of Stormwater in Areas Underlain by Carbonate Bedrock within the Little Lehigh Creek Watershed (LVPC, 2002). Although this document specifically addresses carbonate rock conditions of the Lehigh Valley, site evaluation design guidance can be applied in Chester County.
 - 3. Water quality treatment of stormwater runoff shall be provided for all discharges prior to release to a receiving water body. If a stormwater management practice does not provide water quality treatment, then water quality best management practices shall be utilized prior to the runoff entering the stormwater management practice.

4. Water quality management shall be provided through the use of structural and/or non-structural stormwater management practices. Water quality stormwater management practices shall be designed to reduce or eliminate solids, sediment, nutrients, and other potential pollutants from the site. It is presumed that a stormwater management practice complies with this requirement if it is:
 - a. Sized to capture the prescribed water quality volume (per section 4.3.1.B);
 - b. Designed according to the specific performance criteria outlined in the Pennsylvania Handbook of Best Management Practices for Developing Areas (PACD, 1998) (latest edition or the PA stormwater management design manual when published), or the 2000 Maryland Stormwater Design Manual (MDE, 2000), or other handbooks or manuals approved by the municipality;
 - c. Constructed in accordance with all permits and approved plans and specifications; and
 - d. Maintained per an approved operation and maintenance plan or agreement or, in lieu of that, in accordance with customary practices.
5. Stormwater discharges from land uses or activities with higher potential for pollutant loadings (hotspots) may require the use of specific structural stormwater management practices and pollution prevention practices. In addition, stormwater from a hotspot land use shall be provided with proper pretreatment prior to infiltration. For the purpose of this ordinance, the sites/facilities listed in Section 4.1.3.A.6 below, are considered hotspots.
6. Certain industrial sites may be required to prepare and implement a stormwater pollution prevention plan and file notice of intent as required under the provision of the EPA Industrial Stormwater NPDES Permit Requirements. Other industrial sites storing significant quantities of chemicals/wastes should also prepare a prevention plan. Sites that are required by EPA to prepare a plan include, but are not limited to:
 - a. Vehicle salvage yards and recycling facilities;
 - b. Vehicle and equipment cleaning facilities;
 - c. Fleet storage areas for buses, trucks etc.;
 - d. Marinas (service and maintenance);
 - e. Facilities that generate or store hazardous materials.

Note: Municipalities may add more quantifiable standards regarding the meaning of "significant quantities of chemicals/waste." For example, the 2000 International Building Code table 307.7(1) gives maximum allowable chemicals regarding hazardous materials posing a physical hazard. The PADEP spill prevention control program may also provide guidance. Additional categories of land use could be added to this list as warranted.

7. Conveyance structures/channels shall be designed and adequately sized so as to protect the properties receiving runoff from impacts of flooding and erosion. Where necessary, and to the maximum extent permitted under the Municipalities Planning Code and Act 167, or any amendments thereto drainage easement from adjoining properties shall be obtained to ensure the drainage way and the property and shall also establish the operation and maintenance requirements for the drainage way.
8. All stormwater management practices shall have an Operation and Maintenance Plan pursuant to Section 5.3 of this Ordinance and an enforceable Operation and Maintenance Agreement per Section 5.4 of this Ordinance to ensure the system functions as designed and to provide remedies for system failure.

Note: This model ordinance includes a sample operation and maintenance agreement document (refer to Appendix C). Municipalities should consult with their legal counsel on contents of any agreement prepared for operation and maintenance of stormwater management facilities. The PADEP document titled Guidance on MS4 Ordinance Provisions, document number 392-0300-003, dated August 2, 2003 should be consulted for further guidance.

9. Stormwater runoff generated from development and discharged directly into a jurisdictional wetland or waters of the United States and their adjacent wetlands shall be treated by an approved stormwater management practice prior to release into a wetland. Natural wetlands shall not be used to meet the minimum design requirements for stormwater management or stormwater runoff quality treatment, except when used as part of a treatment train that incorporates a portion of the outer zone (filter strip) of the wetland's riparian buffer as a stormwater outfall. In such instances, the discharge velocity from the terminal end of a pipe or associated energy dissipation practice shall not exceed two feet per second for the two-year frequency storm event. Where such a management strategy is used, all feasible methods shall be used to convert concentrated flow to uniform, shallow sheet flow before entering the outer zone of the wetland's riparian buffer. In addition, it shall be demonstrated that such an approach will not cause erosion.
- B. The following minimum performance standards shall apply to all applicable **new development** activities, pursuant to Section 2.2.1.
1. Water quality improvement shall be achieved in conjunction with or as part of infiltration practices. Water quality improvements shall also be provided for drainage areas not otherwise addressed by infiltration practices either at the source of runoff and/or during conveyance away from the source of runoff. Stormwater quality management practices shall be designed to capture and treat stormwater runoff generated by the one-inch rainfall event. Refer to Section 4.3.1.B for Water Quality Volume design standards and assumptions. Stormwater quality management practice selection, design and implementation shall be based upon appropriate reference materials, including the Pennsylvania Handbook of Best Management Practices for

Developing Areas (PACD, 1998), (latest edition or the PA stormwater management design manual when published), or the 2000 Maryland Stormwater Design Manual (MDE, 2000), and may include constructed wetlands, grass channels, dry swales, wet swales, filter strips, bioretention and other stormwater management practices.

2. The post development peak discharge rate shall not exceed the predevelopment peak discharge rate for the 2-year, 10-year, 25-year, 50-year and 100-year 24-hour storm events pursuant to the predevelopment cover assumption described in Section 4.2.2. Where the runoff volume design standards under Section 4.3.1.A.1.a and Section 4.3.1.A.1.b are **not** met, the post-development peak discharge rates for all storms up to and including the 10-year event shall not exceed the predevelopment discharge rate for the 2-year event given predevelopment cover assumptions per Section 4.2.2. For events greater than the 10-year event up to the 100-year event (i.e., the 25, 50 and 100 year events), the post-development peak discharge rates shall not exceed ninety-percent (90%) of the peak discharge rate given predevelopment cover assumptions per Section 4.2.2.
3. Facilities capable of attenuating rainfall runoff shall be provided and designed to attenuate the runoff volume from the 1-year 24-hour storm event for at least 24 hours (i.e., the stormwater runoff will be released over a minimum of 24 hours). The rate of release to the receiving stream shall be based on the ability of the stream channel to contain the volume of discharge within the banks of the stream.
4. Stormwater shall be infiltrated and/or discharged within the same drainage area of the stream receiving the runoff from the development site prior to development.
5. Structural and non-structural stormwater management practices that provide, promote or otherwise make best possible use of infiltration on-site shall be considered first and foremost in all site designs. Stormwater infiltration practices shall be designed in accordance with the sizing criteria and hierarchy described in Section 4.3.1.A of this ordinance.

- C. The following minimum performance standards shall apply to all applicable **redevelopment** activities, pursuant to Section 2.2.1.

Note: The intent of Section 4.1.3.C is to accommodate redevelopment that is designed to provide improved stormwater management while recognizing that redevelopment sites have inherent physical constraints, which may make the application of the new development stormwater design parameters difficult to achieve.

1. One of the following minimum performance standards shall be accomplished. Selection of the performance standard shall be whichever is most appropriate for the given site conditions as determined by [municipality]:

- a. Reduce the total impervious cover on the site by at least twenty percent (20%), based on a comparison of existing impervious cover to proposed impervious cover, **or**
 - b. Achieve a ten percent (10%) reduction in the total volume of runoff generated and discharged from the site by a 2-year storm event. Runoff calculations shall be based on a comparison of existing site conditions to post development site conditions, **or**
 - c. Reduce the post development peak discharge rates to ninety percent (90%) of the predevelopment peak discharge rates for the 2-year, 10-year, 25-year, 50-year and 100-year 24-hour storm events based on a comparison of existing ground cover to post development site conditions.
2. In addition to the minimum performance standards of Section 4.1.3.C above, water quality improvements shall be provided for drainage areas not otherwise addressed by infiltration practices either at the source of runoff and/or during conveyance away from the source of runoff. Stormwater quality management practices shall be designed to capture and treat stormwater runoff generated by the one-inch rainfall event. Refer to Section 4.3.1.B for Water Quality Volume design standards and assumptions. Stormwater quality management practice selection, design and implementation shall be based upon appropriate reference materials, including the Pennsylvania Handbook of Best Management Practices for Developing Areas (PACD, 1998), (latest edition or the PA stormwater management design manual when published), or the 2000 Maryland Stormwater Design Manual (MDE, 2000), and may include constructed wetlands, grass channels, dry swales, wet swales, filter strips, bioretention and other stormwater management practices.

4.2 Stormwater Runoff Calculation Methods

In addition to the infiltration and water quality requirements of this ordinance, peak flow from those activities resulting in increases in impervious surface and/or regrading and compaction shall be attenuated consistent with the following stormwater calculation methods:

- 4.2.1 The following design storms shall be analyzed for the peak discharge and volumes from the pre and post development conditions. These values are applicable to the Soil-Cover-Complex Method:
- A. A one-year, twenty four hour storm of 2.6 inches of rainfall (PADEP, March 2000);
 - B. A two-year, twenty-four hour storm (rainfall per NOAA Atlas 14, Volume 2);
 - C. A ten-year, twenty-four hour storm (rainfall per NOAA Atlas 14, Volume 2);
 - D. A twenty-five-year, twenty-four hour storm (rainfall per NOAA Atlas 14, Volume 2);

- E. A fifty-year, twenty-four hour storm (rainfall per NOAA Atlas 14, Volume 2);
- F. A one-hundred-year, twenty-four-hour storm (rainfall per NOAA Atlas 14, Volume 2).

The precipitation values for each frequency storm listed above (with the exception of the one-year storm) shall be the precipitation frequency estimates developed by the National Oceanic and Atmospheric Administration as set forth in NOAA Atlas 14, Volume 2 (NOAA June 2004). The NOAA data are available from the Hydrometeorological Design Studies Center of the National Weather Service. The one-year storm value is per Technical Paper No. 40, (Hershfield, 1961) since the NOAA data referenced do not include precipitation values for the one-year frequency storm.

Note: The National Oceanic and Atmospheric Administration has updated Technical Paper No. 40 titled Rainfall Frequency Atlas of the United States for Durations from 30 minutes to 24 Hours and Return Periods from 1 to 100 Years (Hershfield, 1961) with a new report titled NOAA Atlas 14, Volume 2 (NOAA June 2004). The results of this update are a much more sophisticated and detailed statistical analysis of precipitation frequency relative to geographical location. This allows for the selection of precipitation values on a local level. Therefore, Section 4.2.1.B, C, D, E and F all reference the NOAA Atlas 14, Volume 2 report. The one-year storm rainfall value is given a specific value in this model ordinance since the new report does not include one-year frequency values. Municipalities may want to establish a set of local rainfall values to be used throughout the municipalities based on NOAA Atlas 14, Volume 2. The NOAA Atlas 14, volume 2 report can be accessed from the NOAA website at <http://hdsc.nws.noaa.gov/hdsc/pfds/>.

4.2.2 The following assumptions shall be used for runoff calculations:

- A. For new development sites, the ground cover used as the predevelopment assumption for runoff calculations shall be as follows;
 - 1. Wooded sites shall use a ground cover of woodland in good condition. Portions of a site having more than one viable tree of a 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.

Note: The intent of Section 4.2.2.A.1 is to recognize woodland conditions and not inadvertently encourage tree harvesting.

- 2. Agricultural sites shall use a ground cover of pasture in good condition.

Note: The use of “pasture in good condition” is supported by the requirements of the Chester County Conservation District that agricultural lands be stabilized by pasture ground cover when farming activity is ceased. Although this conversion is not always done, the pre-development ground cover assumption of “pasture in good condition” should be applied for any agricultural land area.

3. All other portions of a site shall use a ground cover of meadow in good condition even if the area is impervious.
4. The ground cover used for redevelopment sites is provided under Section 4.1.3.C.

B. The runoff curve numbers listed in the table below shall be used in developing the runoff calculations for the ground covers noted in Section 4.2.2.A. These values are referenced from the Urban Hydrology for Small Watersheds Technical Release No. 55 (USDA, 1986). Coefficients for equivalent ground cover conditions shall be used if a runoff method other than the Soil Cover Complex Method is used.

Ground Cover	Hydrologic Soil Group Curve Numbers			
	A	B	C	D
Woodland	30	55	70	77
Meadow	30	58	71	78
Pasture	39	61	74	80

- C. Average antecedent moisture conditions (for the Soil Cover Complex Method only for example, TR-55, TR-20).
- D. A type II distribution storm (for the Soil Cover Complex Method only for example, TR-55, TR-20).

