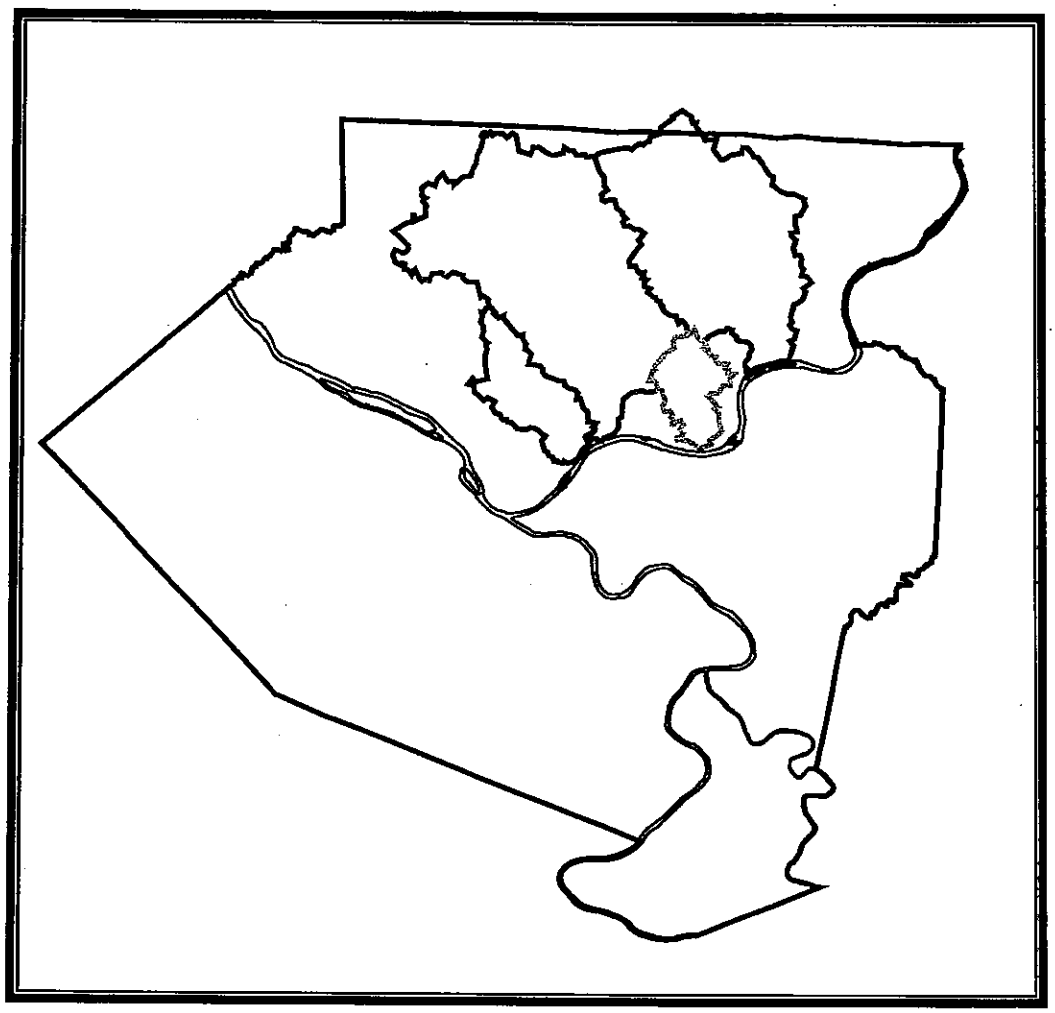
BOROUGH OF ETNA

ORDINANCE NO. 1320

"AN ORDINANCE OF THE BOROUGH OF ETNA, ALLEGHENY COUNTY, PENNSYLVANIA REPEALING ORDINANCE NO. 1191, DATED JULY 21, 1987, AND ENACTING REQUIREMENTS FOR THE SAFE MANAGEMENT OF STORMWATER RUNOFF IN ACCORDANCE WITH THE PINE CREEK WATERSHED MANAGEMENT PLAN ADOPTED AND APPROVED PURSUANT TO THE PENNSYLVANIA STORM WATER MANAGEMENT ACT (ACT 167 OF 1978, AS AMENDED); ESTABLISHING PROVISIONS FOR THE SUBMISSION AND APPROVAL OF STORMWATER MANAGEMENT PLANS PRIOR TO THE ISSUANCE OF ANY BUILDING PERMIT; AND SETTING PROCEDURES FOR ENFORCING THE PROVISIONS OF THIS ORDINANCE"

Chapter 10
Stormwater Ordinance



Act 167 Stormwater Management Plan Update
Girtys Runs, Pine Creek, Squaw Run and Deer Creek Watersheds
Allegheny County, Pennsylvania

ADOPTED

SEPTEMBER 16, 2008

ETNA BOROUGH COUNCIL MEETING

BOROUGH OF ETNA

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Acknowledgement

This project is a multi-municipal effort to "Update" the Act 167 Stormwater Management Plan and Ordinance for the Girtys Run, Pine Creek, Squaw Run and Deer Creek watersheds in Allegheny County, Pennsylvania.

There are many significant improvements contained within the new regional Act 167 Stormwater Management Ordinance, such as;

- The incorporation of water quality and infiltration standards
- Provision of credits for the use of non-structural best management practices, such as; the protection of existing wooded and natural areas, the use of stream buffers, the use of enhanced swales and infiltration practices and for the use of low density development practices
- Continued 2, 10, 25 and 100 year storm peak rate reduction requirements
- The application of stormwater management requirements to all sites having a disturbed area of greater than 400 square feet
- Stormwater management requirements for existing sites that undergo redevelopment
- Ordinance requirements may not be waived by the local municipality and must be approved by Allegheny County or its designee
- The development of a standardized BMP design method for small projects

The Update was brought about by the coordinated efforts of the municipalities in these watersheds. The project was initiated and managed by Art Gazdik, P.E., the Ross Township Engineer, who acted as the project's engineer and project manager. Project funding was provided by the State Of Pennsylvania through Act 167 and by pro-bono contributions from Ross Township, Art Gazdik, the North Hills Council of Governments and the Allegheny County Department of Economic Development

The development of the Update was overseen by the Watershed Plan Advisory Committee (WPAC). The WPAC was made up of individuals from local environmental groups, PA DEP, the Allegheny County Conservation District, the Allegheny County Department of Economic Development, the North Hills Council of Governments and municipal managers, planners and engineers.

In particular, the contributions of the following individuals who greatly assisted in the development of this important stormwater management effort should be recognized.

Bud Schubel	Allegheny County Department of Economic Development
Wayne Roller	North Hill Council of Governments
Andy Banfield, P.E.	Partridge Venture Engineering
Mary A. Moretti	Bradford Woods Borough, Manager
Mark Weber	Bradford Woods
Mary Ellen Ramage	Etna Borough Manager
Bill Gordon, P.E.	Fox Chapel Borough Manager

Ambrose Rocca	Franklin Park Borough Manager
W. Christopher Lochner	Hampton Township Manager
Martin Orban	Hampton Township Planner
Dan Anderson	Indiana Township Manager
Dan Slagle, P.E.	Indianan Township Engineer
Neil D. McFadden	Marshall Township Manager
Bill Campbell	Marshall Township
Scot Fodi	Middlesex Township Manager
Tobias M. Cordek	Town of McCandless Manager
Bruce Betty	Town of McCandless
Mark Sabina	Town of McCandless
Virginia Heller	Millvale Borough Manager
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John Swinderman	Pine Township
Dick Hadley	Reserve Township Manager
Dean E. Bastianini	Richland Township Manager
Jeff Walzer	Richland Township
Thomas D. Lavorini	Ross Township Manager
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Kevin Creagh, P.E.	Shaler Township Engineer
Debbie Vita	Shaler Township
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Scott Shoup, P.E.	Shoup Engineering
Jason Dailey	West Deer Township Manager
Gary Bogan	West Deer Township
Kenneth Wolf	West View Borough Manager
Dave McMillen	Montour Run Watershed Association
Bill Moul	North Area Environmental Council
Mary Wilson	North Area Environmental Council
Jen Novak	Pennsylvania Environmental Council
Rick Kowalski	Allegheny County Conservation District
Steve Haubner	Atlanta Regional Commission
Barry Newman, P.E.	PA DEP
Bob Scheib, P.E.	PA DEP
Greg Holish, P.E.	PA DEP
Ed Ritzer	PA DEP

It was a pleasure being involved with this effort and it is my hope that the standards contained in our plan will be used by others, within Allegheny County and our region, to reduce the effects of flooding and to improve the quality of our waterways.

Art Gazdik, P.E.
Ross Township Engineer
Act 167 Project Manager
Gazdik@ross.pa.us

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Appendices

STORMWATER MANAGEMENT

Section 1.0 Purpose

In order to protect the health, safety, and general welfare of the residents of the Municipality, as well as to protect, sustain, and enhance the surface and ground water resources of the Municipality, drainage and stormwater management practices shall be utilized as directed herein to achieve the following goals and 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 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 the 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, 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 the Municipality, and protect and/or restore natural hydrologic characteristics and habitats wherever possible throughout the watershed systems.

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.

Section 2.0 General Provisions

2.1 Statutory Authority

Primary Authority:

The municipality is empowered to regulate these activities by the authority of the Act of October 4, 1978, P.L. 864 (Act 167), 32 P.S. Section 680.1, et seq., as amended, the "Storm Water Management Act" and the (appropriate municipal code).

Secondary Authority:

The Municipality also is empowered to regulate land use activities that affect runoff by the authority of the Act of July 31, 1968, P.L. 805, No. 247, The Pennsylvania Municipalities Planning Code, as amended.

2.2 Applicability

The standards contained herein shall apply to all Regulated Activities within the municipality. In addition, all local, county and State erosion and sedimentation control approvals must be in place to proceed with any Regulated Activity.

2.2.1 Activities regulated by this Ordinance include, but are not limited to, the following:

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.

G. Any Earth Disturbances or any activities that involve the alteration or development of land or removal of tree and vegetation in a manner that may affect post construction stormwater runoff.

2.2.2 Redevelopments shall conform to the requirements contained in Section 4.1.3.C, when more than a two thousand (2,000) square feet area of an existing facility is reconstructed, following the demolition, or partially demolition of the existing facility. The area determination shall be made using the footprint of the area being reconstructed, including all impervious surfaces proposed in the reconstructed area and the area of the parking lot required to support the reconstructed facility. The area of the parking lot required to support the reconstructed facility shall be determined using the Municipal Zoning Ordinance requirements for parking.

2.3 Exemptions

2.3.1 With the approval of Municipality's 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 and approved by the Municipal Engineer.

A. Regulated Activities smaller than 400 sq. ft. are exempt from the requirements of this Ordinance to implement SWM BMPs, unless the activity is found to be a significant contributor to pollution of the Waters of this Commonwealth.

B. Small Project Exemption. Activities having a Disturbed Area of less than five thousand (5000) square feet are exempt from the Peak Rate Control requirements of this Ordinance. These projects shall comply with the Water Quality Volume standards contained in Section 4.1.3.A and the Extended Detention requirement contained in Section 4.3.1.A. The "Small Project Standardized SWM Guidance" document provided in Appendix F was prepared to assist Applicants in meeting this requirement **for individual lots only**. The reduced site plan requirements contained in the "Small Project Standardized SWM Guidance" document shall apply.

C. Emergency Exemption. Emergency maintenance work performed for the protection of public health, safety and welfare may be exempted from the requirements in this Ordinance to obtain approval for a Stormwater Management Plan before commencement of the activity; however, 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 may not resume until a written Stormwater Management Plan is submitted and approved.

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

E. Gardening. Use of land for gardening for home consumption.

F. Agricultural Activities. Agriculture when operated in accordance with a conservation plan, nutrient management plan or erosion and sedimentation control plan approved by the Allegheny 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 less than one thousand (1,000) square feet are exempt from the requirement to submit a written Stormwater Management Plan.

G. 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.

2.3.2 Waivers

A. The provisions of this Ordinance are the minimum standards for the protection of the public health, safety, property, and welfare.

B. If an Applicant demonstrates to the satisfaction of the County or its designee 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 County or its designee upon obtaining the comments and recommendations of the Municipality and the Allegheny 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 Applicants shall refer to the Pennsylvania Stormwater Best Management Practices Manual, Pennsylvania Department of Environmental Protection (DEP). No. 363-0300-002 (2006), as amended and updated, or the Erosion and Sediment Pollution Control Program Manual, Pennsylvania Department of Environmental Protection (DEP). 363-2134-008 (2000), as amended and updated, or other appropriate references for guidance in the design of stormwatermanagement facilities most appropriate to individual site conditions. References to the Maryland Manual, if not deleted, should be to specific sections of Maryland's manual in order to minimize NPDES permitting conflicts with the guidance provided by the Pennsylvania Stormwater BMP Manual. 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 Allegheny County or its designee for review and approval. Copies of the waiver request shall also be submitted to the Municipality.