4.2.3 In all plans and designs for stormwater management systems and facilities submitted to the municipal engineer for approval, stormwater peak discharge and runoff shall be determined through the use of the NRCS Soil Cover Complex Method as set forth in Urban Hydrology for Small Watersheds, Technical Release No. 55 (USDA, 1986), with specific attention given to antecedent moisture conditions, flood routing, time of concentration, and peak discharge specifications included therein and in Hydrology National Engineering Handbook, Section 4, (USDA, 1985) both by the U.S. Department of Agriculture, Natural Resources Conservation Service. Note that when TR-55 is used for natural system-based approaches and practices encouraged herein, calculations must be performed on a detailed small sub-area basis. Use of Technical Release No. 20 and other methods listed in Table 1 are also acceptable. The design professional's selection of a specific method shall be based on the suitability of the method for the given project site conditions with due consideration to the limitations of the method chosen. Table 1 herein summarizes the computational methods available.

Table 1
ACCEPTABLE COMPUTATION METHODOLOGIES FOR STORMWATER
MANAGEMENT PLANS

METHOD	SOURCE	APPLICABILITY
TR-20 or commercial Package Based on TR-20	USDA – NRCS	When use of full model is desirable or necessary
TR-55 or Commercial Package Based on TR-55	USDA – NRCS	Applicable for plans within the model's limitations
HEC – HMS	U.S. Army Corps of Engineers	When full model is desirable or necessary
PSRM	Penn State University	When full model is desirable or necessary
VT/PSUHM	Virginia Polytechnic Institute & Penn State University	When full model is desirable or necessary
Modified Rational Method or Commercial package based On this Method	Emil Kuiching (1889)	For sites less than 20 acres
SWMM or commercial package based on SWMM	U.S. EPA	Most applicable in urban areas
Small Storm Hydrology Method (as included in SLAMM)	PV & Associates, or the website www.winslamm.com	Calculation of runoff volume from urban and suburban areas
Other Methods	Various	As approved by the municipal engineer

Note: The Small Storm Hydrology Method presented in the SLAMM model is very useful in calculating runoff volumes from smaller storms (e.g. one inch). Runoff is calculated using volumetric runoff coefficients developed for use in the Small Storm Hydrology method.

- 4.2.4 A Modified Rational Method analysis may be used for drainage areas smaller than twenty (20) acres when permitted by the municipal engineer. The term “Modified Rational Method” used herein refers to a procedure for manipulation of the basic rational method techniques to reflect the fact that storms with a duration greater than the normal time of concentration for a basin will result in a larger volume of runoff even though the peak discharge is reduced. The methodology and model chosen for use shall be well documented as being appropriate for use in this region, and all relevant assumptions, methodologies, calculations and data used shall be provided to the municipal engineer for review. Information on the Modified Rational Method is presented in the Recommended Hydrologic Procedures for Computing Urban Runoff from Small Watersheds in Pennsylvania (PADEP, 1982).
- 4.2.5 Rainfall intensities used for the Modified Rational Method shall be based on the current Penn DOT Storm Intensity-Duration-Frequency chart appropriate to the specific site.
- 4.2.6 The Rational Method (that is, $Q = CIA$) shall be used for calculations of the peak rate of runoff for the design of storm sewers and drainage swales but **not** for the design of stormwater management facilities where a full hydrograph is needed. The equation representing the Rational Method is comprised of the following (in English units):
- Q = Peak flow rate, cubic feet per second (CFS)
C = Runoff coefficient, dependent on land use/cover
I = Design rainfall intensity, inches per hour
A = Drainage area, acres.
- 4.2.7 Runoff characteristics of off-site areas that drain through a proposed development shall be based on actual existing conditions.

4.3 Design Standards for Stormwater Management Practices

The Pennsylvania Handbook of Best Management Practices for Developing Areas (PACD, 1998), (latest edition or the PA stormwater management design manual when published), shall serve as a guide for the design of stormwater management practices. Additional design guidance may also be obtained from other related sources, including the 2000 Maryland Stormwater Design Manual, Volumes I and II (MDE, 2000), Design of Stormwater Filtering Systems (CWP, 1996), and the American Society of Civil Engineers Manual and Report on Engineering Practice, No. 87, Urban Runoff Quality Management (ASCE, 1998) for the design of stormwater runoff quality control features for site development. A list of references is provided with this ordinance. The Water Quality Volume design measures used herein are partially based on the methodology expressed in the Maryland manual referenced above. Water Quality Volume (WQv) represents the storage needed to capture and treat the runoff from ninety percent (90%) of the average annual rainfall. Applicants are encouraged to refer to the Maryland manual for additional guidance.

Pursuant to the design options recommended in the above documents, the following standards shall be adhered to:

4.3.1 Runoff Volume and Water Quality Facility Sizing Criteria

The following sizing criteria shall be followed at all sites required to meet the standards of this Ordinance.

A. Runoff Volume

Note: The standards under Section 4.3.1.A and B are essential and should be strictly adhered to. Requests for waivers or modifications of these standards should be granted only where the requirement of strict adherence would be unreasonable, cause undue hardship or an alternative standard can be demonstrated to provide equal or better results.

1. Stormwater runoff shall be managed according to a hierarchy in which the minimum design standards are examined in the following order:

Note: The purposes of the standards described in Section 4.3.1.A.1.a, b, c and d are two-fold: to protect ground water recharge, and to avoid offsite discharge of the volume of stormwater created by the loss of infiltration and evapo-transpiration that results from increased imperviousness of the site. On all sites, the volume of infiltration required in Section 4.3.1.A.1.d must be achieved to protect ground water recharge. The additional volume of stormwater required to be permanently retained on site over and above that volume necessary to protect ground water recharge may be infiltrated or managed through other techniques or practices as long as it is not discharged offsite.

- a. To the extent that a site is located in and/or discharges to a stream or water body designated by the Commonwealth of Pennsylvania as High Quality and/or Exceptional Value Special Protection Watershed and is altered as a result of development, **there shall be no net increase in the total volume of stormwater discharged from the site over that which was calculated for the predevelopment condition** (as defined in Section 4.2.2.A) **as a result of the runoff generated by the two-year, twenty-four hour storm.** Compliance with this standard shall also satisfy the Water Quality Volume criteria described in Section 4.3.1.B. However, those drainage areas that do not satisfy this standard shall meet the water quality volume criteria described in Section 4.3.1.B. Achieving this standard will contribute significantly to maintaining constant total stormwater volumes.
- b. To the extent that a site is **not** located in and does not discharge to a stream or water body designated by the Commonwealth of Pennsylvania as High Quality and/or Exceptional Value Watershed or any site where the Applicant can demonstrate through on-site soils evaluations and supporting engineering calculations that site conditions preclude a design complying with Section 4.3.1.A.1.a, above, **then best management practices shall be provided that capture and infiltrate, or otherwise**

permanently retain on site the total volume of runoff generated from the one and one-half-inch (1.5”), twenty-four hour storm such that this quantity of runoff is not discharged from the site. The calculation of runoff generated shall be based on a summation of the runoff generated by each individual cover type. Impervious and pervious covers shall be calculated separately. The averaging or weighting of a composite curve number (CN) or runoff coefficient (c) is prohibited for volume calculations. Runoff calculations shall include all areas proposed to be disturbed and/or regraded.

- c. Where the Applicant can demonstrate through on-site soils evaluations and supporting engineering calculations that site conditions preclude a design complying with Section 4.3.1.A.1.b above, **then best management practices shall be provided that capture and infiltrate, or otherwise permanently retain on site the largest percentage of the total volume of runoff generated from the one and one-half-inch (1.5”), twenty-four hour storm that site conditions allow such that this quantity of runoff is not discharged from the site.** The calculation of runoff generated shall be based on a summation of the runoff generated by each individual cover type. Impervious and pervious covers shall be calculated separately. The averaging or weighting of a composite curve number (CN) or runoff coefficient (c) is prohibited for volume calculations. Runoff calculations shall include all areas proposed to be disturbed and/or regraded.
- d. In complying with Section 4.3.1.A.1.a, Section 4.3.1.A.1.b and Section 4.3.1.A.1.c, above, **infiltration practices shall be provided that capture and infiltrate at least the first one-half-inch (0.5”) of runoff generated by each rainfall event from all impervious areas** to assure protection of ground water recharge.

Note: It is important to establish a minimum infiltration standard to protect ground water recharge and stream baseflow. The use of 0.5 inches of runoff from impervious areas is recommended based on information and analyses emerging from the state stormwater manual development, review of USGS water budget data for Chester County watersheds, and analyses conducted for the Darby Creek Act 167 study. The state stormwater design manual (when completed) is anticipated to provide further guidance on minimum recharge requirements.

- e. Water quality improvement shall be achieved in conjunction with the standards described in Section 4.3.1.A.1.a, b, c and d as well as in drainage areas not otherwise provided with stormwater runoff volume management practices. The Water Quality Volume (WQv) shall be calculated per Section 4.3.1.B and shall meet the following standard:
 - 1. If the calculated WQv is less than the volume infiltrated and/or retained on site, then the WQv requirement is satisfied.

2. If the calculated WQv is greater than the volume required to be infiltrated and/or retained on site, then the difference between the two volumes shall be treated for water quality by an acceptable stormwater management practice(s).

Note: Minimization of runoff generated by a proposed site is directly related to the various land use and design standards for site improvements required under the municipal zoning, and subdivision and land development ordinances. The affect that these requirements have on generating stormwater should be taken into consideration. Site design should implement runoff reduction techniques such as those described in Appendix B.

B. Water Quality Volume

1. Treatment of the Water Quality Volume (WQv) of stormwater prior to its release to receiving waters or water bodies shall be provided at all developments where stormwater management is required. The WQv equals the storage volume needed to capture and treat the runoff from storms of one (1) inch or less. Runoff from the first one (1) inch of rainfall transports most of the total pollutant load. The one (1) inch storm event represents 80% of the total volume of rainfall and 95% of all rainfall events that occur in a typical year in Chester County. Thus, capture of a one (1) inch storm is established as the criteria for calculating the WQv.

The WQv is based on the following equation:

$$WQv = [(P)(Rv)(A)]/12 \text{ (acre-feet)}$$

Where:

P = rainfall depth in inches (set to 1 inch)

Rv = volumetric runoff coefficient, $0.05 + 0.009(I)$ where I is percent impervious cover

A = area (acres).

2. The formula assumes approximately five percent (5%) runoff from pervious surfaces, and ninety percent (90%) runoff from impervious surfaces. A minimum of 0.2 inches per acre of runoff volume shall be met at sites or in drainage areas that have less than fifteen percent (15%) impervious cover.
3. Drainage areas having no impervious cover and no proposed disturbance during development may be excluded from the WQv calculations. However, designers are encouraged to incorporate water quality treatment practices for these areas.
4. Stormwater Quality Treatment: The final WQv shall be treated by an acceptable stormwater management practice(s) from those described in this Section or as approved by the [municipality].

- a. For new developments and redevelopments, infiltration is considered an acceptable method of satisfying part or all of the Water Quality Volume.
 - b. For new developments, the WQv requirements of this section shall be sized and designed in conjunction with the standards under Section 4.3.1.A.
5. As a basis for design, the following assumptions may be made:
- a. Multiple Drainage Areas: When a project contains or is divided by multiple drainage areas, the WQv volume shall be addressed for each drainage area.
 - b. Offsite Drainage Areas: The WQv shall be based on the impervious cover of the proposed site. Offsite existing impervious areas may be excluded from the calculation of the water quality volume requirements.

Note: The following minimum design standards are given as examples of the various requirements possible. Each municipality and their engineer must decide what design standards are important for inclusion here. Conversely, municipalities can also rely on the Applicant to document their designs using acceptable design practices. The latter approach requires a thorough review by the municipal engineer but also provides maximum flexibility to the Applicant to design systems conducive to individual sites.

4.3.2 Stormwater Infiltration Practices

Note: A "Soil Use Guide" is provided in Appendix D of this ordinance. It is intended to provide users of the ordinance with initial basic information about soil series within a municipality. If used, each soil type within a municipality should be evaluated and charted. The Soil Use Guide is a planning tool only and does not replace the need for on-site soils evaluations and infiltration tests.

- A. Infiltration practices shall be selected based on suitability of soils and site conditions. Initial site evaluation shall include the information provided in Appendix D Soil Use Guide. Acceptable infiltration practices include, but are not limited to: filter strips or stormwater filtering systems (for example bioretention facilities, sand filters), open vegetated channels (that is, dry swales and wet swales), infiltration trenches, dry wells, infiltration basins, porous paving systems, retention basins, wet extended detention ponds, riparian corridor management, riparian forested buffers, rooftop runoff management systems, and sand filters (closed or open), or as otherwise described in the manuals referenced in Section 4.3 and Appendix E.

Where sediment transport in the stormwater runoff is anticipated to reach the infiltration system, appropriate permanent measures to prevent or collect sediment shall be installed prior to discharge to the infiltration system.

- B. Pursuant to Section 4.1.2.B soil infiltration tests shall be performed. The soil infiltration rate of discharge from the infiltration area being used in the proposed design shall be based on these measurements.

Soil evaluations shall be performed to determine the feasibility and extent to which infiltration systems can be used. The evaluation shall be performed by a qualified, licensed geologist, geotechnical/civil engineer or soil scientist and, at a minimum, address soil types, soil permeability, depth to bedrock, limitations of soils, presence/absence of carbonate geology susceptibility to subsidence and/or sinkhole formation and subgrade stability. The testing and evaluation should be completed at the preliminary design stage. See Section 4.3.2.L for discussion of infiltration in areas of karst and/or carbonate geology.

Infiltration requirements shall be based on the portions of the site that are permeable prior to disturbance and the degree to which development will reduce the permeability of the site. Permeability of the site shall be determined based on the detailed evaluations described herein. Use of stormwater management practices to retain stormwater for infiltration should be applied to all areas where the soils evaluation indicates favorable conditions. Areas generally not favorable

for infiltration shall still be provided with an appropriate water quality practice (refer to Section 4.1.3.A.4).

Soil infiltration tests shall be performed to an equivalent depth or elevation of the bottom of the proposed infiltration areas. These tests shall follow the procedures of percolation test holes as established by the Chester County Health Department (CCHD) for on-lot septic systems. The testing shall include a test pit and percolation test holes. The test hole shall be excavated to a depth so that the presence or absence of bedrock and/or seasonal high water table can be determined. A soil log describing the soils present in each test pit shall be performed. All test holes used for evaluating the percolation rate shall be pre-soaked in accordance with the procedures established by the CCHD. The location and number of test pits and percolation holes shall be determined based on the type(s) of stormwater management practices being designed in consultation with and guidance from the municipal engineer. Acceptability of infiltration rates shall be based on sound engineering judgment and recommended design considerations described in the design manuals listed in the references or other source material acceptable to the municipal engineer.

- C. All infiltration practices shall be set back at least fifteen (15) feet from all structures with sub-grade elements (e.g., basements, foundation walls).
- D. The lowest elevation of the infiltration area shall be at least two (2) feet above the Seasonal High Water Table and bedrock, except in the case of areas underlain by karst and/or carbonate geology, in which case the distance shall be determined on a site specific basis (refer to Section 4.3.2.L).
- E. Where roof drains are designed to discharge to infiltration practices, they shall have appropriate measures to prevent clogging by unwanted debris (for example, silt, leaves and vegetation). Such measures shall include but are not limited to leaf traps, gutter guards and cleanouts.
- F. All infiltration practices shall have appropriate positive overflow controls to prevent storage within one (1) foot of the finished surface or grade, unless a specific amount of surface storage away from pedestrian and vehicular traffic is provided and such areas infiltrate the stored volume within forty-eight (48) hours.
- G. All infiltration practices shall be designed to infiltrate the stored volume within forty-eight (48) hours.
- H. All surface inflows shall be treated to prevent the direct discharge of sediment into the infiltration practice; accumulated sediment reduces stormwater storage capacity and ultimately clogs the infiltration mechanism. No sand, salt or other particulate matter may be applied to a porous (pervious) surface for winter ice conditions.
- I. During site construction, all infiltration practice components shall be protected from compaction due to heavy equipment operation or storage of fill or construction material. Infiltration areas shall also be protected from sedimentation. Areas that are accidentally compacted or graded shall be

remediated to restore soil composition and porosity. Adequate documentation to this effect shall be submitted for review by the municipal engineer. All areas designated for infiltration shall not receive runoff until the contributory drainage area has achieved final stabilization.

- J. The following procedures and materials shall be required during the construction of all subsurface facilities:
1. Excavation for the infiltration facility shall be performed with equipment that will not compact the bottom of the seepage bed/trench or like facility.
 2. The bottom of the bed and/or trench shall be scarified prior to the placement of aggregate.
 3. Only clean aggregate with documented porosity, free of fines, shall be allowed.
 4. The tops and sides of all seepage beds, trenches, or like facilities shall be covered with drainage fabric. Fabric shall meet the specifications of Penn DOT Publication 408, Section 735, Construction Class 1.
 5. Perforated distribution pipes connected to centralized catch basins and/or manholes with the provision for the collection of debris shall be provided in all facilities unless the municipal engineer agrees that site soils provide superior infiltration (A soils or highly porous B soils). Where perforated pipes are used to distribute stormwater to the infiltration practice, stormwater shall be distributed throughout the entire seepage bed/trench or like facility.
- K. All infiltration practices that serve more than one (1) lot and are considered a common facility shall have a drainage easement. The easement shall provide to the [municipality] the right of access.

Note: Infiltration of stormwater in areas underlain by karst and/or carbonate geology (units susceptible to subsidence and/or formation of sinkholes) can provide a safe and effective approach to protect and maintain ground water resources, if properly designed for the existing site conditions. Several infiltration BMPs have been successfully installed in areas underlain by karst and/or carbonate geology in Chester County and remain fully operational after many years. Infiltration in areas of karst and/or carbonate geology may be viable and practical in some locations, but not in others. Infiltration should not be rejected merely because of the existence of underlying karst and/or carbonate geology. In such areas, a site-specific evaluation of surface and subsurface characteristics and conditions should be conducted to determine site suitability and design needs as well as to determine the volume of stormwater infiltration that can be achieved. Where such an assessment concludes that the use of infiltration BMPs anywhere on the site will pose a significant risk of formation of sinkholes or other karst features that could result in surface collapse or subsidence, infiltration should be avoided.

The stormwater and geotechnical engineering communities have not yet developed generic design standards for infiltration BMPs in areas of karst and/or carbonate geology and strong emphasis is placed on site-specific evaluation and design. This ordinance reflects that emphasis and requires that a site evaluation be used as the basis

for determining if infiltration is viable and practical and, if so, requires that the infiltration BMP design be based on the findings of the site evaluation.

For municipalities with areas of karst and/or carbonate geology, the following should be included within the stormwater ordinance. For municipalities where no karst or carbonate geology exists, this item should be excluded.

- L. In areas underlain by karst and/or carbonate geology, the viability and specific design standards of infiltration BMPs at a given site must be determined on a site-specific basis to avoid ground water contamination and formation and/or expansion of solution channels, sinkholes, and other potentially dangerous karst features. A site evaluation shall be conducted by a qualified professional geologist, geotechnical engineer, or other qualified professional, licensed by the Commonwealth of Pennsylvania, to ascertain the subsurface conditions of soil, rock and ground water relevant to formation of karst features. Such an evaluation shall include, but not be limited to:
1. Soil thickness, gradation, anisotropy, and permeability (from existing soil data and soil borings) to determine the capacity and rate of infiltration of the soil, and relative depth of soil necessary to protect against sinkhole formation.
 2. Karst characteristics of geologic units underlying the site (from current publications, maps and information of U.S. Geological Survey, PA Geological Survey, PA Department of Transportation, etc.).
 3. Inventory of existing karst landforms, visual indications and/or surface manifestations of subsurface features or other karst features (from interviews with municipal representatives familiar with known problem areas, review of aerial photography, and site reconnaissance).
 4. Geophysical survey of the site to identify locations and extent of existing subsurface karst features.
 5. Effectiveness of soil mantle to remove pollutants from infiltrating water to determine whether or not the need exists for removal of pollutants from stormwater runoff prior to infiltration (for example, soil thickness and soil cation exchange capacity, etc.).
 6. Depth to ground water and vertical location of water table relative to carbonate geologic unit (from existing information and/or borings).
 7. Other appropriate site specific parameters affecting infiltration.

Location of infiltration BMPs is critical and should be considered early on in the site planning process. Where karst conditions exist, infiltration BMPs shall be located and designed based on the subsurface conditions identified in the site evaluation, to avoid formation of new karst features and to protect existing karst features from accelerated development. Infiltration BMPs shall be located at least 100 feet away from existing karst features and sited away from buildings,

roadways or other structures where subsidence could damage the structure and create an unsafe condition. Where underlying geologic units are prone to formation of karst features, but no karst features are identified on the site, infiltration BMPs shall be designed to avoid formation of new karst features.

Ground water quality of the carbonate aquifer shall be protected from infiltration of pollutants. At a minimum, stormwater runoff from “hotspots” (i.e., sources of significant pollutant runoff) shall first be discharged through a water quality BMP(s) to remove pollutants prior to infiltration. Where soil characteristics are insufficient to provide removal of pollutants from sources other than “hotspots”, stormwater runoff shall first be discharged through a water quality BMP(s) to remove pollutants prior to infiltration.

4.3.3 Open Vegetated Channels

- A. Open Vegetated Channels are conveyance systems that are engineered to also perform as water quality and infiltration practices. Such systems can be used for the conveyance, retention, infiltration and filtration of stormwater runoff.
- B. Open Vegetated Channels primarily serve a water quality function (WQv), they also have the potential to augment infiltration. Examples of such systems include, but are not limited to: dry swales, wet swales, grass channels, and biofilters. Open vegetated Channels are primarily applicable for land uses such as roads, highways, residential developments (dry swales only) and pervious areas.
- C. Open Vegetated Channels shall be designed to meet the following minimum standards:
 - 1. The channel shall be designed to safely convey the ten-year frequency storm event with a freeboard of at least six (6) inches. Freeboard is the difference between the elevation of the design flow in the channel and the top elevation of the channel.
 - 2. The peak velocity of the runoff from the ten-year storm shall be non-erosive for the soil and ground cover provided in the channel.
 - 3. The longitudinal slope shall be no greater than four percent (4%).
 - 4. Channels shall be trapezoidal in cross section. The minimum bottom width shall be two (2) feet. The maximum bottom width shall be eight (8) feet.
 - 5. Channels shall be designed with moderate side slopes of four (4) horizontal to one (1) vertical. Flatter side slopes may be necessary under certain circumstances.
 - 6. The maximum allowable ponding time in the channel shall be less than 48 hours.
 - 7. Channels (for example, dry swales) may require an underdrain in order to function and dewater.

8. Channels shall be designed to temporarily store the WQv within the system for a maximum period of 48 hours and a minimum period of one (1) hour.
 9. Landscape specifications shall address the grass species, wetland plantings (if applicable), soil amendment and hydric conditions present along the channel.
 10. Accumulated sediment within the channel bottom shall be removed when twenty-five (25%) of the original WQv volume has been exceeded.
 11. Check dams along the channel length may be warranted.
 12. The bottom of dry swales shall be situated at least two (2) feet above the seasonal high water table.
- D. Additional design information for Open Vegetated Channels is available in Design of Stormwater Filtering Systems (CWP, 1996).

4.3.4 Retention Basins

- A. Retention basins shall be designed to create a healthy ecological community with sufficient circulation of water to prevent the growth of unwanted vegetation and mosquitoes. Care should be taken to landscape retention basins in accordance with Section 4.4.
- B. The retention basin shall be of sufficient size to allow the appropriate aquatic community needed to maintain healthy pond ecology and avoid mosquitoes capable of carrying West Nile Virus and other diseases. The Chester County Health Department, Pennsylvania Fish and Boat Commission, the Natural Resource Conservation Service, the Pennsylvania Extension Service, or other qualified professional consultant shall be consulted during the design of these facilities in order to ensure the health of aquatic communities and minimize the risk of creating mosquito breeding areas.
- C. An outlet structure shall be designed to allow complete drainage of the pond for maintenance.
- D. The design of a retention basin shall include the determination of the proposed site's ability to support a viable permanent pool. The design shall take into account such factors as the available and required rate and quality of dry weather inflow, the stormwater inflow, seasonal and longer-term variations in ground water table, and impacts of potential pollutant loadings.
- E. Sediment storage volume equal to at least twenty percent (20%) of the volume of the permanent pool shall be provided.
- F. A sediment forebay with a hardened bottom shall be provided at each inlet into the retention basin. The forebay storage capacity shall at minimum be ten percent (10%) of the permanent pool storage. The forebay shall be designed to allow for access by maintenance equipment for periodic cleaning.