E. The Governing Body shall keep a written record of all actions on waiver requests.

F. The Governing Body 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 Municipality, the County and the Allegheny County Conservation District for reasonable and necessary fees that may be incurred in any review of a waiver request.

G. In granting waivers, the County or its designee may impose reasonable conditions that will, in its judgment, secure substantially the objectives of the standards or requirements that are to be modified.

H. The County or its designee may grant applications for waivers when the following findings are made:

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 solely 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 post-development peak flow from the site will not occur and will, in fact, be reduced by the appropriate amount if the site is in a subbasin having a release rate of less than 100%.
9. There will be no increase in the of the post-development total runoff volume for all storms equal to or less than the 2 year / 24 hour storm event.
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 no receiving streams and/or water bodies within 2000 feet downstream will be adversely impacted in flood carrying capacity, aquatic habitat, channel stability or 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, 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 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 Storm Water Best Management Practices Manual, as amended, Pennsylvania Handbook of Best Management Practices for Developing Areas (PACD, 1998), 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 SWM design work must be completed by a Qualified Design Professional. All designs proposing the use of a SWM retention or detention facility with outlet structure(s) shall be completed by a professional engineer licensed in the state of Pennsylvania.

2.4.4 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, unless an approval is received from PA DEP. The natural conveyance characteristics of the site and the receiving floodplain shall be incorporated into the stormwater management practices proposed for the site.

2.4.5 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.

2.4.6 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.

2.4.7 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.

2.4.8 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.

2.4.9 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, except as needed for roadways, driveways and walkways, or 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.

2.4.10 For all Regulated Activities, stormwater management BMPs shall be designed, implemented, operated, and maintained to meet the purposes and requirements of this Ordinance and to meet all requirements under Pennsylvania Code Title 25, the Clean Streams Law, and the Storm Water Management Act.

2.4.11 Any Regulated Activity that may affect the stormwater flows toward or onto a State or County highway right-of-way or facility shall be designed, implemented, operated, and maintained in accordance with the regulations of the Pennsylvania Department of Transportation (PennDOT) or Allegheny County, as the case may be.

2.4.12 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.

2.4.13 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.

2.4.14 For all Regulated Earth Disturbance Activities, erosion and sediment control BMPs shall be designed, implemented, operated, and maintained during the Regulated Earth Disturbance Activities (e.g., during construction) to meet the purposes and requirements of this Ordinance and to meet all requirements under the Pennsylvania Code Title 25 and the Clean Streams Law. Various BMPs and their design standards are listed in the Erosion and Sediment Pollution Control Program Manual (E&S Manual), Commonwealth of Pennsylvania, Department of Environmental Protection, No. 363-2134-008, as amended and updated.

2.4.15 No regulated earth disturbance activities within the Municipality shall commence until the requirements of this Ordinance are met.

2.4.16 Post-construction water quality protection shall be addressed as required by the Stormwater Management requirements contained in this Ordinance.

2.4.17 Operations and maintenance of permanent stormwater BMPs shall be addressed as required by Section 5.0.

2.4.18 All best management practices (BMPs) used to meet the requirements of this Ordinance shall conform to the State Water Quality Requirements, and any more stringent requirements as required by the Municipality.

2.4.19 Techniques described in Appendix B (Non-Structural Stormwater Management Practices) of this Ordinance are encouraged, because they reduce the costs of complying with the requirements of this Ordinance and the State Water Quality Requirements.

2.4.20 In selecting the appropriate BMPs or combinations thereof, the Applicant shall consider the following:

A. Total contributing area.
B. Permeability and infiltration rate of the site soils.
C. Slope and depth to bedrock.
D. Seasonal high water table.
E. Proximity to building foundations and wellheads.
F. Erodibility of soils.
G. Land availability and configuration of the topography
H. Peak discharge and required volume control.
I. Stream bank erosion.
J. Efficiency of the BMPs to mitigate potential water quality problems.
K. The volume of runoff that will be effectively treated.
L. The nature of the pollutant being removed.
M. Maintenance requirements.
N. Creation/protection of aquatic and wildlife habitat.

2.4.20 Transference of runoff from one DEP designated Act 167 watershed to another shall be prohibited unless approved by the municipality.

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, or any other ordinance of the Municipality, the more stringent requirements shall govern.

2.8 Permit Requirements by Other Government Entities

2.8.1 All regulated earth disturbance activities subject to permit requirements by DEP under regulations at 25 Pa. Code Chapter 102.

2.8.2 Work within natural drainage ways subject to permit by DEP under 25 Pa. Code Chapter 105.

2.8.3 Any stormwater management facility that would be located in or adjacent to surface waters of the Commonwealth, including wetlands, subject to permit by DEP under 25 Pa. Code Chapter 105.

2.8.4 Any stormwater management facility that would be located on a State highway right-of-way, or require access from a State highway, shall be subject to approval by the Pennsylvania Department of Transportation (PennDOT).

2.8.5 Culverts, bridges, storm sewers or any other facilities which must pass or convey flows from the tributary area and any facility which may constitute a dam subject to permit by DEP under 25 Pa. Code Chapter 105.

2.9 Erosion and Sediment Control During Regulated Earth Disturbance Activities

2.9.1 No Regulated Earth Disturbance activities within the Municipality shall commence until the Municipality receives a copy of any required approvals from the Conservation District or DEP for an Erosion and Sediment Control Plan.

2.9.2 DEP has regulations that require an Erosion and Sediment Control Plan for any earth disturbance activity of 5,000 square feet or more, under 25 Pa. Code § 102.4(b).

2.9.3 In addition, under 25 Pa. Code Chapter 92, a DEP "NPDES Construction Activities" permit is required for Regulated Earth Disturbance activities.

2.9.4 Evidence of any necessary permit(s) for Regulated Earth Disturbance activities from the appropriate DEP regional office or County Conservation District must be provided to the Municipality.

2.9.5 A copy of the Erosion and Sediment Control plan and any required permits, as required by DEP regulations, shall be available at the project site at all times.

2.9.6 Additional erosion and sediment control design standards and criteria are recommended to be applied where infiltration BMPs are proposed and shall include the following.

A. Areas proposed for infiltration BMPs shall be protected from sedimentation and compaction during the construction phase to maintain maximum infiltration capacity.

B. Infiltration BMPs shall not be constructed nor receive runoff until the entire contributory drainage area to the infiltration BMP has achieved final stabilization

2.10 Prohibited Discharges and Connections

2.10.1 No person in the Municipality shall allow, or cause to allow, stormwater discharges into the Municipality's separate storm sewer system and or Waters of this Commonwealth which are not composed entirely of stormwater, except (1) as provided in Subsection 2.10.2. below, and (2) discharges allowed under a State or Federal permit.

2.10.2 The following discharges are authorized unless they are determined to be significant contributors to pollution to the Waters of this Commonwealth:

- Discharges from fire fighting activities
- Potable water sources including dechlorinated water line and fire hydrant flushings
- Irrigation drainage
- Routine external building washdown (which does not use detergents or other compounds)
- Air conditioning condensate
- Water from individual residential car washing
- Spring water from crawl space pumps
- Uncontaminated water from foundation or from footing drains
- Flows from riparian habitats and wetlands
- Lawn watering
- Pavement wash waters where spills or leaks of toxic or hazardous materials have not occurred (unless all spill material has been removed) and where detergents are not used
- Dechlorinated swimming pool discharges
- Uncontaminated groundwater

2.10.3 In the event that the Municipality determines that any of the discharges identified in Section 2.10.2 significantly contribute to pollution of waters of the Commonwealth, or is so notified by DEP, the Municipality or PADEP will notify the responsible person to cease the discharge.

2.10.4 Nothing in this Section shall affect a discharger's responsibilities under State law.

2.10.5 Existing roof drain, underdrain and sump pump discharge should be directed to lawn area or other pervious areas. If required by the Municipality, the discharge shall be directed to a stone sump or infiltration BMP. If approved by the Municipality the discharge may also be directly connected to the storm sewer system.

2.11 Enforcement and Penalties

2.11.1 Right-of-Entry

Upon presentation of proper credentials, the Municipality may enter at reasonable times upon any property within the Municipality to inspect the condition of the stormwater structures and facilities in regard to any aspect regulated by this Ordinance.

2.11.2 Inspection

SWM BMPs should be inspected by the land owner/developer (including Municipality for dedicated facilities) according to the following list of frequencies:

A. Annually for the first 5 years.

B. Once every 3 years thereafter,

C. During or immediately after the cessation of a 10-year or greater storm.

2.11.3 Enforcement

A. It shall be unlawful for a person to undertake any Regulated Activity except as provided in an approved SWM Site Plan.

B. It shall be unlawful to alter or remove any control structure required by the SWM Site Plan.

C. Inspections regarding compliance with the SWM Site Plan are a responsibility of the Municipality.

2.11.4 Suspension and Revocation

A. Any approval for a Regulated Activity issued may be suspended or revoked, in whole or in part, by the Municipality for:

1. Non-compliance with or failure to implement any provision of the approval.

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

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

B. A suspended approval may be reinstated by the Municipality when:

1. The Municipality has inspected and approved the corrections to the violations that caused the suspension.

2. The Municipality is satisfied that the violation has been corrected.

C. An approval that has been revoked by the Municipality cannot be reinstated. The Applicant may apply for a new approval under the provisions of this Ordinance.

D. Prior to revocation or suspension of a permit, if there is no immediate danger to life, public health, or property the Municipality may notify the land owner/ developer to discuss the non-compliance.

2.11.5 Penalties

A. Anyone violating the provisions of this Ordinance shall be guilty of a summary offense, and upon conviction shall be subject to a fine of not more than $1000.00 for each violation, recoverable with costs. Each day that the violation continues shall be a separate offense and penalties shall be cumulative.

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

2.11.6 Appeals

A. Any person aggrieved by any decision of the Municipality, relevant to the provisions of this Ordinance, may appeal to the County Court Of Common Pleas in the county where the activity has taken place within thirty (30) days of the Municipality's decision.

Section 3.0 Stormwater Management Plan

For all Regulated Activities not eligible for exemptions pursuant to Section 2.3 of this Ordinance 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. Final copies of all plans, specifications and reports shall also be submitted to the municipality in Adobe PDF format.

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. The Chapter 93 Water Quality Standards use designation must also be provided on the plan.

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 (if needed).

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 wetland delineation report for the project site with a location map identifying wetland areas if any were found.

3.10 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.

3.11 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.

3.12 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. Topographic contours showing the existing

and proposed final contours at an interval of two (2') feet; in areas having slope of greater than 15% a five (5') contour interval may be used.

3.13 A plan of the erosion and sedimentation procedures to be utilized as required by local ordinance and State Regulations.

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, graphic 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.

3.20 A listing of all permits required for the site providing the status of the permit application(s) and approval(s).

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 when appropriate;

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.

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 a mechanism for stormwater management based on hydrologic soil group (or 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 into 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, slope stability concerns, 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 and extended detention 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, pervious pavement systems and infiltration trenches).

E. When designing stormwater management facilities to satisfy the peak flow attenuation and extended detention requirements (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 considered and where possible incorporated into design decisions.

4.1.3 Minimum Performance Criteria

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. 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.

2. 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. Designed according to the specific performance criteria outlined in Section 2.4.2.

   b. Constructed in accordance with all permits and approved plans and specifications; and

   c. Maintained per an approved operation and maintenance plan or agreement or, in lieu of that, in accordance with customary practices.

3. 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.4, below, are considered hotspots.

4. 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.

5. 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.

6. All stormwater management practices shall have an Operation and Maintenance Plan pursuant to Section 5.3 of this Ordinance, and if to be privately owned, 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.

7. 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 natural wetlands and 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 (if used). 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, as provided in Section 2.4.2.

2. The post development peak discharge rate shall not exceed the predevelopment peak discharge rate multiplied by the "subbasin release rate percentage" (where determined in Act 167 watersheds) for the 2-year, 10-year, 25-year, and 100-year 24-hour storm events pursuant to the predevelopment cover assumption described in Section 4.2.2. Refer to Appendix A for release rate percentages information.

3. Facilities capable of attenuating rainfall runoff shall be provided and be designed to attenuate the runoff volume from the 1-year 24-hour storm event for at least 24 hours.

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 make best possible use of infiltration on-site shall be considered in all site designs, when appropriate.