- G. Emergency spillways shall be sized and located to permit the safe passage of stormwater flows from a 100-year storm. The maximum velocities in vegetated spillways excavated in otherwise undisturbed soil shall be analyzed based upon the velocity of peak flow in the emergency spillway during an assumed clogged primary outlet condition. Where maximum velocities exceed design standards contained in the Engineering Field Manual for Conservation Practices (USDA, SCS, July 1984) suitable lining shall be provided. All emergency spillways placed on fill materials shall be lined. Lining for emergency spillways shall incorporate native colors and materials where possible including mono slab revetments, grass pavers and native stone.
- H. Existing ponds or permanent pool basins can be used for stormwater management provided that it can be demonstrated that the ponds are structurally sound and meet the design requirements herein.
- I. Inlet structures and outlet structures shall be separated to the greatest extent possible in order to maximize the flow path through the retention basin.
- J. Retention basins shall be designed to provide a length-to-width ratio of at least 3L:1W as measured in plan view (for example, a ratio of 4L:1W is too narrow).
- K. The retention basin depth shall average three (3) to six (6) feet with no area shallower than three (3) feet. In residential areas, ponds shall be equipped with management practices that reduce the potential for unauthorized entry and use of the pond by the general public. Preference shall be given to split rail fences equipped with mesh wire or other such practices that are both functional and attractive. A securable gate shall be provided to allow for periodic maintenance equipment/vehicle access. Any fence or barrier around a retention basin shall be no less than 42 inches in height or as otherwise required by local building codes or ordinances.
- L. An aquatic bench/shelf at least ten (10) feet wide and with a gentle slope not exceeding 10H:1V shall be provided along the entire perimeter of the retention basin.
- M. Any side slopes below the permanent water surface level shall not exceed 5H:1V. Side slopes above the permanent water surface level shall not exceed 3H:1V.
- N. Stabilization. Proper stabilization structures, including stilling basins, energy dissipaters, and channel lining shall be constructed at the outlets of all retention basins and emergency spillways. The stabilization structures shall control water to: avoid erosion; reduce velocities of released water and direct water so that it does not interfere with downstream activities.
- O. Energy Dissipaters and Level Spreaders. Energy dissipaters and/or level spreaders shall be installed to prevent erosion and/or initiate sheet flow at points where pipes or drainage ways discharge to or from basins. Energy dissipaters shall comply with criteria in Hydraulic Engineering Circular No. 15- Design for Stable Channels with Flexible Linings (USDOT, FHWA, 1986) or the Engineering Field Manual for Conservation Practices (USDA, SCS, July 1984).

Such facilities shall be both functional and harmonious with the surrounding environment; for example, native rock shall be used in constructing dissipaters where practical.

- P. Discharge Points. The minimum distance between a proposed basin discharge point (including the energy dissipater, etc.) and a downstream property boundary shall in no case be less than fifteen (15) feet. Where there is discharge onto or through adjacent properties prior to release to a stream, designers shall demonstrate how downstream properties are to be protected. The municipal engineer may require that the setback distance be increased based upon factors such as topography, soil conditions, the size of structures, the location of structures, and discharge rates. A drainage easement may also be required.
- Q. Outlet Structures. Outlet structures shall meet the following specifications:
1. To minimize clogging and to facilitate cleaning and inspecting, outlet pipes shall have an internal diameter of at least eighteen (18) inches and a minimum grade of one percent (1%).
 2. Anti-seep collars shall be provided on all outlet pipes within a constructed berm.
 3. All principal outlet structures shall be built using reinforced concrete with watertight construction joints.
 4. The use of architecturally treated concrete, stucco, painted surface or stone facade treatment shall be considered for enhancing the outlet structure. Such facilities shall be both functional and harmonious in design with the surrounding environment. .
 5. Outlet pipes shall be constructed of reinforced concrete with rubber gaskets in conformance with AASHTO M170, M198 and M207.
 6. Basin outlet structures shall have childproof non-clogging trash racks over all design openings exceeding twelve (12) inches in diameter except those openings designed to carry perennial stream flows. Periodic cleaning of debris from trash racks shall be included in the operation and maintenance plan.
 7. Anti-vortex devices, consisting of a thin vertical plate normal to the basin berm, shall be provided at the top of all circular risers or stand pipes.

4.3.5 Detention Basins

Note: Detention basins should be considered only where other practices cannot be used effectively. Detention basins have historically been used in stormwater management systems that concentrate and pipe flows to the low end of a project site to quickly release downstream. Such an approach is ineffective in meeting the stormwater management requirements and the design approach advocated herein. Stormwater management techniques described in this model ordinance strive to disconnect flows (rather than concentrate them), provide infiltration and water quality treatment, maintain or increase the predevelopment time of concentration (rather than decrease it), and manage flows as close to where they are generated as possible. Detention basins typically do not accomplish these goals.

- A. Detention basins are generally discouraged as a stormwater management practice and should only be used as a last resort where no other management facility is practical. Detention basins typically collect and quickly release runoff from a site in a manner that is contrary to the principles, goals and standards presented within this ordinance. The landscape standards of Section 4.4 shall apply.
- B. The maximum inside side slopes shall not exceed three (3) horizontal to one (1) vertical (3H:1V). The minimum required slope for the basin bottom is two percent (2%). A level bottom is acceptable, provided the designer demonstrates to the [municipality's] satisfaction that the basin bottom will be landscaped with appropriate wetland vegetation pursuant to Section 4.4. In addition, Detention Basins of sufficient size and slope may serve other functions as well, including recreational uses which do not hinder or conflict with the function of the detention basin.
- C. Inlet Structures. The inlet pipe invert into a basin shall be six (6) inches above the basin floor or lining so that the pipe can adequately drain after rainstorms. Inlets shall discharge into areas of the basin that slope toward the outlet structure.
- D. Inlet structures and outlet structures shall be separated to the greatest extent possible in order to maximize the flow path through the retention basin.
- E. Low Flow Channels. Low flow channels constructed of concrete or asphalt are not permitted. Where low flow channels are necessary, they shall be composed of a natural or bioengineered material. Low flow channels shall be designed to promote water quality and slow the rate of flow through the basin. Low flow channels may also be designed to infiltrate where practical.
- F. Outlet Structures. Outlet structures shall meet the following specifications:
 - 1. To minimize clogging and to facilitate cleaning and inspection, outlet pipes shall have an internal diameter of at least eighteen (18) inches and a minimum grade of one percent (1%).
 - 2. Anti-seep collars shall be provided on all outlet pipes within a constructed berm.

3. All principal outlet structures shall be built using reinforced concrete with watertight construction joints.
 4. The use of architecturally treated concrete, stucco, painted surface or stone facade treatment shall be considered for enhancing the outlet structure. Such facilities shall be both functional and harmonious in design with the surrounding environment.
 5. Outlet pipes shall be constructed of reinforced concrete with rubber gaskets in conformance with AASHTO M170, M198 and M207.
 1. Energy dissipation practices that convert concentrated flow to uniform shallow sheet flow shall be used where appropriate.
 2. Basin outlet structures shall have childproof non-clogging trash racks over all design opening exceeding twelve (12) inches in diameter except those openings designed to carry perennial stream flows.
 8. Anti-vortex devices, consisting of a thin vertical plate normal to the basin berm, shall be provided at the top of all circular risers or stand pipes.
- G. Emergency spillways shall be sized and located to permit the safe passage of stormwater flows from a 100-year storm. The maximum velocities in vegetated spillways excavated in otherwise undisturbed soil shall be analyzed based upon the velocity of peak flow in the emergency spillway during an assumed clogged primary outlet condition. Where maximum velocities exceed design standards contained in the Engineering Field Manual for Conservation Practices (USDA, SCS, July 1984) suitable lining shall be provided. In general, emergency spillways should not be located in fill areas; all such practices placed on fill materials shall be lined. Lining for emergency spillways shall incorporate native colors and materials where possible, including mono slab revetments, grass pavers and native stone.
- H. Freeboard. Freeboard is the difference between the elevation of the design flow in the emergency spillway (usually the 100 year peak elevation) and the top elevation of the settled basin embankment (that is, top of berm). The minimum freeboard shall be one (1) foot.
- I. Energy Dissipaters and Level Spreaders. Energy dissipaters and/or level spreaders shall be installed to prevent erosion and/or initiate sheet flow at points where pipes or drainage ways discharge to or from basins. Energy dissipaters shall comply with criteria in Hydraulic Engineering Circular No. 15- Design for Stable Channels with Flexible Linings (USDOT, FHWA, 1986) or the Engineering Field Manual for Conservation Practices (USDA, SCS, July 1984). Such facilities shall be both functional and attractive; for example, native rock shall be used in constructing dissipaters where practical.

- J. Stabilization. Proper stabilization structures, including stilling basins, energy dissipaters, and channel lining, shall be constructed at the outlets of all basins and emergency spillways. The stabilization structures shall control water to: avoid erosion, reduce velocities of released water and direct water so that it does not interfere with downstream activities.
- K. Discharge Points. The minimum distance between a proposed basin discharge point (including the energy dissipater, etc.) and a downstream property boundary shall in no case be less than fifteen (15) feet. Where there is discharge onto or through adjacent properties prior to release to a stream, designers shall demonstrate how downstream properties are to be protected. The municipal engineer may require that the setback distance be increased based upon factors such as topography, soil conditions, the size of structures, the location of structures, and discharge rates. A drainage easement may also be required.
- L. A sediment forebay with a hardened bottom shall be provided at each inlet into the detention basin. The forebay storage capacity shall at minimum be ten (10) percent of the permanent pool storage. The forebay shall be designed to allow for access by maintenance equipment for periodic cleaning.

4.3.6 Conveyance Systems (Open Channels, Drainageways, and Storm Sewers)

- A. Applicants are encouraged to design conveyance systems that encourage infiltration and improve water quality wherever practicable.
- B. Wherever conveyance channels are necessary, drainage shall be maintained by an open channel with landscaped banks designed to carry the 10-year, 24-hour stormwater runoff from upstream contributory areas. The municipal engineer may increase the design storm, as conditions require. All open channels shall be designed with one (1) foot of freeboard above the design water surface elevation of the design runoff condition.
- C. Flood relief channels shall be provided and designed to convey the runoff from the 100-year, 24-hour storm, such that a positive discharge of this runoff to an adequate receiving stream or conveyance system occurs without allowing this runoff to encroach upon other properties.
- D. Open channels along existing roadways may be required to be enclosed by the [*municipality*] if Penn DOT standards for safety and maintenance cannot be satisfied. All drainage structures shall conform to the latest edition of Form 408, Penn DOT specifications.
- E. Manholes and/or inlets shall not be spaced more than three hundred (300) feet apart for pipe sizes up to twenty-four (24) inches in diameter and not more than four hundred fifty (450) feet apart for larger pipe sizes.

- F. Where drainage swales are used in lieu of or in addition to storm sewers, they shall be designed to carry the required runoff without erosion and in a manner not detrimental to the properties they cross. Drainage swales shall provide a minimum grade of two percent (2%) but shall not exceed a grade of nine percent (9%). Drainage swales used strictly for conveyance are not the same as Open Vegetated Channels. Design standards for Open Vegetated Channels are provided under Section 4.3.3 of this ordinance.
- G. Street curbing for the purpose of stormwater conveyance is discouraged. On streets that must contain curbing, storm sewers shall be placed in front of the curbing. To the greatest extent possible, storm sewers shall not be placed directly under curbing. At curbed street intersections, storm inlets shall be placed in the tangent section of the road.
- H. Use of grassed swales or open vegetated swales in lieu of curbing to convey, infiltrate and/or treat stormwater runoff from roadways is encouraged. Inlets shall be placed at the center of the shoulder swale draining the street and shall be located no closer than four (4) feet from the edge of the cartway.
- I. [*Municipality*] shall be granted a minimum twenty (20)-foot-wide drainage easement over all storm sewers, drainage swales, channels, etc., that are a component of the stormwater management system when located within undedicated land. All permanent detention basins and/or other stormwater management facilities providing stormwater control for other than a single residential lot shall be located within a defined drainage easement that allows proper legal access and maintenance vehicle access by [*municipal*] personnel if the need arises for such access.
- J. No property owner shall obstruct or alter the flow, location or carrying capacity of a stream, channel or drainage swale to the detriment of any other property owner, whether upstream or downstream. All subdivision and/or land development plans containing streams, channels, drainage swales, storm sewers or other conveyance systems that cross property boundaries, existing or proposed, or whose discharge crosses such boundaries shall contain a note stating the above.
- K. Water Quality Inlets. Storm drainage systems that collect runoff from parking areas and/or loading areas exceeding 10,000 square feet of impervious coverage and discharge to stormwater management systems, including surface or subsurface infiltration systems, shall have a minimum of one (1) water quality inlet per each acre of drainage area. The purpose of water quality inlets is to remove oil, grease, and heavy particulates or total suspended solids, hydrocarbons and other floating substances from stormwater runoff. Methods other than water quality inlets may be permitted if the Applicant demonstrates to the [*municipality's*] satisfaction that any such alternative will be as effective and as easily maintained. Periodic cleaning of these systems shall be addressed in the Operation and Maintenance Plan submitted to the [*municipality*].

Note: Municipalities may wish to expand on the types of stormwater practices listed above (only the general categories of stormwater management practices are covered in this ordinance). For example, it is recommended that sections be added on porous paving, water quality inlets, bioretention, rain barrels, and sand filters, to name a few. On the other hand, the design and construction of many stormwater management practices evolves over time and some municipalities may wish to list only the general categories for that purpose (but provide for other techniques in accordance with new design manuals, etc.). Also, riparian corridors and other native plant landscaping can provide a valuable stormwater management benefit and should be addressed but may best be implemented through a separate ordinance.

4.4 Landscaping of Stormwater Management Practices

Stormwater management practices shall be landscaped in accordance with the following standards. Landscape plans shall be prepared by a professional Landscape Architect licensed in the Commonwealth of Pennsylvania.

Note: Many municipalities require that stormwater management practices be landscaped in order to create more natural facilities that blend into the landscape. Accordingly, such landscaping can contribute to the effectiveness of the facility to hold and filter water as well. The standards listed below are an example of the type of landscaping practices that might be required. Also note that these standards relate specifically to structural practices; other types of management strategies, including riparian buffers, constructed wetlands, etc., may need landscaping and enhancement standards as well.

4.4.1 Landscaping shall be required in and around all constructed stormwater management practices with a minimum surface area of one thousand (1,000) square feet for the purposes of:

- A. Assisting in the management of stormwater;
- B. Stabilizing the soil within such facilities to minimize and control erosion;
- C. Enhancing the visual appearance of such facilities; and
- D. Mitigating maintenance problems commonly associated with the creation of such facilities.

4.4.2. A planting plan and planting schedule shall be submitted in accordance with the following:

- A. Wet meadows including floors of stormwater management practices.
 - 1. Wet meadows and floors of stormwater management practices shall be planted with wildflowers and nonaggressive grasses, the intent being to create a mixed meadow of such plantings, where appropriate. Selection of plantings shall be based on whether the area in question is usually well drained or permanently wet and whether the area will be used for recreation purposes. No woody plants shall be planted within the saturated zone

(phreatic line) of a stormwater management practice or on a berm constructed for impounded water.

2. Seeding by drills, corrugated rollers, cyclone or drop seeders or hand seeding of such areas is preferred; however, hydroseeding followed by hydromulching can be used on wet ground and steep slopes.
3. Fertilizers, as a nutrient supplement, shall not be used unless it is documented that soil conditions warrant such use and nutrient applied does not exceed plant uptake. Soil for planting of wildflowers shall contain not less than three percent (3%) or more than ten percent (10%) organic matter, as determined by an agricultural chemist, with certification of the test before planting.
4. Seeding shall take place either between April 1 and May 15 or between September 1 and October 15. Planting areas shall be soaked to maintain a consistent level of moisture for at least four (4) to six (6) weeks after planting.
5. Once established, a single annual mowing when plants are dormant should be sufficient to maintain a wet meadow and/or floor of a stormwater management practice.

B. Wet edges that remain wet all or most of the year shall be planted with wildflowers, grasses and shrubs. Plants to be located on rims or banks, which remain dry most of the year, shall be planted with species tolerant of dry soil conditions.

C. Wooded areas

1. Where stormwater management practices adjoin wooded areas, trees and shrubs shall be selected and planted outside the practice so as to blend with existing surroundings.
2. Plantings in such areas shall be of sufficient density to eliminate the need for mowing.
3. It is recommended that clusters of trees and shrubs be planted around stormwater management facilities but well away from outfalls and any constructed berms, where applicable, to provide for wildlife habitat, wind control and buffering and screening.
4. Vegetation shall be planted during appropriate times of the year, predominantly between late March and mid May or from early October until evidence of ground freezing, depending upon the species selected. Most deciduous trees and shrubs can be planted in either spring or fall. Evergreens are best planted in late summer or early fall.

D. Slopes

1. Where slopes are gentle, a mixture of meadow grasses and wildflowers (for wet meadows) shall be planted.
2. On steep slopes as defined by the [*municipality*] code of ordinances, dense spreading shrubs (shrubs tolerant of dry soils) shall be planted. Heavy mat mulch shall be used during the period of establishment.
3. No woody plant materials or trees shall be located on a constructed or natural berm acting as the impoundment structure of a stormwater management practice. Trees shall be located downstream of an impoundment berm a sufficient distance from the toe of the constructed slope to assure that the toe of the slope is outside the dripline of the species planted at maturity but in no case less than fifteen (15) feet.

E. In cases where stormwater management practices are to be located in proximity to wetlands or waterways, the Applicant's planting plan and schedule shall consider the sensitive conditions existing therein and be modified accordingly to reflect existing flora.

F. Stormwater management practices shall be screened in a manner which complements the existing landscape and provides sufficient access for maintenance.

Section 5.0 OPERATION AND MAINTENANCE RESPONSIBILITIES

5.1 General Responsibilities

5.1.1 The owner of stormwater management facilities shall be responsible for the proper operation and maintenance of those facilities during and after construction. An Operation and Maintenance Plan consistent with the requirements of Section 5.3 shall be prepared for review and approval by the municipal engineer and shall be executed and signed by the municipal engineer and Applicant.

5.1.2 The Owner of the stormwater management facilities for a tract shall be responsible for the proper installation and function of those facilities in accordance with the approved Stormwater Management Plan. All temporary soil erosion and sedimentation control measures shall be removed or converted to their permanent configuration in accordance with an approved erosion control plan. This requirement in no way precludes the authority of the Chester County Conservation District to determine when sufficient stabilization has occurred on a site in order to convert to the permanent stormwater management facilities.

5.1.3 Dedication and Acceptance of Stormwater Management Practices.

- A. Upon completion of construction of stormwater management facilities shown on an approved subdivision or land development plan and within ninety (90) days after approval of such construction, the Applicant shall submit written offer of such stormwater management facilities for dedication to the Township. Said offer shall include a deed of dedication covering said facilities together with satisfactory proof establishing an Applicant's clear title to said property. Such documents are to be filed with the [*municipal*] Secretary for review by the [*municipal*] solicitor. Deeds of dedication for stormwater management facilities may be accepted by resolution of the [*municipality*] at a regular meeting thereof.
- B. [*Municipality*] may require that stormwater management facilities remain undedicated, with operation and maintenance the responsibility of individual lot owners or a homeowners association or similar entity, or an organization capable of carrying out maintenance responsibilities.
- C. Regardless of ownership, the Applicant shall submit a written offer deeding an access and/or drainage easement to [*municipality*] pursuant to Section 5.2. Such easement shall cover the stormwater management facilities, any drainage to and from such facilities, and shall clearly permit entry for inspection and/or maintenance purposes.
- D. Regardless of ownership, the Applicant shall submit to [*municipality*] an actual “as built” plan for the stormwater management facilities required per the approved Stormwater Management Plan. The “as built” plan shall show all final design specifications for all permanent stormwater management facilities and shall be prepared and certified by a licensed professional engineer. The “as built” plan shall be based on an actual field survey performed by a licensed professional land surveyor. The surveyor shall certify as to the accuracy of the plan. The “as built” plan shall be submitted to [*municipality*] for review and final inspection by the municipal engineer. Any performance and/or financial securities established for the project shall include requirements for submittal of “as built” plans.

5.2 Ownership and Maintenance

All stormwater management facilities identified within an approved Stormwater Management Plan shall be owned and maintained by one, or a combination of, the following entities:

5.2.1 Individual On-Lot Stormwater Management Facilities

- A. Where individual on-lot stormwater management facilities are proposed, the subdivision and/or land development plan shall contain a note in a form satisfactory to the [*municipal*] solicitor designating the entity responsible for operation and maintenance of the on-lot facilities consistent with an approved Operation and Maintenance Plan and, in the event that the responsible person or entity fails to do so, granting to the [*municipality*] the right but not the duty to enter upon the premises to repair or restore said facilities, to charge and assess the costs thereof to the owner and to enforce said charges and assessments by lien upon the property. In addition, the deed for each lot shall contain a covenant

binding on the grantee and all successors in interest designating the responsibility for operation and maintenance of the on-lot facilities. The following is an example of such a clause:

"UNDER AND SUBJECT, nevertheless, to the following conditions and restrictions: Prior to the construction of a dwelling or any other earthmoving activities, Grantee shall construct the permanent stormwater management facilities as shown on the stormwater management plan prepared by P.E., dated and last revised and approved by [municipality]; thereafter, the Grantee, his heirs, executors, administrators, successors and assigns ("owner"), at his or their sole cost and expense, shall operate, maintain and repair said stormwater management facilities on the lot in accordance with said plan, so that the facilities shall at all times continue to operate and function in the same manner and capacity as they were designed. In the event of the failure of the owner to comply with these conditions and restrictions, [municipality] shall have said stormwater management facilities repaired or restored as required, and the costs thereof shall be assessed to the owner; said assessment shall be a charge and a continuing lien upon the property herein. The [municipality], before it may exercise this right, shall notify the owner by certified mail of its intention to take the aforementioned action. The notice shall set forth in what manner the owner has neglected the operation and maintenance of or repair to the stormwater management facilities, and if the owner fails to correct or repair the items listed in the notice from the [municipality], then and only then may the [municipality] exercise this right."

- B. In addition to the above, developers of parcels with more than one (1) dwelling unit shall record in the Office of Recorder of Deeds for Chester County a declaration of covenants and restrictions in a form satisfactory to the [municipal] solicitor describing the responsibility for operation and maintenance of the on-lot facilities, consistent with an approved Operation and Maintenance Plan, prior to the sale of any individual lots. The terms of this covenant and restriction shall run with the land and be binding upon the initial grantees of each lot within the subdivision, his, her or their heirs, administrators, successors or assigns.

5.2.2 Homeowners or Condominium Association Ownership

Where a homeowners' association is created to own and manage common facilities, the subdivision and/or land development plan shall contain a note in a form satisfactory to the [municipal] solicitor designating the entity responsible for construction and/or maintenance of the stormwater management facilities consistent with an approved Operation and Maintenance Plan and, in the event that the responsible entity fails to do so, granting to the [municipality] the right but not the duty to enter upon the premises to repair or restore said facilities, to charge and assess the costs thereof to each owner of property within the development and to enforce said charges and assessments by lien upon each property within the development. In addition, the developer shall record in the office of Recorder of Deeds for Chester County a declaration of covenants in a form satisfactory to the [municipal] solicitor setting forth the rights and responsibilities of the homeowners' association for operation and maintenance of the stormwater management facilities, prior to the sale of individual lots. The terms of this covenant and restriction

shall run with the land and be binding upon the initial grantees of each lot within the subdivision, his, her or their heirs, administrators, successors and assigns.

5.2.3 Municipal Ownership

Where the [*municipality*] has accepted an offer of dedication of the permanent stormwater management facilities, the [*municipality*] shall be responsible for operation and maintenance. Municipal ownership notwithstanding, the Applicant is required to prepare a Stormwater Management Plan and an Operation and Maintenance Plan, as defined herein. Upon approval of the stormwater management facilities by the [*municipality*], the Applicant shall provide a lump sum long-term maintenance payment to the [*municipality*], to be reserved and used at all times by [*municipality*] only for costs of operation and maintenance of the dedicated facilities, as follows:

- A. Long-term Maintenance Payment – the long-term maintenance payment shall be in an amount equal to the present value of operation and maintenance costs for the facilities for a ten-year period. The long-term maintenance payment shall be based on a ten-year cost estimate prepared by the Applicant’s engineer and reviewed and approved by the municipal engineer. The amount of the payment shall include all costs of operation and maintenance which shall include but not be limited to, typical operation and maintenance costs as well as costs such as landscaping and planting, tax payments required and construction of any kind associated with the use, benefit and enjoyment of the facilities by the owners. In particular, a description of routine facility operation and day-to-day management requirements and a description of projected maintenance actions and schedules necessary to ensure proper operation of stormwater management facilities shall be submitted for review and approval to the municipal engineer.
- B. Documentation. The terms of the long-term maintenance payment shall be documented as part of the Stormwater Management Plan and the Operation and Maintenance Plan.

5.3 Operation and Maintenance Plan

An Operation and Maintenance Plan shall be prepared to identify the ownership, operation and maintenance responsibilities and as-built conditions for all stormwater management facilities. At a minimum, the operation and maintenance plan shall include the following:

- 5.3.1. Any obligations concerning perpetuation and/or maintenance of natural drainage or infiltration facilities, and other facilities identified within the Stormwater Management Plan. Ownership of and responsibility for operation and maintenance of stormwater management facilities, including names and contact information, shall be required.
- 5.3.2. A description of the permanent stormwater management practices on the site, explaining how each practice is intended to function and operate over time. All drainage and access easements shall be depicted and any site restrictions to be recorded against the property shall be identified on the plan. All such easements and restrictions shall be perfected to run with the land and be binding upon the landowner and any successors in interest.