C. The following minimum performance standards shall apply to all applicable **redevelopment** activities, pursuant to Section 2.2.2.

> *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:

   a. Reduce the total impervious cover on the site (e.g., by using pervious pavement, replacement of pavement with pervious planting areas or green roof systems) by at least twenty five percent (25%), based on

a comparison of existing impervious cover to proposed impervious cover, **or**

b. Provide facilities designed to attenuate the runoff volume from the one (1) year 24-hour post development storm event for at least 24 hours, or

c. Provide facilities to insure that the post development peak discharge rate shall not exceed the predevelopment peak discharge rate multiplied by the "subbasin release rate percentage" (where determined in Act 167 watersheds) for the 2-year and 10-year 24-hour storm events. A predevelopment cover CN of 71 shall be assumed.

2. In addition to the minimum performance standards for redevelopment areas in 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 facilities shall be designed to capture and treat one quarter of one inch (0.25") of runoff from all pavement areas (i.e. parking lots, pavements and non-covered sidewalks). Roof area may be excluded from this calculation.

4.2 Stormwater Runoff Calculation Criteria

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 used for analysis of the pre and post development conditions. These values are applicable to the Soil-Cover-Complex Method:

Return Period (years)	24 Hour Storm (inches)
1	2.00
2	2.35
10	3.30
25	3.91
100	4.92

The precipitation values for each frequency storm listed above were abstracted from 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 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 (Diameter at breast height (**DBH**) is the diameter of the tree stem 4 1/2 feet above the ground) of six (6) inches or greater per fifteen-hundred (1,500) square feet shall be considered wooded where such trees existed within ten (10) years of application. If there is evidence of logging within the ten (10) year period logged area shall be consider as woodland in good condition.

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.

3. All other portions of a site shall use a ground cover of meadow in good condition.

4. All watershed area(s) contributing to the point of interest including off-site area shall be considered.

5. For redevelopment sites, see 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
Grass	39	61	74	80

C. Impervious cover shall have a curve number of 98.

D. Gravel pavement shall have a curve number of 89.

E. Average antecedent moisture conditions, or AMC II, shall be used (for the Soil Cover Complex Method only for example, TR-55, TR-20).

F. A type II distribution storm (for the Soil Cover Complex Method only for example, TR-55, TR-20).

G. For time of concentration calculations, sheet flow lengths shall not exceed 100 feet and shallow concentrated flow lengths shall not exceed 1000 feet.

F. The kinematic "n" value in the sheet flow equation should be applied as per the following table. (Values taken from TR-55)

Impervious Surfaces	0.011
Agricultural Lands	0.17
Grass, Lawn, or Open Space	0.24
Wooded Areas	0.40

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

4.2.4 A Modified Rational Method analysis may be used for drainage areas smaller than two (2) 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 precipitation frequency estimates developed by the National Oceanic and Atmospheric Administration as set forth in NOAA Atlas 14.

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 considered and be based on the existing conditions in the off-site area.

4.3 Standards for Stormwater Management Practices

The Pennsylvania Stormwater Best Management Practices Manual 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.

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

4.3.1 Extended Detention, Water Quality Volume, Infiltration & Nonstructural BMP Credits Criteria

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

A. Extended Detention

1. Detain the 1-year, 24-hour design storm using the SCS Type II distribution. Provisions shall be made so that the 1-year storm takes a minimum of 24 hours to drain from the facility from a point where the maximum volume of water from the 1-year storm is captured. (i.e., the maximum water surface elevation is achieved in the facility). Release of water can begin at the start of the storm (i.e., the invert of the water quality orifice is at the invert of the facility). The design of the facility shall consider and minimize the chances of clogging and sedimentation potential.

2. Detention ponds shall detain the 1-year storm event and allow it to naturally infiltrate and recharge the groundwater table. All subsequent orifices for the 2, 10, 25, and 100-year storm events shall be placed above the maximum water surface elevation of the 1-year storm.

3. Flow from off-site areas must be considered as pass-through flow if it is conveyed through the BMP and should be modeled as "present condition" for the one year storm event.

4. The length of overland flow used in time of concentration (t_c) calculations is limited to no more than 100 feet for post development conditions.

5. The models TR-55 and TR-20 (or approved equivalent) can be used for determining peak discharge rates.

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 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 = site 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.

5. For new developments and redevelopments, infiltration is considered an acceptable method of satisfying part or all of the Water Quality Volume.

6. 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.

7. 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.

C. Infiltration Volume

Where possible, all of the Water Quality Volume should be treated using infiltration BMPs. The following calculation shall be used to determine the minimum recharge goal for the site.

Recharge Volume (Re_v), (acre-feet) Fraction of WQ_v, depending on soil hydrologic group. $Re_v = (S)(A_i)$ Where; S = soil specific recharge factor in inches A_i = the measured impervious cover	
Hydrologic Soil Group	Soil Specific Recharge Factor (S)
A	*0.40 inches*
B	*0.25 inches of runoff*
C	*0.10 inches of runoff*
D	*0.05 inches of runoff*

1. Infiltrated volume may be subtracted from the total site WQ_v

2. Infiltration should not be considered for sites or areas of sites that have activities that may allow pollution to be infiltrated. For example the use of infiltration for the runoff of a service stations paved lot would not be appropriate, although roof water from the service station may be infiltrated.

3. Infiltration should only be used when in the opinion of a professional engineer it will not contribute to slope instability or cause seepage problems into basements or developed down-gradient areas.

4. If more than one hydrologic soil group is present at a site, a composite recharge volume shall be computed based upon the proportion of total site area within each hydrologic soil group.

5. All infiltration facilities shall be set back at least fifteen (15) feet from all structures with sub-grade elements (e.g., basements, foundation walls).

D. Credits for Use of Nonstructural BMPs

The developer may obtain credits for the use of nonstructural BMPs using the procedures outlined below. Examples of nonstructural credit calculations are provided in Appendix E.

Volume Reduction Method #1: Natural Area Conservation

A water quality volume reduction can be taken when undisturbed natural areas are conserved on a site, thereby retaining their pre-development hydrologic and water quality characteristics. Under this method, a designer would be able to subtract the conservation areas from the total site area when computing the water quality protection volume. An added benefit is that the post-development peak discharges will be smaller, and hence, water quantity control volumes will be reduced due to lower post-development curve numbers or rational formula "C" values.

Rule: Subtract conservation areas from total site area when computing water quality protection volume requirements.

Criteria:

• Conservation area cannot be disturbed during project construction and must be protected from sediment deposition. The conservation area shall be protected with a safety fence until construction has been completed. After construction the area shall be posted with signage indicating that it is a conservation area.

• Shall be protected by limits of disturbance clearly shown on all construction drawings

• Shall be located within an acceptable conservation easement instrument that ensures perpetual protection of the proposed area. The easement must clearly specify how the natural area vegetation shall be managed and boundaries will be marked [Note: managed turf (e.g., playgrounds, regularly maintained open areas) is not an acceptable form of vegetation management]

• Shall have a minimum contiguous area requirement of 10,000 square feet

• R_v is kept constant when calculating WQ_v

- Must be forested or have a stable, natural ground cover.

Volume Reduction Method #2: Stream Buffers

This reduction can be taken when a stream buffer effectively treats storm water runoff. Effective treatment constitutes treating runoff through overland flow in a naturally vegetated or forested buffer. Under the proposed method, a designer would be able to subtract areas draining via overland flow to the buffer from total site area when computing water quality protection volume requirements. The design of the stream buffer treatment system must use appropriate methods for conveying flows above the annual recurrence (1-yr storm) event.

Rule: Subtract areas draining via overland flow to the buffer from total site area when computing water quality protection volume requirements.

Criteria:

- The minimum undisturbed buffer width shall be 50 feet from top of bank
- The maximum contributing length shall be 150 feet for pervious surfaces and 75 feet for impervious surfaces
- The average contributing slope shall be 3% maximum unless a flow spreader is used. In no case shall the average contributing slope be greater than 10%.
- Runoff shall enter the buffer as overland sheet flow. A flow spreader can be installed to ensure this
- Buffers shall remain as naturally vegetated or forested areas and will require only routine debris removal or erosion repairs
- R_v is kept constant when calculating WQ_v
- Not applicable if overland flow filtration/groundwater recharge reduction is already being taken

Volume Reduction Method #3: Enhanced Swales

This reduction may be taken when enhanced swales are used for water quality protection. Under the proposed method, a designer would be able to subtract the areas draining to an enhanced swale from total site area when computing water quality protection volume requirements. An enhanced swale can fully meet the water quality protection volume requirements for certain kinds of low-density residential development (see Volume Reduction Method #5). An added benefit is the post-development peak discharges will likely be lower due to a longer time of concentration for the site.

Rule: Subtract the areas draining to an enhanced swale from total site area when computing water quality protection volume requirements.

Criteria:

- This method is typically only applicable to moderate or low density residential land uses (3 dwelling units per acre maximum)
- The maximum flow velocity for water quality design storm shall be less than or equal to 1.0 feet per second

- The minimum residence time for the water quality storm shall be 5 minutes
- The bottom width shall be a maximum of 6 feet. If a larger channel is needed use of a compound cross section is required
- The side slopes shall be 3:1 (horizontal:vertical) or flatter
- The channel slope shall be 3 percent or less
- R_v is kept constant when calculating WQ_v

Volume Reduction Method #4: Overland Flow Filtration/Groundwater Recharge Zones

This reduction can be taken when "overland flow filtration/infiltration zones" are incorporated into the site design to receive runoff from rooftops or other small impervious areas (e.g., driveways, small parking lots, etc). This can be achieved by grading the site to promote overland vegetative filtering or by providing infiltration or "rain garden" areas. If impervious areas are adequately disconnected, they can be deducted from total site area when computing the water quality protection volume requirements. An added benefit will be that the post-development peak discharges will likely be lower due to a longer time of concentration for the site.

Rule: If impervious areas are adequately disconnected, they can be deducted from total site area when computing the water quality protection volume requirements.

Criteria:

- Relatively permeable soils (hydrologic soil groups A and B) should be present
- Runoff shall not come from a designated hotspot
- The maximum contributing impervious flow path length shall be 75 feet
- Downspouts shall be at least 10 feet away from the nearest impervious surface to discourage "re-connections"
- The disconnection shall drain continuously through a vegetated channel, swale, or filter strip to the property line or structural storm water control
- The length of the "disconnection" shall be equal to or greater than the contributing length
- The entire vegetative "disconnection" shall be on a slope less than or equal to 3 percent
- The surface impervious area tributary to any one discharge location shall not exceed 5,000 square feet
- For those areas draining directly to a buffer, reduction can be obtained from either overland flow filtration *-or-* stream buffers (See Method #2)
- R_v is kept constant when calculating WQ_v

Volume Reduction Method #5: Environmentally Sensitive Large Lot Subdivisions

This reduction can be taken when a group of environmental site design techniques are applied to low and very low density residential development (e.g., 1 dwelling unit per

2 acres [du/ac] or lower). The use of this method can eliminate the need for structural storm water controls to treat water quality protection volume requirements. This method is targeted towards large lot subdivisions and will likely have limited application.

Rule: Targeted towards large lot subdivisions (e.g. 2 acre lots and greater). The requirement for structural facilities to treat the water quality protection volume may be waived.

Criteria:

For Single Lot Development:

- Total site impervious cover is less than 15%
- Lot size shall be at least two acres
- Rooftop runoff is disconnected in accordance with the criteria in Method #4
- Grass channels are used to convey runoff versus curb and gutter

For Multiple Lots:

- Total impervious cover footprint shall be less than 15% of the area
- Lot areas should be at least 2 acres, unless clustering is implemented. Open space developments should have a minimum of 25% of the site protected as natural conservation areas and shall be at least a half-acre average individual lot size
- Grass channels should be used to convey runoff versus curb and gutter (see Method #3)
- Overland flow filtration/infiltration zones should be established (see Method #4)

Note: The following sections provide minimum design standards for Stormwater Management Facilities.

4.3.2 Stormwater Infiltration Practices

A. In selecting the appropriate infiltration BMPs, the Applicant shall consider the following:

1. Permeability and infiltration rate of the site soils.
2. Slope and depth to bedrock.
3. Seasonal high water table.
4. Proximity to building foundations and well heads.
5. Erodibility of soils.
6. Land availability and topography.
7. Slope stability.
8. Effects on nearby properties and structures.

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

1. Analyze hydrologic soil groups as well as natural and man-made features within the watershed to determine general areas of suitability for infiltration BMPs.

2. Provide field testing data to determine appropriate percolation rate and/or hydraulic connectivity.

3. Design infiltration BMPs for required stormwater volume based on field-determined capacity at the level of the proposed infiltration surface.

C. Soil characteristics, as subject to the specific considerations below:

1. Infiltration BMPs are particularly appropriate in hydrologic soil groups A and B, as described in the Natural Resources Conservation Manual TR-55.

2. Low-erodibility factors ("K" factors) are preferred for the construction of basins.

3. There must be a minimum depth of 48 inches between the bottom of any facility and the seasonal high water table and/or bedrock (limiting zones), except for infiltration BMPs receiving only roof runoff which shall be placed in soils having a minimum depth of 24 inches between the bottom of the facility and the limiting zone.

4. There must be an infiltration and/or percolation rate sufficient to accept the additional stormwater load, and to drain completely as determined by field tests.

5. The infiltration system shall have positive overflow controls to prevent storage within 1 foot of the finished surface or grade.

6. Infiltration rates shall not be used the computing the storage volume of the infiltration system.

7. Surface inflows shall be designed to prevent direct discharge of sediment into the infiltration system.

D. The recharge volume provided at the site shall be directed to the most permeable hydrologic soil group available, except where other considerations apply such as in limestone geology.

E. Any infiltration BMP shall be capable of completely infiltrating the impounded water within 48 hours. The 48 hour period is to be measured from the end of the 24 hour design storm.

F. The Municipality may require additional analyses for stormwater management facilities proposed for susceptible areas such as:

1. Strip mines.

2. Storage areas for salt, chloride, other materials for winter deicing.

3. Unstable Slopes.

G. During the period of land disturbance, runoff shall be controlled prior to entering any proposed infiltration area. Areas proposed for infiltration BMP's shall be protected from sedimentation and compaction during the construction phase, so as to maintain their maximum infiltration capacity.

H. Infiltration BMP's shall not be constructed nor receive runoff until the entire contributory drainage area to the infiltration BMP has received final stabilization.

I. Infiltration facilities shall be selected based on suitability of soils and site conditions. Acceptable infiltration facilities 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).

J. 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

K. All infiltration facilities shall be set back at least fifteen (15) feet from all structures with sub-grade elements (e.g., basements, foundation walls).

L. All infiltration facilities 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.

M. If detailed infiltration study is required, the following guidance shall be followed:

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.

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 facilities 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.

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 Allegheny County Health Department (ACHD) 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 ACHD. The location and number of test pits and percolation holes shall be determined based on the type(s) of stormwater management facilities being designed. 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.

N. The following design and construction standards shall be followed when planning and constructing infiltration BMPs.

1. The lowest elevation of the infiltration area shall be at least two (2) feet above the Seasonal High Water Table and bedrock.

2. Where roof drains are designed to discharge to infiltration facilities, 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.

3. All infiltration facilities 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 48 hours after the end of the 24-hour design storm.

4. All infiltration facilities shall be designed to infiltrate the stored volume within 48 hours after the end of the 24-hour design storm.

5. 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.

6. 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.

7. The following procedures and materials shall be required during the construction of all subsurface facilities:

    a. Excavation for the infiltration facility shall be performed with equipment that will not compact the bottom of the seepage bed/trench or like facility.

    b. The bottom of the bed and/or trench shall be scarified prior to the placement of aggregate.

    c. Only clean aggregate with documented porosity, free of fines, shall be allowed.

    d. The tops and sides of all seepage beds, trenches, or like facilities shall be covered with drainage fabric. Fabric shall meet the specifications of PennDOT Publication 408, Section 735, Construction Class 1.

    e. 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. Where perforated pipes are used to distribute stormwater to the infiltration practice, stormwater shall be distributed uniformly throughout the entire seepage bed/trench or like facility.

4.3.3 Open Vegetated Channels

A. Open Vegetated Channels are conveyance systems that are engineered to also perform as water quality and infiltration facilities. 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 twelve (12) 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.

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. The channel shall be provided with a permanent concrete cleanout marker that indicates the 25% loss level.

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 Roadside Channels with Flexible Linings, HEC 15, FHWA, September 2005.

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 or other vectors. If circulation cannot be provided via natural means, then artificial aeration and circulation shall be provided. Care shall 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 Allegheny 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. A permanent concrete cleanout maker shall be installed in the forebay to indicate the level where 25% for the forebay storage has been used.

G. Emergency spillways shall be sized and located to permit the safe passage of stormwater flows from an unattenuated 100-year post-development storm with 1 foot of freeboard. 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, rip rap and native stone.

H. Basin and pond embankments must be designed by a professional engineer registered in the State of Pennsylvania. The design must include an investigation of the subsurface conditions at the proposed embankment location to evaluate settlement potential, groundwater impacts, and the need for seepage controls. The submittal of a geotechnical report from a geotechnical engineer for any embankment over 10 feet in effective height or posing a significant hazard to downstream property or life is required. The selection of fill materials must be subject to approval of the design engineer. Fill must be free of frozen soil, rocks over six inches, sod, brush, stumps, tree roots, wood, or other perishable materials. Embankment fills less than 10 feet in fill height must be compacted using compaction methods that would reasonably guarantee that the fill density is at least 90% of the maximum density as determined by standard proctor (ASTM-698). All embankment fills more than 10 feet in fill height must be compacted to at least 90% of the maximum density as determined by standard proctor (ASTM-698) and must have their density verified by field density testing. A PADEP Dam permit is required for embankments having; a maximum depth of water, measured from the upstream toe of the dam to the top of the dam at maximum storage elevation, of greater than 15 feet; and or for ponds having contributory drainage area of greater than 100 acres; and or for impoundments of greater than 50 acre-feet.

I. The embankment's interior slope may not be steeper than 3:1 (3 horizontal to 1 vertical). The exterior slope of the embankment may not exceed 2:1 (2 horizontal to 1 vertical).

J. The minimum embankment width shall be 4' for embankments less than 6' in height, 6' if the embankment is between 6.1' and 9.9' in height and 8' if the embankment is between 10' and 15' in height.

K. 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.

L. Inlet structures and outlet structures shall be separated to the greatest extent possible in order to maximize the flow path through the retention basin.

M. 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).

N. The retention basin depth shall average three (3) to six (6) feet.

O. Fencing of the facility is not required if the interior slope of the pond is 4H:1V or flatter and the design also includes a five (5') wide bench around the pond perimeter at an elevation 1' below the permanent water surface elevation.

P. Any side slopes below the permanent water surface level shall not exceed 3H:1V. Interior side slopes above the permanent water surface level shall not exceed 3H:1V.

Q. Stabilization. Proper stabilization structures, including stilling basins, energy dissipators, 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.

R. Energy dissipators 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. Level Spreaders shall be used only where the maximum slope between the discharge point and the waterway does not exceed five (5%) percent. Energy dissipators shall comply with criteria in Hydraulic Design of Energy Dissipators for Culverts and Channels, HEC 14, FHWA, July, 2006.. Such facilities shall be both functional and harmonious with the surrounding environment; for example, native rock shall be used in constructing dissipators where practical.

S. Discharge Points. The minimum distance between a proposed basin discharge point (including the energy dissipator, 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.

T. 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 fifteen (15) inches and a minimum grade of one percent (1%).

2. Bentonite plugs 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, or smooth interior HDPE pipe in conformance with AASHTO M252 or M294.

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 standpipes.

4.3.5 Detention Basins

A. 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 fifteen (15) inches and a minimum grade of one percent (1%).

2. Bentonite plugs 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, or smooth interior HDPE pipe in conformance with AASHTO M252 or M294.

6. Energy dissipation facilities that convert concentrated flow to uniform shallow sheet flow shall be used where appropriate.

7. 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 standpipes.

G. Emergency spillways shall be sized and located to permit the safe passage of stormwater flows from an unattenuated 100-year post-development storm with 1 foot of freeboard. 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 facilities 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, rip rap and native stone.

H. Basin and pond embankments must be designed by a professional engineer registered in the State of Pennsylvania. The design must include an investigation of the subsurface conditions at the proposed embankment location to evaluate settlement potential, groundwater impacts, and the need for seepage controls. The submittal of a geotechnical report from a geotechnical engineer for any embankment over 10 feet in effective height or posing a significant hazard to downstream property or life is required. The selection of fill materials must be subject to approval of the design engineer. Fill must be free of frozen soil, rocks over six inches, sod, brush, stumps, tree roots, wood, or other perishable materials. Embankment fills less than 10 feet in fill height must be compacted using compaction methods that would reasonably guarantee that the fill density is at least 90% of the maximum density as determined by standard proctor (ASTM-698). All embankment fills more than 10 feet in fill height must be compacted to at least 90% of the maximum density as determined by standard proctor (ASTM-698) and must have their density verified by field density testing. A PADEP Dam permit is required for embankments having; a maximum depth of water, measured from the upstream toe of the dam to the top of the dam at

maximum storage elevation, of greater than 15 feet; and or for ponds having contributory drainage area of greater than 100 acres; and or for impoundments of greater than 50 acre-feet.

I. The embankment's interior slope may not be steeper than 3:1 (3 horizontal to 1 vertical). The exterior slope of the embankment may not exceed 2:1 (2 horizontal to 1 vertical).

J. The minimum embankment width shall be 4' for embankments less than 6' in height, 6' if the embankment is between 6.1' and 9.9' in height and 8' if the embankment is between 10' and 15' in height.

K. Fencing of the facility is not required if the interior slope of the pond is 4:1 or flatter.

L. 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.

M. Energy dissipators 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. Level Spreaders shall be used only where the maximum slope between the discharge point and the waterway does not exceed five (5%) percent. Energy dissipators shall comply with criteria in Hydraulic Design of Energy Dissipators for Culverts and Channels, HEC 14, FHWA, July, 2006. Such facilities shall be both functional and attractive; for example, native rock shall be used in constructing dissipators where practical.

N. Stabilization. Proper stabilization structures, including stilling basins, energy dissipators, 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.

O. Discharge Points. The minimum distance between a proposed basin discharge point (including the energy dissipator, 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.

P. 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. 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.

E. 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.

F. 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.

G. 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.

H. [When requested by the municipality] the developers shall obtain or grant 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.

I. 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.

J. 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 Facilities

Stormwater management facilities shall be landscaped in accordance with the following standards.

Note: Many municipalities require that stormwater management facilities 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 facilities; 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 facilities 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 facilities.

1. Wet meadows and floors of stormwater management facilities shall be planted with non-invasive plants native to western Pennsylvania such as wildflowers and non-invasive 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. For seeding recommendations, reference the DEP's E&S Pollution Control Program Manual.

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 facilities 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's 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 facilities 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 facilities shall be screened in a manner which complements the existing landscape and provides sufficient access for maintenance.

4.5 Stream Buffer Requirements

Stream buffers shall be provided for new development sites as per the following requirements:

4.5.1 A minimum stream buffer width of 50 feet landward in each direction from the top of stream banks is required for all waterways having both a defined bank and a contributing watershed area of greater than 100 acres.

4.5.2 A minimum stream buffer width of 15 feet landward in each direction from the centerline of the waterway is required for smaller waterways having a contributing watershed area of less than 100 acres and greater than 10 acres.

4.5.3 The stream buffer area should be maintained in a natural state.

4.5.4 When wetland(s) extend beyond the edge of the required buffer width, the buffer shall be adjusted so that the buffer consists of the extent of the wetland plus a 25-foot zone extending beyond the wetland edge.

4.5.5 Stream buffer averaging may be applied to account for encroachments such as road crossings. The following criteria must be met in order to utilize buffer averaging on a development site:

1. Buffer averaging is required for water quality buffers that have stream crossings.

2. An overall average buffer width of at least 50 feet must be achieved within the boundaries of the property to be developed. Stream buffer corridors on adjoining properties cannot be included with buffer averaging on a separate property, even if owned by the same property owner.

3. The average width must be calculated based upon the entire length of stream bank that is located within the boundaries of the property to be developed. When calculating the buffer length, the natural stream channel should be followed.

4. Stream buffer averaging shall be applied to each side of a stream independently. If the property being developed encompasses both sides of a stream, buffer averaging can be applied to both sides of the stream, but must be applied to both sides of the stream independently.

5. On each stream bank, the total width of the buffer shall not be less than 25 feet at any location, except at approved stream crossings. Those areas of the buffer having a minimum width of 25 feet (or less at approved stream crossings) can comprise no more than 50 percent of the buffer length.

4.5.6 Stream buffer locations and widths should be illustrated on all subdivision plans with notations requiring that they be maintained in a natural state.

4.5.7 Stream buffers should be illustrated on all grading and erosion and sedimentation control plans. The defined stream buffer location should be properly recorded. The recording should provide a plan illustrating the stream buffer location, width and the requirement that it be maintained in a natural state.

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 Allegheny 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 Facilities.