- 5.3.3. A description of the actions, budget and schedule for operating and maintaining the stormwater management facilities. This description should be written in a clear manner, consistent with the knowledge and understanding of the intended user.
- 5.3.4. A general description of operation and maintenance activities and responsibilities for facilities held in common or on-lot, including but not limited to: lawn care, vegetation maintenance, clean out of accumulated debris and sediment (including from grates, trash racks, inlets, etc.), liability insurance, maintenance and repair of stormwater management facilities, landscaping and planting, payment of taxes and construction of any kind associated with the use, benefit and enjoyment of the facilities by the owners. In particular, a description of routine facility operation and day-to-day management requirements (as needed) and a description of routine maintenance actions and schedules necessary to ensure proper operation of stormwater management facilities shall be submitted.
- 5.3.5. Assurances that no action will be taken by any lot owner to disrupt or in any way impair the effectiveness of any stormwater management system, setting forth in deed restrictions the ability of the [municipality] to take corrective measures if it is determined at any time that stipulated permanent stormwater management facilities have been eliminated, altered, or improperly maintained, including the ability of the [municipality] to cause the work to be done and lien all costs against the property should the required corrective measures not be taken by the lot owner, following written notification, within a period of time set by municipal engineer.
- 5.3.6 Parties responsible for the long term operation and maintenance of stormwater management facilities shall make records of the installation and of all maintenance and repairs, and shall retain the records for at least ten (10) years. These records shall be submitted to the [municipality] as established by the Operation and Maintenance Plan or if otherwise required by the [municipality].

5.4 Operations and Maintenance Agreement

- 5.4.1 The owner of any land upon which permanent stormwater management facilities and/or BMPs will be placed, constructed or implemented, as described in an approved Stormwater Management Plan and the Operations and Maintenance Plan, shall record the following documents in the Office of the Recorder of Deeds for Chester County, within 15 days of approval of the Operations and Maintenance Plan by the Municipality:
 - A. The Operations and Maintenance Plan, or a summary thereof,
 - B. Operations and Maintenance Agreement, and
 - C. Access and/or drainage Easements.
- 5.4.2 The Operation and Maintenance Agreement shall be substantially the same as the sample agreement in Appendix C of this Ordinance.
- 5.4.3 Other items or conditions may be included in the Operation and Maintenance Agreement where determined necessary to guarantee the satisfactory operation and maintenance of all permanent stormwater facilities and BMPs. The agreement shall be subject to the review and approval of the Municipality.

- 5.4.4 The Municipality may suspend or revoke any approvals granted for the project site upon discovery of the failure of the owner to comply with Section 5 of this Ordinance.

Section 6.0 DEFINITIONS

Note: The following definitions are absolutely necessary in supporting this model ordinance. Municipalities may have some of these terms already defined in current ordinances for other purposes outside the scope of this model ordinance. Overlapping of defined terms must be addressed so there is no ambiguity in how a term is defined.

Additional terms, which are typically defined in most municipal ordinances, (for example, land development, subdivision, Applicant, owner, floodplain, riparian buffer) are not included here but are still applicable to this model ordinance. The municipality and their solicitor should review this model ordinance in the context of the other local ordinances for applicability and cross-referencing. Modifications to those existing definitions may be appropriate.

AASHTO - American Association of State Highway & Transportation Officials. The web site home page for ASHTO is <http://transportation1.org/aashtonew/>

Attenuate – To reduce the magnitude of the flow rate by increasing the time it takes to release a specified volume of runoff (for example the 1 year, 24 hour storm event). Attenuation is a method of reducing the peak flow rates for post development compared to the peak flow rates in predevelopment.

Aquifer - A geologic formation, group of formations, or part of a formation that contains sufficient saturated, permeable material to yield useful quantities of ground water to wells and springs.

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

Best Management Practice (BMP) – Methods, measures or practices to prevent or reduce surface runoff and/or water pollution, including but not limited to, structural and non-structural stormwater management practices and operation and maintenance procedures.

CCHD - Chester County Health Department.

CFS – Cubic Feet per Second.

Channel - A natural or artificial watercourse that conveys, continuously or periodically, flowing water.

Conservation Design - A series of holistic land development design practices that maximize protection of key land and environmental resources, preserve significant concentrations of open space and greenways, evaluate and maintain site hydrology, and ensure flexibility in development design to meet community needs for complementary and aesthetically pleasing development. Conservation Design encompasses the following objectives: conservation/enhancement of natural resources, wildlife habitat, biodiversity corridors and greenways (interconnected open space); minimization of environmental impact resulting from a change in land use (minimum disturbance, minimum maintenance); maintenance of a balanced water budget by making use of site characteristics and infiltration; incorporation of unique natural, scenic and historic site features into the configuration of the development; preservation of the

integral characteristics of the site as viewed from adjoining roads; and reduction in maintenance required for stormwater management practices. Such objectives can be met on a site through an integrated development process that respects natural site conditions and attempts, to the maximum extent possible, to replicate or improve the natural hydrology of a site.

Concentrated Storm Runoff - Surface runoff from rainfall events, which converges and flows primarily through water conveyance features such as swales, gullies, waterways, channels or storm sewers and which exceeds the maximum specified flow rates of filters or perimeter controls intended to control sheet flow.

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

Detention 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 shortly after any given rainfall event and are dry until the next rainfall event.

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

Ditch - An artificial waterway for irrigation or stormwater conveyance.

Drainage Area - That land area contributing runoff to a single point and that is enclosed by a ridge line.

Drainage System - All facilities and natural features used for the movement of stormwater through and from a drainage area, including, but not limited to, any and all of the following; conduits, pipes and appurtenant features: channels, ditches, flumes, culverts, streets, swales, gutters as well as all watercourses, water bodies and wetlands.

EPA - Environmental Protection Agency.

Easement – A right of use of a specified portion of land of another for a specified purpose.

Erosion – The wearing away of land surface by water or wind which occurs naturally from weather or runoff, but is often intensified by human activity.

FEMA – Federal Emergency Management Agency.

First Order Stream – Upper-most perennial tributary in a watershed that has not yet confluenced with another perennial stream. The confluence of two first order streams forms a “second” order stream.

Ground Water – Water that occurs in the subsurface and fills or saturates the porous openings, fractures and fissures of under-ground soils and rock units.

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

Hydrology – The study of the properties, distribution, circulation and effects of water on the Earth’s surface, soil and atmosphere.

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

Impervious Cover – See “Impervious Surface”.

Impervious Surface - A surface, which has been compacted or covered with a layer of material so that it is resistant to infiltration by water. It includes semi-pervious surfaces such as compacted clayey soils, as well as most conventionally surfaced streets, roofs, sidewalks, parking lots, and other similar surfaces. Net Increase of Impervious Surface refers to the difference between the existing impervious coverage and the total impervious surface proposed.

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

Intensity - The depth of accumulated rainfall per unit of time.

Intermittent Stream – A defined channel in which surface water is absent during a portion of the year, as ground water levels drop below the channel bottom.

Karst – A type of topography that is formed over limestone or other carbonate rock formations by dissolving or solution of the rock by water, and that is characterized by closed depressions, sinkholes, caves, a subsurface network of solution conduits and fissures through which ground water moves, and no perennial surface drainage features.

LVPC – Lehigh Valley Planning Commission.

Level Spreader – A low earthen berm constructed perpendicular to the direction of slope and extending across the width of the slope for the purpose of intercepting surface runoff and spreading it behind the berm to enhance infiltration and reduce erosion and runoff from the slope. The purpose of a level spreader is to prevent concentrated, erosive flows from occurring and to spread out stormwater runoff uniformly over the ground as sheet flow.

Loading – The total amount (generally measured in pounds or kilograms per acre per year) of material (sediment, nutrients, oxygen-demanding material, or other chemicals or compounds) brought into a lake, stream or water body by inflowing streams, runoff, direct discharge through pipes, ground water, the air (aerial or atmospheric deposition) and other sources over a specific period of time (often annually).

Maintenance -The action taken to restore or preserve the as-built functional design of any facility or system.

Meadow Condition - A natural groundcover with less than one viable tree of a DBH of six (6) inches or greater per fifteen-hundred (1,500) square feet 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.

MS4 - Municipal Separate Storm Sewer System.

NOAA - National Oceanic and Atmospheric Administration.

NRCS – Natural Resources Conservation Service.

National Pollution Discharge Elimination System (NPDES) – Created in 1972 under the Clean Water Act to authorize discharges to local receiving waters only pursuant to governmental permits, in an effort to reduce point source and non-point source pollutants.

New Development – Any activity regulated by this ordinance that is not considered a redevelopment as defined in this ordinance.

Non-structural Stormwater Management Practices - Passive, site design approaches or regulatory approaches that positively impact water quality and reduce or minimize the generation of stormwater runoff without requiring the construction of specific or discrete stormwater management control structures.

Open Channel – Any natural or man-made watercourse or conduit in which water flows with a free surface.

Open Vegetated Channel – also known as swales, grass channels, and biofilters. These systems are used for the conveyance, retention, infiltration and filtration of stormwater runoff.

PACD - Pennsylvania Association of Conservation Districts.

PADEP – Pennsylvania Department of Environmental Protection.

Pasture Condition – A ground cover of grassland or range with continuous forage for grazing and greater than 75% ground cover and lightly or only occasionally grazed; a cover condition for which the Soil Conservation Service curve numbers have been assigned or to which equivalent rational method runoff coefficients have been assigned.

Penn DOT – Pennsylvania Department of Transportation.

Percolation Rate – The rate of movement of water under hydrostatic pressure through interstices of rock or soil. For stormwater analysis, it is typically measured as a distance per unit of time (e.g., inches per hour).

Predevelopment Assumption - The ground cover assumption used when analyzing the stormwater runoff characteristics of a drainage area prior to the proposed development.

Rainfall Intensity -The depth of accumulated rainfall per unit of time.

Rate - Volume per unit of time.

Receiving Waters – Any water bodies, watercourses or wetlands into which surface waters flow.

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

Redevelopment - An existing, developed property and/or a graded, altered and compacted site (as of or after the date of adoption of this Ordinance) that is proposed for reconstruction.

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 ground water, exfiltration, and/or evaporation processes and which generally have residence times of less than three days.

Retention Basin - An impoundment designed to collect and retard stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate. Retention basins may also be designed to permanently retain additional stormwater runoff. Retention basins are designed to retain a permanent pool of water during dry weather.

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.

Runoff – see **Stormwater**.

SLAMM – Source Loading and Management Model. This model is based on small storm hydrology and pollutant runoff from urban land uses. Pollutant sources are identified and both structural and nonstructural stormwater practices can be accounted for in the model.

SCS – Soil Conservation Service.

SWMM – Stormwater Management Model. EPA developed this model for analyzing stormwater quantity and quality associated with runoff from urban areas. Both single event and continuous simulation can be performed on catchments having storm sewers, or combined sewers and natural drainage, for prediction of flows, stages and pollutant concentrations. Information on SWMM is available at <http://www.epa.gov/ceampubl/swater/swmm/index.htm>.

Sediment – Fragmented material that originated from weathering rocks and decomposing organic material that is transported by, suspended in, and eventually deposited in the streambed.

Sedimentation – Occurs when sediment particles that have been suspended within flowing water are deposited on the stream bottom or floodplain.

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

Special Flood Hazard Area - Those areas identified by the Federal Emergency Management Agency (FEMA), Federal Insurance Administration (FIA) as floodway area (FW), flood fringe area (FF), and general floodplain area (FA); where determined by the [*municipality*] identified alluvial soils may be included as well.

Storm Event - The storm of a specific duration, intensity, and frequency.

Stormwater or Runoff - The flow of water overland and/or in water bodies that results from and occurs during and immediately following a rainfall event.

Stormwater Management Plan - The approved detailed analysis, design, and drawings of the stormwater management system required for all construction.

Stormwater Management Practices - The designed and/or constructed features which infiltrate, treat, collect, convey, channel, store, inhibit, or divert the movement of stormwater; such practices include structural and non-structural practices.

Structure - Anything constructed or installed with a fixed location on the ground, or attached to something having a fixed location on the ground.

Structural Stormwater Management Practices - Any measures that require the design and construction of a facility to help reduce or eliminate a non-point source of pollution and control stormwater.

Subgrade -The top elevation of graded and compacted earth underlying roadway pavement.

Swale - An artificial or natural waterway which may contain contiguous areas of standing or flowing water only following a rainfall event, or is planted with or has stabilized vegetation suitable for soil stabilization, stormwater treatment, and nutrient uptake, or is designed to take into account the soil erodibility, soil percolation, slope, slope length, and contributing drainage area so as to prevent erosion and reduce the pollutant concentration of any discharge.

USDA – United States Department of Agriculture.

USDOT FHWA – United States Department of Transportation Federal Highway Administration.

Water Body - Any natural or artificial pond, lake, reservoir, or other area which ordinarily or intermittently contains water and which has a discernible shoreline and receives surface water flow.

Watercourse – A permanent or intermittent stream or other body of water, whether natural or man-made, which gathers or carries surface water.

Water Table – The upper most level of saturation of pore space or fractures by subsurface water in an aquifer. Seasonal High Water Table refers to a water table that rises and falls with the seasons due either to natural or man-made causes.

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 this Commonwealth.

Watershed - Land area that drains to a common water body. As used within this ordinance, refers to the land areas draining to the twenty-one (21) regionally recognized named streams illustrated in Appendix A of this ordinance.

Wetlands - Land areas that are inundated or saturated by surface or groundwater with 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, and similar areas); or areas that are defined and delineated in accordance with the Federal Manual for Identifying and Delineating Jurisdictional Wetlands, dated January 10, 1989, and as may be amended from time to time; or as further defined and delineated by the United States Army Corps of Engineers, the United States Environmental Protection Agency, or the Pennsylvania Department of Environmental Protection.

Woodland Condition - A natural groundcover with more than one viable tree of a DBH (diameter at breast height) 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.

APPENDIX A

Map of Watersheds Of Chester County With Municipal Borders

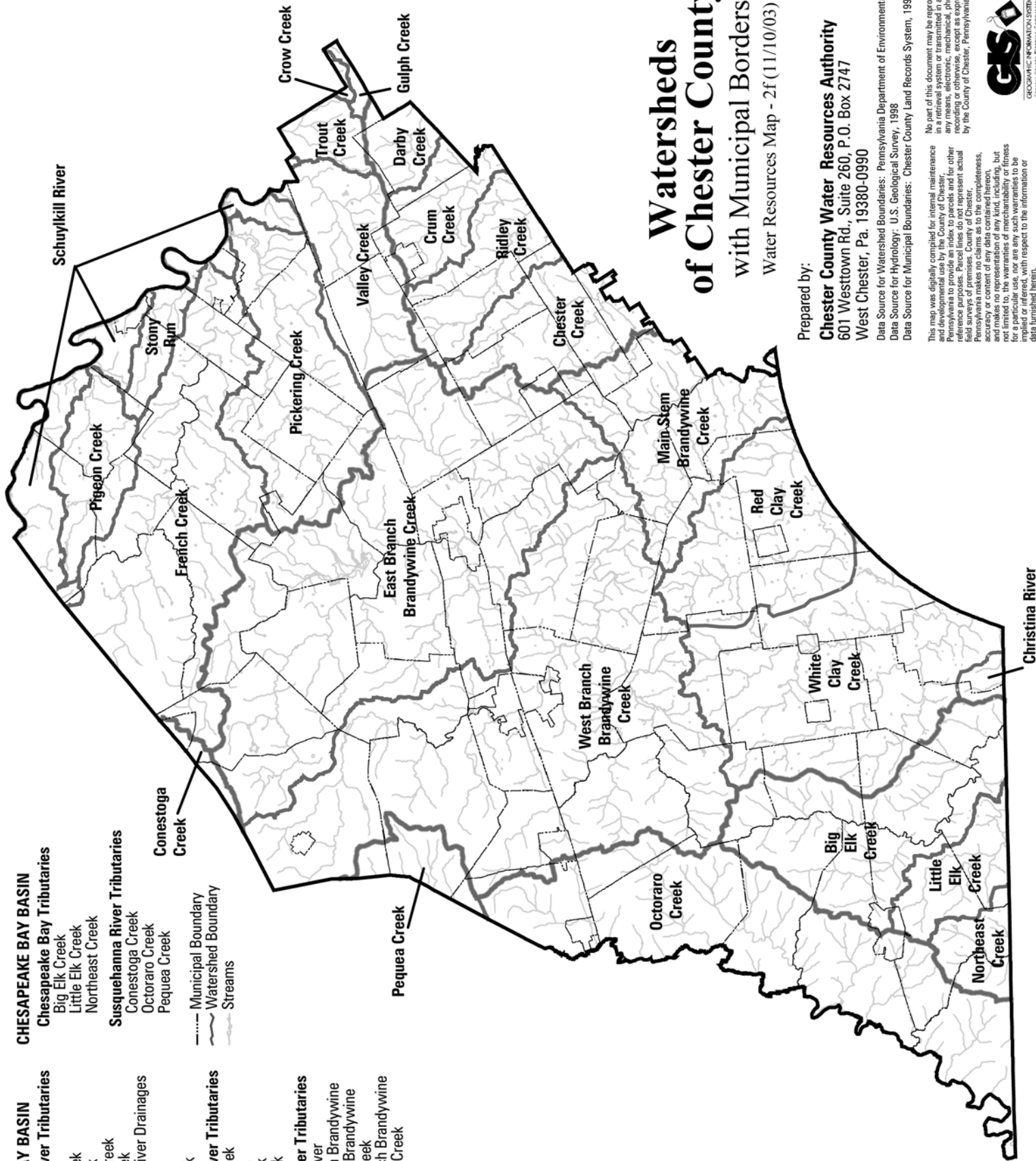
DELAWARE BAY BASIN

- Schuylkill River Tributaries**
 Crow Creek
 French Creek
 Gulph Creek
 Pickering Creek
 Pigeon Creek
 Schuylkill River Drainages
 Stony Run
 Trout Creek
 Valley Creek
- Delaware River Tributaries**
 Chester Creek
 Crum Creek
 Darby Creek
 Ridley Creek
- Christina River Tributaries**
 Christina River
 East Branch Brandywine
 Main Stem Brandywine
 Red Clay Creek
 West Branch Brandywine
 White Clay Creek

CHESAPEAKE BAY BASIN

- Chesapeake Bay Tributaries**
 Big Elk Creek
 Little Elk Creek
 Northeast Creek
- Susquehanna River Tributaries**
 Conestoga Creek
 Octoraro Creek
 Pequea Creek

- Municipal Boundary
 --- Watershed Boundary
 --- Streams



Watersheds of Chester County

with Municipal Borders

Water Resources Map - 2f (11/10/03)

Prepared by:
Chester County Water Resources Authority
 601 Westtown Rd., Suite 260, P.O. Box 2747
 West Chester, Pa. 19380-0990

Data Source for Watershed Boundaries: Pennsylvania Department of Environmental Protection, 1998
 Data Source for Hydrology: U.S. Geological Survey, 1998
 Data Source for Municipal Boundaries: Chester County Land Records System, 1998.

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APPENDIX B

NON-STRUCTURAL STORMWATER MANAGEMENT PRACTICES ALTERNATIVE APPROACH FOR MANAGING STORMWATER RUNOFF

Natural hydrologic conditions may be altered radically by poorly planned development practices, such as introducing unneeded 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 post-development runoff rates and volumes, which will minimize needs for artificial conveyance and storage facilities. To simulate pre-development hydrologic conditions, forced 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 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 typically are 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 minimizes the amount of grading on site.

Protecting Natural Depression Storage Areas. Depressional storage areas 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 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 connections 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 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 is in street length, which also will reduce costs of the development. Cluster development clusters the construction activity onto 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. Other benefits include reduced potential of downstream flooding, water quality degradation of receiving streams/water bodies and enhancement of aesthetics and reduction of development costs. Beneficial results include more stable baseflows in receiving streams, improved groundwater recharge, reduced flood flows, reduced pollutant loads, and reduced costs for conveyance and storage.

(Source: This appendix is taken from, Guidance on MS4 Ordinance Provisions, Document Number 392-0300-003, by the Pennsylvania Department of Environmental Protection, dated August 2, 2003.)

APPENDIX C

STORMWATER BEST MANAGEMENT PRACTICES OPERATIONS AND MAINTENANCE AGREEMENT

THIS AGREEMENT, made and entered into this _____ day of _____, 200__, 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 management 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, as approved by the Municipality, provides for management of stormwater within the confines of the Property through the use of Best Management Practices (BMP’s); 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 Best Management Practices 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 groundwater recharge 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 BMP's 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. and

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 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 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 10 days of receipt of invoice from the Municipality.
6. The intent and purpose of this Agreement is to ensure the proper maintenance of the onsite BMP(s) by the Landowner; provided, however, that this Agreement shall not be deemed to create or effect any additional liability of any party for damage alleged to result from or be caused by stormwater runoff.
7. The Landowner, its executors, administrators, assigns, 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.
8. The Municipality shall inspect the BMP(s) at a minimum of once every three 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 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)

(Source: This appendix is taken from, Guidance on MS4 Ordinance Provisions, Document Number 392-0300-003, by the Pennsylvania Department of Environmental Protection, dated August 2, 2003.)

APPENDIX D

SOIL USE GUIDE

Prepared: January 2005

Prepared By: Chester County Water Resources Authority

Footnotes to the Soil Use Guide table:

1. Potential for infiltration is divided into three broad categories; Low, Medium and High. Actual infiltration will vary. A soils investigation should be performed to determine if infiltration practices are appropriate for a given site. SHWT stands for Seasonal High Water Table.
2. Hydrologic Soil Group designation is per U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) (formerly USDA-SCS). A complete listing is available in Technical Release No. 55, Urban Hydrology For Small watersheds, June 1986.
3. The term "soil erodibility" is distinctly different from that of the term "soil erosion". Soil erosion on a given area generally depends more on the length and steepness of slope, rainstorm characteristics, surface cover and management than on soil properties. Some soils, however, erode more rapidly than others even when slope, rainstorm characteristics, surface cover and management are the same. This is due to soil properties alone and is the basis for predicting soil erodibility. Information on soil erodibility is available in the U.S. Department of Agriculture Natural Resources Conservation Service (USDA-SCS) publication titled, Pennsylvania Soil Interpretations Chester and Delaware Counties, 1975. Erodibility is divided into five classes and an associated erodibility value as follows:
Low (0.10 - 0.20); Medium (0.24 - 0.32)
High (0.37 - 0.49); Very High (0.49 - 0.64)
4. Hydric Soil classification is per United States Department of Agriculture, Hydric Soils List For Pennsylvania, 1995.
5. Alluvial soils classification is per Natural Resources Conservation Service.
6. These soil series may contain hydric soil inclusions within individual map units. It is recommended that an on-site investigation by a professional soil scientist take place to determine the suitability of the site for infiltration practices or stormwater management facilities.
7. If soils otherwise recommended for Retention/Detention basins are available on site, these soils are not recommended where the runoff to those facilities are from areas identified as having the potential for high levels of pollutants (commonly referred to as "hotspots").
8. This soil is an alluvial or colluvial soil frequently found in floodplains and high water areas. Since the municipality's floodplain regulations restrict structures in many of these soil areas, reference must be made to the floodplain map and the ordinance to determine whether a basin may be built at a particular location. High water tables in soils may require basins above ground level, since an excavated area would frequently fill with water.
9. The Unified Soil Classification System (USCS) is a widely used system for identifying soils according to their textural and plasticity qualities and on their grouping with respect to behavior. Additional information on the USCS is available in the United States Department of the Army, Field Manual 5-472, October 1999.