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 a written offer of such stormwater management facilities for dedication to the Municipality. 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 municipal entry for inspection and/or maintenance purposes.

D. Regardless of ownership, the Applicant shall submit an actual "as built" plan to Municipality 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 including, but not limited to, pipe material and diameter, inlet, outlet and overflow elevations, 2' contours for all detention/retention basins and drainage swales and a comparison of "as-built" capacities compared to the capacities of the approved design 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 by the Municipal Engineer. Any

performance and/or financial securities established for the project shall include requirements for submittal of "as built" plans.

E. The "as-built" plan(s) shall be submitted to the Municipality in a digital format or formats approved by the Municipality

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 Private Ownership

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, including a reasonable allowance for overhead, and to enforce said charges and assessments by lien upon the property. In addition, the deed for each lot shall contain a perpetual covenant binding the grantee and all successors in interest designating the responsibility for operation and maintenance of the on-lot facilities essentially in the following form:

"UNDER AND SUBJECT, nevertheless, to the following conditions and restrictions: Prior to any Earth Disturbance for which stormwater management facilities are required by the Municipality, Grantee shall construct the permanent stormwater management facilities as shown on the stormwater management plan (the "Plan") prepared by <NAME>, P.E., dated <DATE> and last revised <DATE> and approved by Municipality; thereafter, the Grantee, his heirs, executors, administrators, successors and assigns ("Owner"), at his 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 plus a reasonable allowance for overhead 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 aforesaid 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, within a period of ninety (90) calendar days, 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 Allegheny 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 plus a reasonable allowance for overhead 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 Allegheny 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 the 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 by an engineer licensed to practice in the Commonwealth of Pennsylvania that identifies 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 facilities on the site, explaining how each facility 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 recorded 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 plus a reasonable overhead allowance 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 Allegheny 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.

The following Section 5.5 the Special Stormwater Facility Maintenance Fund is optional.

Several municipalities in the study area currently use this type of fund and requested that the Stormwater Facilities Fund language from the existing Act 167 SWM Ordinance be considered for inclusion in the model ordinance. The pervious sections of this ordinance have already stated that one of the options for maintaining private BMPs is to require that they be maintained by the facility owner with the municipality having the right to complete repairs and receive compensation if the facility owner fails to do so. Additionally, this section as currently written would require ***every*** *homeowner who installs an on-lot BMP to pay into the fund. It is recommended that significant review be done to revise this language if this Section is to be included in the local SWM ordinance. Alternately, municipalities may choose to delete Section 5.5.*

5.5 Special Stormwater Facility Maintenance Fund (Optional)

5.5.1 Persons installing storm water storage facilities will be required to pay a specified amount to the Municipal Stormwater Facility Maintenance Fund if one exists to help defray costs of periodic inspections and annual maintenance expenses. The amount of the deposit shall be determined as follows:

5.5.1.1 If the storage facilities are to be privately owned and maintained, the deposit shall cover the cost of periodic inspections performed by the Municipality for a period of ten (10) years, as estimated by the Municipal Engineer. After that period of time, inspections will be performed at the expense of the Municipality.

5.5.1.2 If the storage facilities are to be owned and maintained by the Municipality, the deposit shall cover the estimated annual costs for maintenance and inspections for ten (10) years. The Municipal Engineer will establish the estimated annual maintenance costs utilizing information submitted by the applicant.

5.5.1.3 The amount of the deposit to Maintenance Fund, covering annual inspection and maintenance costs, shall be converted to present worth of the annual series values.

The Municipal Engineer or Manager shall determine the present worth equivalents which shall be subject to the final approval of the Governing Body.

5.5.1.4 If a storage facility is proposed, which also serves as a recreation facility such as a lake or ballfield, the Municipality may reduce or waive the amount of the maintenance fund deposit based on the value of the land for public recreational purposes.

5.5.2 If any storage facility (whether publicly or privately owned) is subsequently eliminated due to the installation of storm sewers or another storage facility (e.g., a distributed storage facility), the unused portion of Maintenance Fund may be applied to the cost of abandoning the facility and connecting to the storm sewer system or other facility. Any amount of the deposit remaining after the costs of abandonment are paid will be returned to the depositor.

Section 6 is presented as an example of how the municipalities may handle plan submission and review. Municipalities may revise this section as needed to conform to their procedures.

Section 6 Plan Submission, Review and Review Fees

6.1 Plan Submission- the Municipality shall require receipt of a complete plan, as specified in this Ordinance.

6.1.1 Six (6) copies of the Stormwater Management Plan shall be submitted and distributed as follows:

B. Two (2) copies to the Municipality accompanied by the requisite Municipal Review Fee as established by the Municipality.

C. Two (2) copies to the County Conservation District.

D. One (1) copy to the Municipal Engineer.

E. One (1) copy to the County Planning Commission/Department.

6.2 Review

6.2.1 The Municipal Engineer shall review the Stormwater Management Plan for consistency with the Stormwater Ordinance. Any Stormwater Management Plan found incomplete shall not be accepted for review and shall be returned to the Applicant.

6.2.2 The Municipal Engineer shall review the Stormwater Management Plan for any subdivision or land development against the municipal subdivision and land development ordinance provisions not superseded by this Ordinance.

6.2.3 When required by regulation, the County Conservation District shall review and approve the Erosion & Sedimentation Control Plan for consistency with PADEP's Chapter 102 regulations.

6.2.4 For activities regulated by this Ordinance, the Municipal Engineer shall notify the Applicant and the Municipality, whether the Stormwater Management Plan is consistent with the Ordinance.

B. Should the Stormwater Management Plan be determined to be consistent with the Stormwater Management Plan, the Municipal Engineer shall forward an approval letter to the Municipal Secretary who will then forward a copy to the Applicant.

C. Should the Stormwater Management Plan be determined to be inconsistent with the Stormwater Management Plan, the Municipal Engineer shall forward a disapproval letter to the Municipal Secretary who will then forward a copy to the Applicant. The disapproval letter shall cite the reason(s) and specific Ordinance sections for the disapproval. Disapproval may be due to inadequate information to make a reasonable judgment as to compliance with the stormwater management plan. Any disapproved Stormwater Management Plans may be revised by the Applicant and resubmitted consistent with this Ordinance.

6.2.5 For Regulated Activities specified in Section 2.0 of this Ordinance, which require a building permit, the Municipal Engineer shall notify the Municipal Building Permit Officer in writing, within a time frame consistent with the Municipal Building Code and/or Municipal Subdivision Ordinance, whether the Stormwater Management Plan is consistent with the Stormwater Management Plan and forward a copy of the approval/disapproval letter to the Applicant. Any disapproved Stormwater Management plan may be revised by the Applicant and resubmitted consistent with this Ordinance.

6.2.6 For regulated activities under this Ordinance that require an NPDES Permit Application, the Applicant shall forward a copy of the Municipal Engineer's letter stating that the Stormwater Management Plan is consistent with the stormwater management plan to the County Conservation District. PADEP and the County Conservation District may consider the Municipal Engineer's review comments in determining whether to issue a permit.

6.2.7 The Municipality shall not grant preliminary or final approval to any subdivision or land development for Regulated Activities specified in Section 2.0 of this Ordinance if the Stormwater Management Plan has been found to be inconsistent with the Stormwater Management Plan, as determined by the Municipal Engineer. All required permits from PADEP must be obtained prior to approval of any subdivision or land development.

6.2.8 No building permits shall be issued for any Regulated Activity specified in Section 2.0 of this Ordinance if the Stormwater Management Plan has been found to be inconsistent with the Stormwater Management Plan, as determined by the Municipal Engineer, or without considering the comments of the Municipal Engineer. All required permits from PADEP must be obtained prior to issuance of a building permit.

6.2.9 The Applicant shall be responsible for completing record drawings of all stormwater management facilities included in the approved Stormwater Management Plan. The record drawings and an explanation of any discrepancies with the design plans shall be submitted to the Municipal Engineer for final approval. In no case shall the Municipality approve the record drawings until the Municipality receives a copy of an approved Highway Occupancy Permit from the PennDOT District Office, NPDES Permit, and any other applicable permits or approvals, from PADEP or the County Conservation District. The above permits and approvals must be based on the record drawings. The record drawings must include copies of all applicable permits and approvals.

6.2.10 The Municipality's approval of a Stormwater Management Plan shall be valid for a period not to exceed five (5) years commencing on the date that the Municipality approves the Stormwater Management Plan. If stormwater management facilities included in the

approved Stormwater Management plan have not been constructed, or if constructed and record drawings of these facilities have not been approved within this time period, then the Municipality may consider the Stormwater Management Plan disapproved and may revoke any and all permits. Stormwater Management Plans that are considered disapproved by the Municipality shall be resubmitted in accordance with Section 6.4 of this Ordinance.

6.3 Modification of Plans

6.3.1 A modification to a Stormwater Management Plan under review by the municipality for a development site that involves a change in stormwater management facilities or techniques, or that involves the relocation or re-design of stormwater management facilities, or that is necessary because soil or other conditions are not as stated on the Stormwater Management Plan as determined by the Municipal Engineer, shall require a resubmission of a modified Stormwater Management Plan consistent with this Ordinance and shall be subject to review as specified in Section 6 of this Ordinance.

6.4 Resubmission of Disapproved Stormwater Plans

6.4.1 A disapproved Stormwater Management Plan may be resubmitted; with the revisions addressing the Municipal Engineer's concerns documented in writing, and addressed to the Municipal Secretary in accordance with Section 6 of this Ordinance and distributed accordingly and shall be subject to review as specified in Section 6 of this Ordinance. Any applicable Municipal Review and Inspection Fee must accompany a resubmission of a disapproved Stormwater Management Plan.

6.5 Municipal Stormwater Plan Review and Inspection Fees

6.5.1 Fees may be established from time-to-time by the Municipality in accordance with applicable laws to defray plan review and construction inspection costs incurred by the Municipality. All fees shall be paid by the Applicant at the time of Stormwater Management Plan submission.

6.5.2 Any fees established pursuant to this Ordinance may include, but not necessarily be limited to, any of the following:

A. Administrative costs.
B. The review of the Stormwater Management Plan by the Municipality, County (if applicable), Allegheny County Conservation District (if applicable) and the Municipal Engineer.
C. The site inspections.
D. The inspection of stormwater management facilities and Stormwater Management improvements during construction.
E. The final inspection upon completion of the stormwater management facilities.
F. Any additional work required to enforce any permit provisions regulated by this Ordinance, correct violations, and assure proper completion of stipulated remedial actions.

Section 7.0 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/

ACT 167 - The Storm Water Management Act (Act of October 4, 1978, P.L. 864 No. 167; 32 P.S. §680.1-680.17, as amended).

ACT 167 Plan (or watershed plan) - The plan for managing stormwater runoff throughout a designated watershed adopted by Allegheny County as required by the Pennsylvania Storm Water Management Act.

Agricultural Activity - The work of producing crops including tillage, land clearing, plowing, disking, harrowing, planting, harvesting crops, or pasturing and raising of livestock and installation of conservation measures. Construction of new buildings or impervious area is not considered an Agricultural Activity.

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

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 and facilities to prevent or reduce surface runoff and/or water pollution, including but not limited to, structural and non-structural stormwater management practices and facilities and operation and maintenance procedures.

ACCD – Allegheny County Conservation District

ACHD – Allegheny 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.

Conservation District - A conservation district, as defined in section 3(c) of the Conservation District Law (3 P. S. § 851(c)), which has the authority under a delegation agreement executed with the Department to administer and enforce all or a portion of the erosion and sediment control program in this Commonwealth.

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.

DEP - The Pennsylvania Department of Environmental Protection.

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

Detention 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.

Development Site (Site) - See Project Site.

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).

Disturbed Area – An un-stabilized land area where an Earth Disturbance is occurring or has occurred.

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.

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

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

Engineer - A professional engineer duly appointed as the engineer for municipality.

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.

Existing Condition – The dominant land cover during the five (5) year period immediately preceding a proposed Regulated Activity.

FEMA – Federal Emergency Management Agency.

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

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

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

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.

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.

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.

Hydrologic Soil Group (HSG) - Infiltration rates of soils vary widely and are affected

by subsurface permeability as well as surface intake rates. Soils are classified into four HSG's (A, B, C, and D) according to their minimum infiltration rate, which is obtained for bare soil after prolonged wetting. The Natural Resources Conservation Service (NRCS) of the US Department of Agriculture defines the four groups and provides a list of most of the soils in the United States and their group classification. The soils in the area of the development site may be identified from a soil survey report that can be obtained from local NRCS offices or conservation district offices. Soils become less pervious as the HSG varies from A to D.

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 (area), 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.