APPENDIX D - SOIL USE GUIDE

Prepared By: Chester County Water Resources Authority
Prepared: January 2005

Soil Type	Infiltration Potential (see note 1)	Depth to Seasonally High Water Table	Depth to Bedrock	Hydrologic Soil Group (see note 2)	Retention / Detention Basin Location	Soil Erodibility Class (see note 3)	Unified Soil Classification (see note 9)	Hydric Soil Yes/No? (see note 4)	Alluvial Soil Yes/No? (see note 5)
Aldino	Low (SHWT)	0.5 - 1 ft.	1.5 - 2.5 ft.	C	Not Recommended	High	CL, SM	No (see note 6)	No
Bedford	High	2 - 3 ft.	4 - 6 ft.	C	Recommended	High, Medium when stripped of Topsoil	ML-CL, MH	No	No
Beltsville	Low (SHWT)	1 - 2 ft.	6+ ft.	C	Not Recommended	High, Medium when stripped of Topsoil	CL, ML-CL, SC	No (see note 6)	Alluvial
Bowmansville	Low (potential for flooding)	0 - 1.5 ft.	3 - 6 ft.	B/D	Not Recommended	High, Medium to low when stripped of Topsoil	CL	Yes	Alluvial
Brandywine	High	10+ ft.	3 - 4 ft.	C	Not Recommended Recommended When High Pollution Risk Exists. (See note 7)	Medium to Low	SC, SM	No	No
Brecknock	High	5+ ft.	3 - 4 ft.	B	Recommended	Medium	ML, CL	No	No
Bucks	High	5+ ft.	3-5 ft.	B	Recommended	Medium to Low	ML, ML - CL	No	No

APPENDIX D - SOIL USE GUIDE

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Prepared: January 2005

Soil Type	Infiltration Potential (see note 1)	Depth to Seasonally High Water Table	Depth to Bedrock	Hydrologic Soil Group (see note 2)	Retention / Detention Basin Location	Soil Erodibility Class (see note 3)	Unified Soil Classification (see note 9)	Hydric Soil Yes/No? (see note 4)	Alluvial Soil Yes/No? (see note 5)
Calvert	Low (SHWT limits in Spring)	0 - 1 ft.	3+ ft.	****	Not Recommended	High	SM,MH	Yes	Alluvial
Chester	High	5+ ft.	5 - 6 ft/	B	Recommended	Medium at grade. High when stripped of topsoil	SM,SC,ML-CL	No	No
Chewacla	Low (Subject to Flooding)	0 - 1 ft.	3 - 6 ft.	C	Recommended Except as noted in 8 Below	High	CL	No (see note 6)	Alluvial
Chrome	Medium	5+ ft.	1 - 2.5 ft.	C	Shallow Bedrock restricts Excavation	Medium. Low when stripped of topsoil	GM,ML,MH,SM,GM	No	No
Conestoga	Medium (Subject to Limestone Considerations)	5+ ft.	4 - 6 ft.	B	Recommended	High. Medium when stripped of topsoil	ML-CL,MH,ML	No	No
Conowingo	Medium (SHWT)	1 - 2 ft.	3 - 4 ft.	C	Recommended	High at grade. Medium to low when stripped of topsoil	GM,SM,MH	No	No

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Soil Type	Infiltration Potential (see note 1)	Depth to Seasonally High Water Table	Depth to Bedrock	Hydrologic Soil Group (see note 2)	Retention / Detention Basin Location	Soil Erodibility Class (see note 3)	Unified Soil Classification (see note 9)	Hydric Soil Yes/No? (see note 4)	Alluvial Soil Yes/No? (see note 5)
Croton	Low	0 - 0.5 ft.	3 - 5 ft.	D	Not Recommended	High at grade. Medium when stripped of topsoil	CH,CL,SM,SC	Yes	No
Edgemont	High	5+ ft.	2 - 6 ft.	B	Recommended When High Pollution Risk Exists. (See note 7)	Medium at grade. Low when stripped of topsoil	SM	No	No
Glengelg	High	5+ ft.	3 - 5 ft.	B	Recommended When High Pollution Risk Exists. (See note 7)	Medium	SM,GM,ML	No	No
Glenville	Low (SHWT)	1 - 1.5 ft.	3 - 6 ft.	C	Recommended	High at grade. Medium at 4 feet depth	ML,ML-CL,MH	No (see note 6)	No
Guthrie	Low (SHWT)	0 - .5 ft.	3 - 5 ft.	D	Not Recommended	High at grade. Medium when stripped of topsoil	CL	Yes	Alluvial
Hagerstown	High (Subject to Limestone Consideration)	5+ ft.	4 - 6 ft.	C	Recommended	Medium	CL,ML	No	No

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Soil Type	Infiltration Potential (see note 1)	Depth to Seasonally High Water Table	Depth to Bedrock	Hydrologic Soil Group (see note 2)	Retention / Detention Basin Location	Soil Erodibility Class (see note 3)	Unified Soil Classification (see note 9)	Hydric Soil Yes/No? (see note 4)	Alluvial Soil Yes/No? (see note 5)
Hollinger	Medium (Subject to Limestone Consideration and potential bedrock Issues)	5+ ft.	2 - 6 ft.	B	Recommended	High at grade. Medium when stripped of topsoil	GM,SM,GP-GM	No	No
Lawrence	Low	1 - 2 ft.	4 - 6 ft.	C	Not Recommended	High at grade. Medium when stripped of topsoil	ML-CL	No (see note 6)	Colluvial
Lehigh	Low	1 - 2 ft.	2-4 ft.	C	Not Recommended	High at grade. Medium when stripped of topsoil	CL-ML,GM-GC,ML,CL	No (see note 6)	No
Lindsay	Low	0 - 1 ft.	3 - 6 ft.	C	Not Recommended	High	ML,CL	No (see note 6)	Alluvial
Manor	High	5+ ft.	2 - 7 ft.	B	Recommended	High	GM,SM,GP-GM	No	No
Melvin	Low	0 - 0.5 ft.	4 - 7 ft.	D	Not Recommended	High	CL,ML-CL	Yes	Colluvial
Montalto	High	5+ ft.	3 - 5 ft.	C	Recommended	Medium	MH	No	No

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Soil Type	Infiltration Potential (see note 1)	Depth to Seasonally High Water Table	Depth to Bedrock	Hydrologic Soil Group (see note 2)	Retention / Detention Basin Location	Soil Erodibility Class (see note 3)	Unified Soil Classification (see note 9)	Hydric Soil Yes/No? (see note 4)	Alluvial Soil Yes/No? (see note 5)
Neshaminy	High	5+ ft.	4 - 6 ft.	B	Recommended	Medium at grade. Low when stripped of topsoil	ML, ML-CL, MH, SM	No	No
Penn	High (subject to Depth of Bedrock)	5+ ft.	2 - 4 ft.	C	Recommended; subject to Depth to Bedrock	Medium	ML, CL, ML	No	No
Readington	Low	1+ ft.	2 - 5 ft.	C	Not Recommended	High at grade. Medium at 4 feet depth	CL, SM, ML-CL	No (see note 6)	No
Rowland	Low	0 - 2 ft.	4 - 5 ft.	C	Not Recommended	High at grade. Medium to low at 3 feet depth	CL	No (see note 6)	Alluvial
Watchung	Low	0 - 1 ft.	3 - 4.5 ft.	D	Recommended Except as noted in 8 Below	High. Medium when stripped of topsoil	MH	Yes	No
Wehadkee	Low	0 - 1 ft.	5 - 8 ft.	D	Recommended Except as noted in 8 Below	High. Medium when stripped of topsoil	ML	Yes	Alluvial
Worsham	Low	0 - 1 ft.	3 - 5 ft.	D	Recommended Except as noted in 8 Below	High. Medium when stripped of topsoil	ML, MH	Yes	Alluvial

APPENDIX E

List of References Cited and Additional Sources of Information

Prepared: January 2005

Prepared By: Chester County Water Resources Authority

Note: The adoption of a post construction stormwater management ordinance should always include the references cited in the body of the ordinance as well as additional sources of information. The cited references directly support the ordinance while the additional sources of information provide guidance to users of the ordinance. The additional sources of information listed below are by no means exhaustive or complete. It is expected that municipalities with the assistance of their engineer will update and amend this list over time.

List of References Cited

1. American Society of Civil Engineers and Water Environment Federation, Urban Runoff Quality Management, AM. Soc. Civ. Eng. Manuals and Reports of Engineering Practice No. 87, New York, NY; Water Environ. Fed. Manual of Practice No.23, Alexandria, VA, 1998.
2. Center for Watershed Protection, Design of Stormwater Filtering Systems, December 1996.
3. Chester County Board of Commissioners, *Watersheds: An Integrated Resources Plan for Chester County, Pennsylvania and Its watersheds*, Adopted September 17, 2002.
4. Chester County Water Resources Authority, Chester County, Pennsylvania Water Resources Compendium, Parts 1 and 2, December 2001.
5. Hershfield, D.M., Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years, Technical Paper No. 40 (Washington DC: Weather bureau, U.S. Department of Commerce), 1961.
6. Lehigh Valley Planning Commission, Technical Best Management Practice Manual & Infiltration Feasibility Report: Infiltration of Stormwater in Areas Underlain by Carbonate Bedrock within the Little Lehigh Creek Watershed, Lehigh Valley Planning Commission, November 2002.
7. Maryland Department of the Environment, Water Management Administration, 2000 Maryland Stormwater Design Manual Volume I & II, Baltimore, MD, 2000.
http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/stormwater_design/index.asp
8. National Oceanic and Atmospheric Administration, NOAA Atlas 14, Volume 2, June 2004.
<http://hdsc.nws.noaa.gov/hdsc/pfds/>
9. Pennsylvania Association of Conservation Districts, Pennsylvania Handbook of Best Management Practices for Developing Areas, Harrisburg, PA, 1998.
10. Pennsylvania Department of Environmental Protection, Erosion and Sediment Pollution Control Program Manual, Harrisburg, PA, March 2000.

APPENDIX E

List of References Cited and Additional Sources of Information

List of References Cited (continued)

11. Pennsylvania Department of Environmental Protection, Guidance On MS4 Ordinance Provisions, Document Number 392-0300-003, Harrisburg, PA., August 2, 2003.
12. Pennsylvania Department of Environmental Resources, Recommended Hydrologic Procedures for Computing Urban Runoff From Small Watersheds In Pennsylvania, Harrisburg, Pa., January 1982.
13. Pennsylvania Department of Transportation, Field Manual of Pennsylvania Department of Transportation Storm Intensity-Duration-Frequency Charts PDT-IDF, May 1986.
14. U.S. Department of Agriculture, Soil Conservation Service, Pennsylvania Soil Interpretations Chester and Delaware Counties, 1975.
15. U.S. Department of Agriculture and Natural Resources Conservation Service, Urban Hydrology for Small Watersheds, Technical Release 55, 2nd Edition, Washington, D.C., June 1986.
16. U.S. Department of Agriculture, Soil Conservation Service, National Engineering Handbook, Section 4 – Hydrology, March 1985.
17. U.S. Department of Agriculture, Soil Conservation Service, Engineering Field Manual for Conservation Practices, Washington, D.C., July 1984.
18. U.S. Department of the Army, Field Manual 5-472 NAVFAC MO 330 AFJMAN 32-1221(I), Materials Testing, July 2001.
19. U.S. Department of Transportation, Federal Highway Administration, Design of Stable Channels with Flexible Linings, Hydraulic Engineering Circular No. 15, Washington DC, 1986.

Additional Sources of Information

1. Byle, Michael J., Stormwater Infiltration Practices in Karst, 2001 Southeastern Pennsylvania Stormwater Management Symposium, October 2001, Villanova University.
2. Chester County Planning Commission, Community Planning Handbook Volume 1, A Toolbox for Managing Change In Chester County, May 1997.
3. Chester County Planning Commission, Community Planning Handbook Volume 2, A Toolbox for Managing Change In Chester County, March 1999.
4. Chester County Planning Commission, Planning Bulletin No. 9, Stormwater Management Practices (revised), Chester County Planning Commission, Westtown, PA. 2003.
5. Center for Watershed Protection, Ellicott City, MD. <http://www.cwp.org/>

APPENDIX E

List of References Cited and Additional Sources of Information

Additional Sources of Information (continued)

6. Mays, Larry W., Stormwater Collection Systems Design Handbook, McGraw-Hill, 2001.
7. Metropolitan Washington Council of Governments, A Current Assessment of Urban best Management Practices; Techniques for Reducing Nonpoint Source Pollution in the Coastal Zone, March 1992.
8. New Jersey Department of Environmental Protection, Division of Watershed Management, The New Jersey Stormwater Best Management Practices Manual, April 2004.
http://www.njstormwater.org/bmp_manual2.htm
9. New York State Department of Environmental Conservation and Center for Watershed Protection, New York State Stormwater Design Manual, October 2001.
<http://www.dec.state.ny.us/website/dow/toolbox/swmanual/index.html>
10. Pennsylvania Department of Environmental Protection, Bureau of Watershed Management, Stormwater management Program.
<http://www.dep.state.pa.us/dep/deputate/watermgt/wc/subjects/stormwatermanagement.htm>
11. Prince George's County, Maryland, Department of Environmental Resources, Low-Impact Development Design Manual, November 1997.
12. Prince George's County, Maryland, Department of Environmental Resources, Low-Impact Development Design Strategies, An Integrated Design Approach, January 2000.
13. Prince George's County, Maryland, Department of Environmental Resources, Low-Impact Development Hydrologic Analysis, January 2000.
14. Raiston, Mark R., and Issa S. Oweis, Geotechnical Engineering Considerations for Stormwater Management in Karst Terrain, 1999 Southeastern Pennsylvania Stormwater Management Symposium, October 1999, Villanova University.
15. U.S. Department of Transportation Federal Highway Administration, Urban Drainage Design Manual, Hydraulic Engineering Circular No.22, Second Edition, 2001.