Land Development (Development) – Inclusive of any or all of the following meanings: (i) the improvement of one lot or two or more contiguous lots, tracts, or parcels of land for any purpose involving (a) a group of two or more buildings, or (b) the division or allocation of land or space between or among two or more existing or prospective occupants by means of, or for the purpose of streets, common areas, leaseholds, condominiums, building groups, or other features; (ii) any subdivision of land; (iii) development in accordance with Section 503(1.1) of the PA Municipalities Planning Code.

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 ten (10) 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.

Municipality – the local government that adopted the subject Ordinance.

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.

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

PennDOT – 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).

Pervious Area – Any area not defined as impervious.

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

Project Site - The specific area of land where any Regulated Activities in the Municipality are planned, conducted or maintained.

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

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 involving the demolition or partial demolition of the property.

Regulated Activities- Any Earth Disturbances or any activities that involve the alteration or development of land in a manner that may affect post construction stormwater runoff.

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

Release Rate Percentage - The percentage of predevelopment peak rate of runoff from a watershed subarea (as delineated in the Act 167 watershed plan), which defines the allowable post-development peak discharge from any development site in that subarea.

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.

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

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

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

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.

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

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 BMPs- Is abbreviated as **SWM BMPs** or **BMPs** throughout this Ordinance.

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.

Subarea (subbasin) - A portion of the watershed (basin) that has similar hydrological characteristics and drains to a common point.

Subdivision – As defined in The Pennsylvania Municipalities Planning Code, Act of July 31, 1968, P.L. 805, No. 247.

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.

Total Site Area (Site Area) – Total area of the parcel(s) being developed.

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.

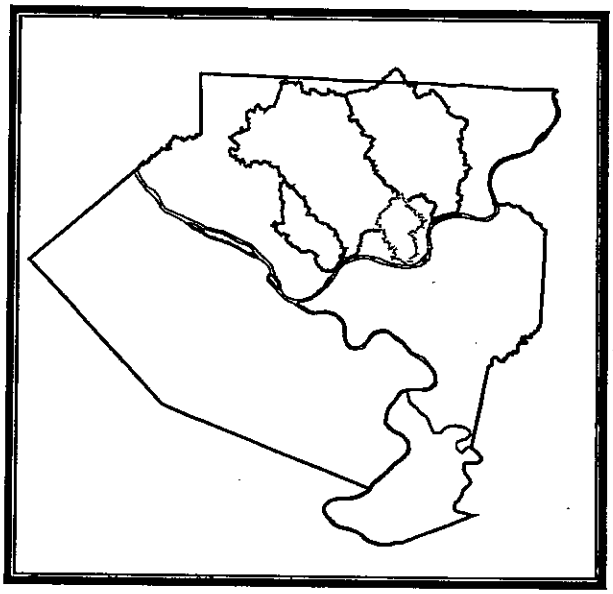
Watershed - Land area that drains to a common water body or downstream point.

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

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 ten (10) 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.

Act 167 Stormwater Ordinance
Girtys Runs, Pine Creek, Squaw Run and Deer Creek Watersheds
Allegheny County, Pennsylvania



Ordinance Appendices

Appendices

ORDINANCE APPENDIX A
Release Rate Percentage Tables by Subarea

Note release rate subarea maps and release rate percentage tables may be obtained on the following web site;

http://www.ross.pa.us/engineer/Act%20167/Act%20167%20Update.htm

Original Act 167 Map Plates (tif format)

Plate 2.1 Girtys Run Release Rate Percentage

Plate 2.2 Pine Creek Release Rate Percentage

Plate 2.3 Deer Creek Release Rate Percentage

Plate 2.4 Squaw Run Release Rate Percentage

Original Act 167 Map Plates (pdf format)

Plate 2.1 Girtys Run Release Rate Percentage

Girtys Release Rate Table

Plate 2.2 Pine Creek Release Rate Percentage

Pine Release Rate Table

Plate 2.3 Deer Creek Release Rate Percentage

Deer Release Rate Table

Plate 2.4 Squaw Run Release Rate Percentage

Squaw Release Rate Table

APPENDIX A

RELEASE RATE PERCENTAGES BY SUBAREA
DEER CREEK WATERSHED

Subarea	Municipality	Release Rate Percentage
1	West Deer	100
2	Richland, West Deer	100
3	Richland, West Deer	100
4	Richland, West Deer	100
5	West Deer	100
6	Richland	100
7	Richland, West Deer	100
8	Richland, West Deer	95
9	West Deer	85
10	West Deer	100
11	West Deer	100
12	West Deer	75
13	Hampton, West Deer	75
14	West Deer	80
15	Indiana, West Deer	100
16	Hampton, Indiana, West Deer	100
17	Indiana, West Deer	100
18	West Deer	100
19	West Deer	100
20	West Deer	100
21	Indiana, West Deer	100
22	Indiana	100
23	Indiana	100
24	Indiana	100
25	Harmar, Indiana	100
26	Indiana, West Deer	60
27	Harmar, Indiana	100
28	Harmar, Indiana	100
29	West Deer	100
30	West Deer	100
31	Frazer, West Deer	95
32	West Deer	100
33	Frazer, West Deer	100
34	Frazer, Indiana, West Deer	100
35	Indiana	90
36	Frazer, Indiana, West Deer	80
37	Frazer, Indiana	70
38	Harmar, Indiana	100
39	Harmar	100
40	Harmar	100

APPENDIX A

RELEASE RATE PERCENTAGES BY SUBAREA
GIRTY'S RUN WATERSHED

Subarea	Municipality	Release Rate Percentage
1	Ross, McCandless	100
2	Ross	70
3	Ross	80
4	Ross	65
5	Ross, West View	100
6	West View	100
7	West View, Ross	100
8	West View, Ross	95
9	Ross	75
10	Ross, McCandless	100
11	Ross	100
12	Ross	100
13	Ross	100
14	Ross	65
15	Ross	75
16	Ross, Shaler	85
17	Ross	95
18	Ross, Pittsburgh	95
19	Ross, Pittsburgh	90
20	Ross, Shaler	70
21	Reserve, Ross, Shaler	95
22	Shaler	80
23	Shaler	90
24	Shaler	95
25	Shaler, Millvale, Reserve	100
26	Reserve, Millvale	100

APPENDIX A

RELEASE RATE PERCENTAGES BY SUBAREA
SQUAW RUN WATERSHED

Subarea	Municipality	Release Rate Percentage
1	Fox Chapel, Indiana	100
2	Fox Chapel, Indiana	90
3	Fox Chapel, Indiana	90
4	Fox Chapel	100
5	Fox Chapel, Harmar, O'Hara	85
6	Fox Chapel, Harmar	65
7	Fox Chapel	100
8	Fox Chapel	100
9	Fox Chapel	80
10	Fox Chapel, Indiana, O'Hara	100
11	Fox Chapel	100
12	Fox Chapel	95
13	Fox Chapel	100
14	Fox Chapel, O'Hara	100
15	Fox Chapel, O'Hara	75
16	O'Hara, City of Pittsburgh	100
17	O'Hara	100

APPENDIX A

RELEASE RATE PERCENTAGES BY SUBAREA
PINE CREEK WATERSHED

Subarea	Municipality	Release Rate Percentage
1	Bradford Woods, Marshall, Pine	100
2	Bradford Woods, Franklin Park, Marshall	100
3	Franklin Park, Marshall	100
4	Franklin Park, Marshall	100
5	Franklin Park, McCandless, Marshall	80
6	Franklin Park	100
7	Franklin Park	100
8	Franklin Park	85
9	Franklin Park, McCandless	75
10	Bradford Woods, Marshall, Pine	100
11	Bradford Woods, Pine	100
12	Marshall, Pine	100
13	Franklin Park, Marshall, Pine	95
14	Franklin Park, McCandless, Marshall, Pine	85
15	McCandless, Pine	75
16	Franklin Park, McCandless	60
17	McCandless, Pine	100
18	McCandless	75
19	McCandless	60
20	McCandless	100
21	McCandless	65
22	McCandless	100
23	McCandless	100
24	McCandless	100
25	McCandless, Pine	100
26	McCandless	100
27	McCandless	100
28	McCandless	100
29	McCandless	100
30	McCandless	100
31	Pine	100
32	Pine	90
33	Pine	100
34	Pine	85
35	Pine	80

APPENDIX A

RELEASE RATE PERCENTAGES BY SUBAREA
PINE CREEK WATERSHED
(Continued)

Subarea	Municipality	Release Rate Percentage
36	Pine	70
37	Pine	85
38	Pine	55
39	Pine	100
40	Pine	75
41	Pine	85
42	Pine	85
43	Pine	100
44	McCandless, Pine	80
45	McCandless, Pine	65
46	Pine	100
47	McCandless, Pine	100
48	McCandless, Pine	95
49	McCandless	100
50	Hampton, McCandless	100
51	Hampton, McCandless	100
52	Pine, Richland	100
53	Pine	100
54	Pine, Richland	100
55	Pine, Richland	100
56	Pine, Richland	85
57	Pine, Richland	85
58	Hampton, McCandless, Pine, Richland	90
59	Hampton, McCandless, Richland	100
60	Hampton	100
61	Richland	100
62	Richland	95
63	Richland	100
64	Richland	90
65	Richland	85
66	Richland	80
67	Richland	70
68	Richland	75
69	Richland	65
70	Hampton, Richland	70

APPENDIX A

RELEASE RATE PERCENTAGES BY SUBAREA
PINE CREEK WATERSHED
(Continued)

Subarea	Municipality	Release Rate Percentage
71	Hampton, Richland	85
72	Hampton	85
73	Hampton	65
74	Hampton	100
75	Hampton	100
76	Hampton	100
77	Hampton, McCandless	100
78	Hampton, McCandless	100
79	Richland	100
80	Hampton, Richland	90
81	Hampton, Richland	95
82	Hampton	75
83	Hampton, Richland	100
84	Hampton	85
85	Hampton	100
86	Hampton	85
87	Hampton	95
88	Hampton	80
89	Hampton	75
90	Hampton	75
91	Hampton	80
92	Hampton	60
93	Hampton	85
94	Hampton	100
95	Hampton, McCandless	100
96	Hampton, McCandless	100
97	Hampton, McCandless	100
98	Hampton	100
99	Hampton	85
100	Hampton	75
101	Hampton	75
102	Hampton	100
103	Hampton	100
104	Hampton	65
105	Hampton	95

APPENDIX A

RELEASE RATE PERCENTAGES BY SUBAREA
PINE CREEK WATERSHED
(Continued)

Subarea	Municipality	Release Rate Percentage
106	Hampton	80
107	Hampton	80
108	Hampton	75
109	Hampton	65
110	Hampton	85
111	Hampton	60
112	Hampton, Shaler	100
113	Hampton, Shaler	100
114	Hampton, Shaler	100
115	Hampton, Shaler	100
116	Shaler	100
117	Shaler	100
118	Shaler	100
119	Shaler	100
120	Shaler	100
121	Shaler	100
122	Shaler	100
123	Shaler	100
124	Shaler	100
125	Shaler	100
126	Shaler	100
127	Etna, Shaler	100
128	Hampton, Indiana	100
129	Hampton, Indiana	100
130	Hampton, Indiana	70
131	Indiana	100
132	Hampton, Indiana	80
133	Indiana	70
134	Fox Chapel, Indiana	90
135	Hampton, Indiana	85
136	Fox Chapel, Indiana, O'Hara	95
137	Fox Chapel, Indiana, O'Hara	80
138	Indiana, O'Hara	65
139	Fox Chapel, Indiana, O'Hara, Shaler	100
140	O'Hara, Shaler	70

APPENDIX A

RELEASE RATE PERCENTAGES BY SUBAREA
PINE CREEK WATERSHED
(Continued)

Subarea	Municipality	Release Rate Percentage
141	O'Hara, Shaler	100
142	O'Hara, Shaler	100
143	Etna, Shaler	100
144	Etna	100
145	McCandless	100
146	McCandless, Ross	95
147	Hampton, McCandless	95
148	McCandless, Ross	90
149	McCandless, Ross	85
150	Hampton, McCandless, Ross, Shaler	70
151	Ross, Shaler	70
152	Ross	75
153	Ross, Shaler	60
154	Ross, Shaler	70
155	Shaler	60
156	Shaler	100
157	Shaler	100
158	Etna, Shaler	100
159	Etna, Shaler	100
160	Etna, Shaler	100
161	Etna, Shaler	100
162	Etna, Shaler	100

ORDINANCE 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.)

ORDINANCE APPENDIX C

STORMWATER BEST MANAGEMENT PRACTICES OPERATIONS AND MAINTENANCE AGREEMENT

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

WITNESSETH

WHEREAS, the Landowner is the owner of certain real property as recorded by deed in the land records of Allegheny County, Pennsylvania, Deed Book _____ at Page _____, Block and Lot No. _____, (Lot(s) ____ in the _____Plan of Lots as recorded in Plan Book Volume ___, 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, provides for management of stormwater within the confines of the Property through the use of Best Management Practices (BMPs); and

WHEREAS, the Municipality and the Landowner, his successors and assigns, agree that the health, safety, and welfare of the residents of the Municipality and the protection and maintenance of water quality require that on-site stormwater BMPs be constructed and maintained on the Property; and

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

- BMP – "Best Management Practice;" activities, facilities, designs, measures or procedures used to manage stormwater impacts from land development, to protect and maintain water quality and 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 (retention) 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,

- Bioretention (Rain Garden) – A BMP overlain with appropriate mulch and suitable vegetation designed, constructed, and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or underground aquifer, and

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

NOW, THEREFORE, in consideration of the foregoing and intending to be legally bound, 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 SWM Plan.

2. The Landowner shall operate and maintain the BMPs 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, if any.

3. The Landowner agrees to inspect each BMP annually and after major storm events and correct any deficiencies noted during each inspection. The results of each inspection shall be provided to the Municipality upon request.

4. 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 BMPs whenever it deems necessary. Whenever possible, the Municipality shall notify the Landowner prior to entering the property.

5. In the event that the Landowner fails to operate and maintain the BMPs 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 BMPs. 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.

6. In the event that the Municipality, pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner shall reimburse the Municipality for all expenses incurred plus 10% for administrative overhead within 10 days of receipt of invoice from the Municipality.

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

8. 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 BMPs 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.

9. This Agreement shall be recorded at the Office of the Recorder of Deeds of Allegheny 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 _____, 2___, do hereby certify that _____ whose name(s) is/are signed to the foregoing Agreement bearing date of the _____ day of _____, 2___, has acknowledged the same before me in my said County and State.

GIVEN UNDER MY HAND THIS _____ day of _____, 2__.

_____ _____

NOTARY PUBLIC **(SEAL)**

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

ORDINANCE APPENDIX D

List of References Cited and Additional Sources of Information
Prepared: February 2007
Prepared By: NHCOG ACT 167 UPDATE

The following lists of references were used in the preparation of this ordinance and the Act 167 Update Report.

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ORDINANCE APPENDIX E

Credits for Use of Nonstructural BMPs
Example Calculations

The developer may obtain credits for the use of nonstructural BMPs using the procedures outlined below.

Volume Reduction Method #1: Natural Area Conservation

A water quality volume reduction can be taken when undisturbed natural areas are conserved on a site, thereby retaining their pre-development hydrologic and water quality characteristics. Under this method, a designer would be able to subtract the conservation areas from the total site area when computing the water quality protection volume. An added benefit is that the post-development peak discharges will be smaller, and hence, water quantity control volumes will be reduced due to lower post-development curve numbers or rational formula "C" values.

Rule: Subtract conservation areas from total site area when computing water quality protection volume requirements.

Criteria:

- Conservation area cannot be disturbed during project construction and must be protected from sediment deposition.
- Shall be protected by limits of disturbance clearly shown on all construction drawings
- Shall be located within an acceptable conservation easement instrument that ensures perpetual protection of the proposed area. The easement must clearly specify how the natural area vegetation shall be managed and boundaries will be marked [Note: managed turf (e.g., playgrounds, regularly maintained open areas) is not an acceptable form of vegetation management]
- Shall have a minimum contiguous area requirement of 10,000 square feet
- R_v is kept constant when calculating WQ_v
- Must be forested or have a stable, natural ground cover.

Example:

Residential Subdivision
Area = 38 acres
Natural Conservation Area = 7 acres
Impervious Area = 13.8 acres

$R_v = 0.05 + 0.009\ (I) = 0.05 + 0.009\ (36.3\%) = 0.38$

Reduction:

7.0 acres in natural conservation area

New drainage area = 38 – 7 = 31 acres

Before reduction:

$WQ_v = (1.5)(0.38)(38)/12 = 1.81$ ac-ft

With reduction:

$WQ_v = (1.5)(0.38)(31)/12 = 1.47$ ac-ft

(19% reduction in water quality protection volume)

Volume Reduction Method #2: Stream Buffers

This reduction can be taken when a stream buffer effectively treats storm water runoff. Effective treatment constitutes treating runoff through overland flow in a naturally vegetated or forested buffer. Under the proposed method, a designer would be able to subtract areas draining via overland flow to the buffer from total site area when computing water quality protection volume requirements. In addition, the volume of runoff draining to the buffer can be subtracted from the streambank protection volume. The design of the stream buffer treatment system must use appropriate methods for conveying flows above the annual recurrence (1-yr storm) event.

Rule: Subtract areas draining via overland flow to the buffer from total site area when computing water quality protection volume requirements.

Criteria:

- The minimum undisturbed buffer width shall be 50 feet
- The maximum contributing length shall be 150 feet for pervious surfaces and 75 feet for impervious surfaces
- The average contributing slope shall be 3% maximum unless a flow spreader is used
- Runoff shall enter the buffer as overland sheet flow. A flow spreader can be installed to ensure this
- Buffers shall remain as naturally vegetated or forested areas and will require only routine debris removal or erosion repairs
- R_v is kept constant when calculating WQ_v
- Not applicable if overland flow filtration/groundwater recharge reduction is already being taken

Example:

Residential Subdivision
Area = 38 acres
Impervious Area = 13.8 acres
Area Draining to Buffer = 5 acres
$R_v = 0.05 + 0.009\ (I) = 0.05 + 0.009\ (36.3\%) = 0.38$
Reduction:

5.0 acres draining to buffer

New drainage area = 38 – 5 = 33 acres
Before reduction:
$WQ_v = (1.5)(0.38)(38)/12 = 1.81$ ac-ft

With reduction:
$WQ_v = (1.5)(0.38)(33)/12 = 1.57$ ac-ft

(13% reduction in water quality protection volume)

Volume Reduction Method #3: Enhanced Swales

This reduction may be taken when enhanced swales are used for water quality protection. Under the proposed method, a designer would be able to subtract the areas draining to an enhanced swale from total site area when computing water quality protection volume requirements. An enhanced swale can fully meet the water quality protection volume requirements for certain kinds of low-density residential development (see Volume Reduction Method #5). An added benefit is the post-development peak discharges will likely be lower due to a longer time of concentration for the site.

Rule: Subtract the areas draining to an enhanced swale from total site area when computing water quality protection volume requirements.

Criteria:

- This method is typically only applicable to moderate or low density residential land uses (3 dwelling units per acre maximum)
- The maximum flow velocity for water quality design storm shall be less than or equal to 1.0 feet per second
- The minimum residence time for the water quality storm shall be 5 minutes
- The bottom width shall be a maximum of 6 feet. If a larger channel is needed use of a compound cross section is required
- The side slopes shall be 3:1 (horizontal:vertical) or flatter
- The channel slope shall be 3 percent or less
- R_v is kept constant when calculating WQ_v

Example:

Residential Subdivision
Area = 38 acres
Impervious Area = 13.8 acres
$R_v = 0.05 + 0.009\ (I) = 0.05 + 0.009\ (36.3\%) = 0.38$
Reduction:

12.5 acres meet enhanced swale criteria

New drainage area = 38 – 12.5 = 25.5 acres
Before reduction:
$WQ_v = (1.5)(0.38)(38)/12 = 1.81$ ac-ft

With reduction:
$WQ_v = (1.5)(0.38)(25.5)/12 = 1.21$ ac-ft

(33% reduction in water quality protection volume)

Volume Reduction Method #4: Overland Flow Filtration/Groundwater Recharge Zones

This reduction can be taken when "overland flow filtration/infiltration zones" are incorporated into the site design to receive runoff from rooftops or other small impervious areas (e.g., driveways, small parking lots, etc). This can be achieved by grading the site to promote overland vegetative filtering or by providing infiltration or "rain garden" areas. If impervious areas are adequately disconnected, they can be deducted from total site area when computing the water quality protection volume requirements. An added benefit will be that the post-development peak discharges will likely be lower due to a longer time of concentration for the site.

Rule: If impervious areas are adequately disconnected, they can be deducted from total site area when computing the water quality protection volume requirements.

Criteria:

- Relatively permeable soils (hydrologic soil groups A and B) should be present
- Runoff shall not come from a designated hotspot
- The maximum contributing impervious flow path length shall be 75 feet
- Downspouts shall be at least 10 feet away from the nearest impervious surface to discourage "re-connections"
- The disconnection shall drain continuously through a vegetated channel, swale, or filter strip to the property line or structural storm water control
- The length of the "disconnection" shall be equal to or greater than the contributing length
- The entire vegetative "disconnection" shall be on a slope less than or equal to 3 percent
- The surface imperviousness area to any one discharge location shall not exceed 5,000 square feet
- For those areas draining directly to a buffer, reduction can be obtained from either overland flow filtration *-or-* stream buffers (See Method #2)
- R_v is kept constant when calculating WQ_v

Example:

Site Area = 3.0 acres
Impervious Area = 1.9 acres (or 63.3% impervious cover)
"Disconnected" Impervious Area = 0.5 acres

$R_v = 0.05 + 0.009\ (I) = 0.05 + 0.009\ (63.3\%) = 0.62$

Reduction:

0.5 acres of surface imperviousness hydrologically disconnected

New drainage area = 3 – 0.5 = 2.5 acres

Before reduction:

$WQ_v = (1.5)(0.62)(3)/12 = 0.23$ ac-ft

With reduction:

$WQ_v = (1.5)(0.62)(2.5)/12 = 0.19$ ac-ft

(17% reduction in water quality protection volume)

Volume Reduction Method #5: Environmentally Sensitive Large Lot Subdivisions

This reduction can be taken when a group of environmental site design techniques are applied to low and very low density residential development (e.g., 1 dwelling unit per 2 acres [du/ac] or lower). The use of this method can eliminate the need for structural storm water controls to treat water quality protection volume requirements. This method is targeted towards large lot subdivisions and will likely have limited application.

Rule: Targeted towards large lot subdivisions (e.g. 2 acre lots and greater). The requirement for structural practices to treat the water quality protection volume shall be waived.

Criteria:

For Single Lot Development:

- Total site impervious cover is less than 15%
- Lot size shall be at least two acres
- Rooftop runoff is disconnected in accordance with the criteria in Method #4
- Grass channels are used to convey runoff versus curb and gutter

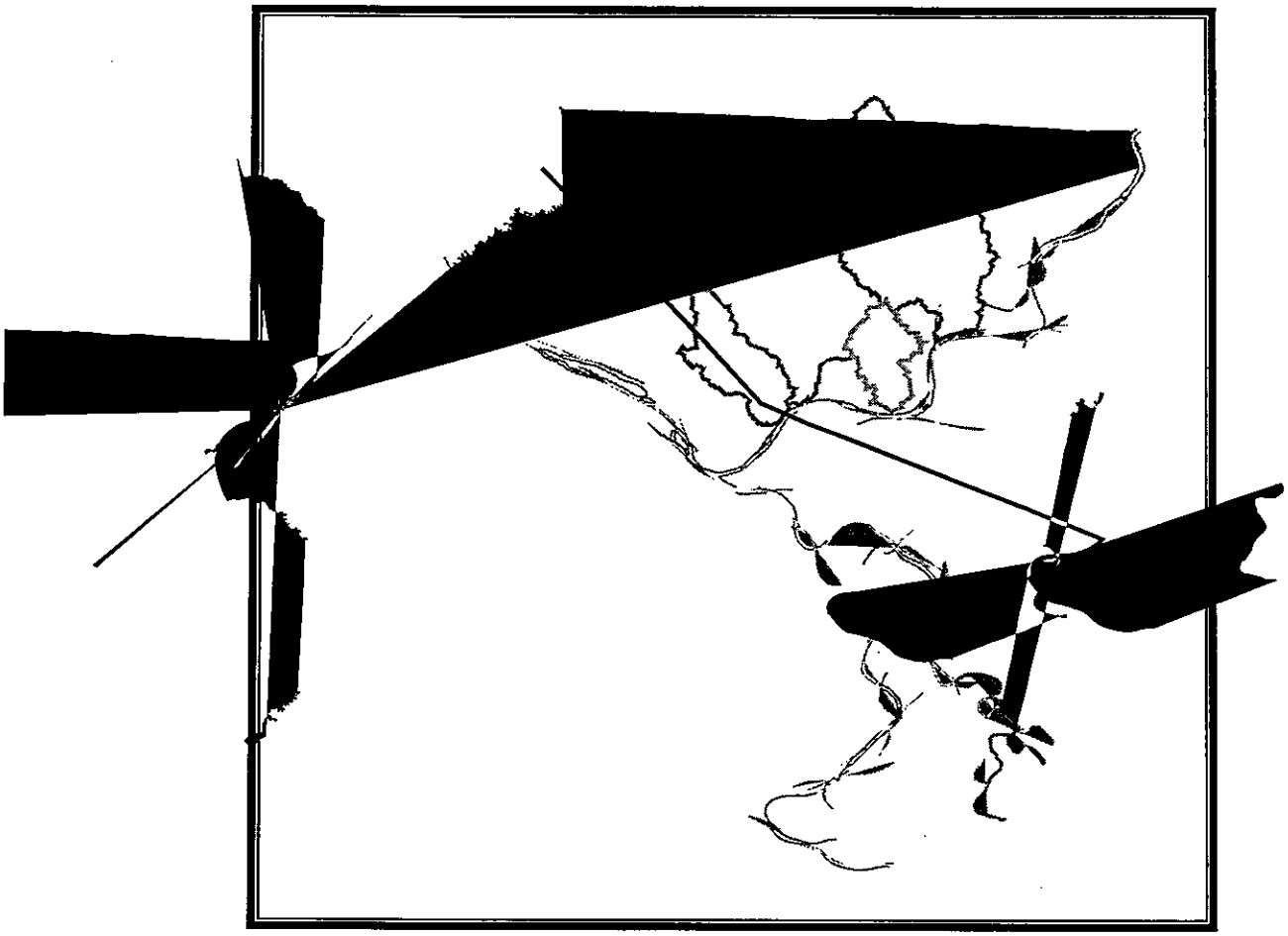
For Multiple Lots:

- Total impervious cover footprint shall be less than 15% of the area
- Lot areas should be at least 2 acres, unless clustering is implemented. Open space developments should have a minimum of 25% of the site protected as natural conservation areas and shall be at least a half-acre average individual lot size
- Grass channels should be used to convey runoff versus curb and gutter (see Method #3)
- Overland flow filtration/infiltration zones should be established (see Method #4)

Ordinance Appendix F

Small Project Standardized SWM Planning Guidance

Small Project
Standardized Stormwater Management Planning Guidance



Act 167 Stormwater Management Plan Update
Girtys Runs, Pine Creek, Squaw Run and Deer Creek Watersheds
Allegheny County, Pennsylvania

Prepared By
Art Gazdik, P.E.

April 28, 2008

Standardized Stormwater Management Planning Guidance
For Small Projects

Applicability

These criteria may be used to develop a stormwater management (SWM) plan for a small projects, having a disturbed area of less than 5000 square feet, in an area where a comprehensive subdivision SWM plan has not been planned or constructed. It is not to be used to plan for multiple lots without the written approval of the Municipal Engineer.

This guidance may not be appropriate for all locations (e.g., in areas on or adjacent to steep slopes, in areas on or adjacent to fill slopes, in areas having unsuitable soil conditions (e.g., clayey soils) or in areas having a high water table). The Municipal Building Inspector or Engineer may require that a more detailed stormwater management plan be prepared by a qualified design professional if, in their opinion, unusual site conditions exist.

These standardized SWM facilities, if properly sized and installed, should provide the water quality volume, infiltration volume and extended detention protections required by the municipality's SWM Ordinance. These standardized facilities are not specifically sized to provide for the peak flow reduction requirement, if any, but will generally provide peak flow control of storm events that do not exceed a 10 year – 24 hour return period.

What are the Standardized SWM facilities?

The Standardized SWM facilities (Standardized BMPs) are a set of three methods, or best management practices (BMPs), that have been selected because of their potential for being sited on individual residential lots. Each of the methods has been sized using a specific set of design assumptions. A list of the Standardized SWM facilities and the basic design assumptions used are outlined below. A more detailed set of the design assumptions used to size the Standardized SWM facilities is provided later in this Guide. It is the Applicant's responsibility to verify that the assumptions are appropriate for the subject property. Construction details and more detailed information about the design installation and maintenance requirements for of each of the facilities are also provided later in this document.

SWM Facility Name	Basic Design Assumptions		
Bioretention	4' Filter Bed Depth	0.5' Ponding Depth	Drain Time = 2 Days
Rock Sump	4' Rock Depth		
Porous Pavement	2' Gravel Depth	0.32 Gravel Porousity	Fill Time = 2 Hours

What is required?

A. Install "Stormwater Management Facilities (BMPs)" to reduce downstream flooding and protect the water quality of our streams.

B. Install erosion and sedimentation control devices during construction to keep silt and sediment from washing into the storm sewers, ditches or streams on or adjacent to the site.

C. Properly record a maintenance agreement to insure the continued maintenance and protection of the SWM facilities.

When is it required?

Applicants will be required to file a SWM plan with their building permit or land disturbance / grading permit application as per the municipality's requirements.

Are professional services required?

Yes, the SWM facilities must be designed by a licensed professional engineer or other Qualified Professional experienced in the design of stormwater management.

Are the Standardized SWM facilities in this Guide required?

No, any SWM facilities meeting the municipality's Stormwater Management Regulations will be acceptable.

How should this Guide be used?

Step 1 – Determine the Impervious Area and the Disturbed Area

Calculate the following:

1. The total area in square feet of roofs, driveways, sidewalks, paved areas and any other impervious surfaces proposed for the lot.
2. The total area in square feet of the lot that is to be disturbed. "Disturbed Area" is all area that is to be stripped of natural vegetation and converted to lawn, roof, pavement, sidewalk or driveway.

Step 2 – Determine the required surface area of the Standardized BMPs

Go to the Determination of SWM Facility Sizing Tables (Disturbed Area Table) and find the table that is titled with a "Disturbed Area = [Value] SF" where [Value] is equal to or greater than the proposed "Disturbed Area" for the lot. For example, if the lot will have a disturbed area of 2200 SF, use the table titled "Disturbed Area = 2500 SF or Less" as shown below.

Using the correct Disturbed Area Table, determine the sizing of the standardized SWM facility or facilities to be used, using the area in square feet of **all** impervious surface tributary to the SWM facility or facilities. This area is referred to as "Area Impervious" on the Table and is found in Column "1".

Go down Column "1" to the "Area Impervious" value that is greater than or equal to the impervious area tributary to the SWM facilities. For example, if it is determined that the total area of all roof and pavements tributary to the SWM facilities will be 1921 square feet (SF), use a value of 2000 square feet to determine the SWM facility sizing for the three standardized best management practices provided in Columns 3, 4 and 5 of the table. NOTE: If runoff from existing impervious areas will also be tributary to the SWM facilities, that area must also be included in the calculations.

For this example where the Disturbed Area is 2200 SF and the Area Impervious is 1921 SF, the surface area (foot print size) of the Standardized BMP Options provided are:

Column 3 - Bioretention Surface Area = 151 SF
Column 4 – Rock Sump Foot Print = 212.5 SF
Column 5 – Porous Pavement Surface Area = 222 SF

Disturbed Area = 2500 SF or Less

Determination of SWM Facility Sizing Note: Disturbed area is all area that is to be stripped of natural vegetation and converted to lawn, roof, pavement, sidewalk or driveway.					AG 3/3/7	Bioretention Assumptions k = 0.5 ft/day for silt loam df = filter bed depth = 4' hf = half of ponding depth = 0.25' tf = filter drain time = 2 days			Rock Sump Assumptions Assume 4' Sump Depth	Pourous Pavement Assumptions n = porosity of gravel = 0.32 d = gravel depth = 2' k = percolation = 0.5 in/hour T = fill time = 2 hours
1			2					3	4	5
Area Impervious (Square Feet)	Area Impervious (acre)	Disturbed Area (acre)	Disturbed Area (Square Feet)	Percent Impervious (%)	Volumetric Runoff Coeficient (Rv)	Water Quality Volume (acre - feet)	Water Quality Volume (cubic feet)	Bioretention Surface Area (Square Feet)	Rock Sump Surface Foot Print (Square Feet)	Pourous Pavement Surface Area (Square Feet)
250	0.005739	0.0573921	2500	10.00%	0.1400	0.0006696	29	27	26.6	40
300	0.006887	0.0573921	2500	12.00%	0.1580	0.0007557	33	31	31.9	48
400	0.009183	0.0573921	2500	16.00%	0.1940	0.0009278	40	38	42.5	56
500	0.011478	0.0573921	2500	20.00%	0.2300	0.0011000	48	45	53.1	66
600	0.013774	0.0573921	2500	24.00%	0.2660	0.0012722	55	52	63.8	77
700	0.016070	0.0573921	2500	28.00%	0.3020	0.0014444	63	59	74.4	87
800	0.018365	0.0573921	2500	32.00%	0.3380	0.0016165	70	66	85.0	97
900	0.020661	0.0573921	2500	36.00%	0.3740	0.0017887	78	73	95.6	108
1000	0.022957	0.0573921	2500	40.00%	0.4100	0.0019609	85	80	106.3	118
1100	0.025253	0.0573921	2500	44.00%	0.4460	0.0021331	93	87	116.9	128
1200	0.027548	0.0573921	2500	48.00%	0.4820	0.0023052	100	95	127.5	139
1300	0.029844	0.0573921	2500	52.00%	0.5180	0.0024774	108	102	138.1	149
1400	0.032140	0.0573921	2500	56.00%	0.5540	0.0026496	115	109	148.8	160
1500	0.034435	0.0573921	2500	60.00%	0.5900	0.0028218	123	116	159.4	170
1600	0.036731	0.0573921	2500	64.00%	0.6260	0.0029940	130	123	170.0	180
1700	0.039027	0.0573921	2500	68.00%	0.6620	0.0031661	138	130	180.6	191
1800	0.041322	0.0573921	2500	72.00%	0.6980	0.0033383	145	137	191.3	201
1900	0.043618	0.0573921	2500	76.00%	0.7340	0.0035105	153	144	201.9	211
2000	0.045914	0.0573921	2500	80.00%	0.7700	0.0036827	160	151	212.5	222
2100	0.048209	0.0573921	2500	84.00%	0.8060	0.0038548	168	158	223.1	232
2200	0.050505	0.0573921	2500	88.00%	0.8420	0.0040270	175	165	233.8	243
2300	0.052801	0.0573921	2500	92.00%	0.8780	0.0041992	183	172	244.4	253
2400	0.055096	0.0573921	2500	96.00%	0.9140	0.0043714	190	179	255.0	263
2500	0.057392	0.0573921	2500	100.00%	0.9500	0.0045435	198	186	265.6	274

Figure -Example Table "Determination of SWM Facility Sizing (Disturbed Area Table)

Applicants may use a single option to satisfy the SWM requirements or a combination of options.

For example, a single type of facility, say Bioretention, could be installed as set forth below:

SWM Facility Type	Total Required	Actual SF Installed	Percentage of SWM Requirement
	(SF)	(SF)	(%)
Bioretention	151	151	100%
Rock Sump	212.5	0	0%
Porous Pavement	222	0	0%
			100%

or multiple SWM facility types could be proposed:

SWM Facility Type	Total Required	Actual SF Installed	Percentage of SWM Requirement
	(SF)	(SF)	(%)
Bioretention	151	50	33%
Rock Sump	212.5	35	16%
Porous Pavement	222	111	50%
			100%

Step 3 – Preparing the SWM Site Plan

Applicants shall submit three (3) copies of a plot plan survey or site plan drawn on a single sheet no larger that 8 1/2" x 14" (or folded to 8 1/2" x 11") containing all of the following information. (Submission of one plan showing existing conditions and a second plan(s) showing proposed work generally will not be acceptable.)

1) Name and address of owner(s).

2) Lot number, name of subdivision, size of lot, street address, scale, date.

3) North arrow.

4) All existing and proposed structures, including accessory structures, additions, driveways, decks, patios, utilities, storm sewers, sanitary sewers including laterals, fresh-air vents and cleanouts, storm water sumps, swimming pools and sports courts with all dimensions. When the existing sewer lateral is within the limit of disturbance, the site plan must show its exact location based on existing records. When no such records exist, laterals shall be located using underground pipe locator equipment.

5) Setback distances from all property lines. Building lines must be shown.

6) The distance and direction to the nearest intersection.

7) Existing topography by two-foot (2') contours and all proposed grading clearly delineated to distinguish between existing and proposed grades and the datum upon which the grades are based.

8) The limits, type and degree of risk as shown on any Hazard Maps that the municipality has available.

9) Shading, coloring, cross-hatching, etc. between contour lines to clearly distinguish the areas of Steep Slopes (15% - 25%) and Very Steep Slopes (25%+).

10) The PRECISE "Limit of Disturbance" and the area thereof.

11) All right-of-ways, easements, streams or ponds.

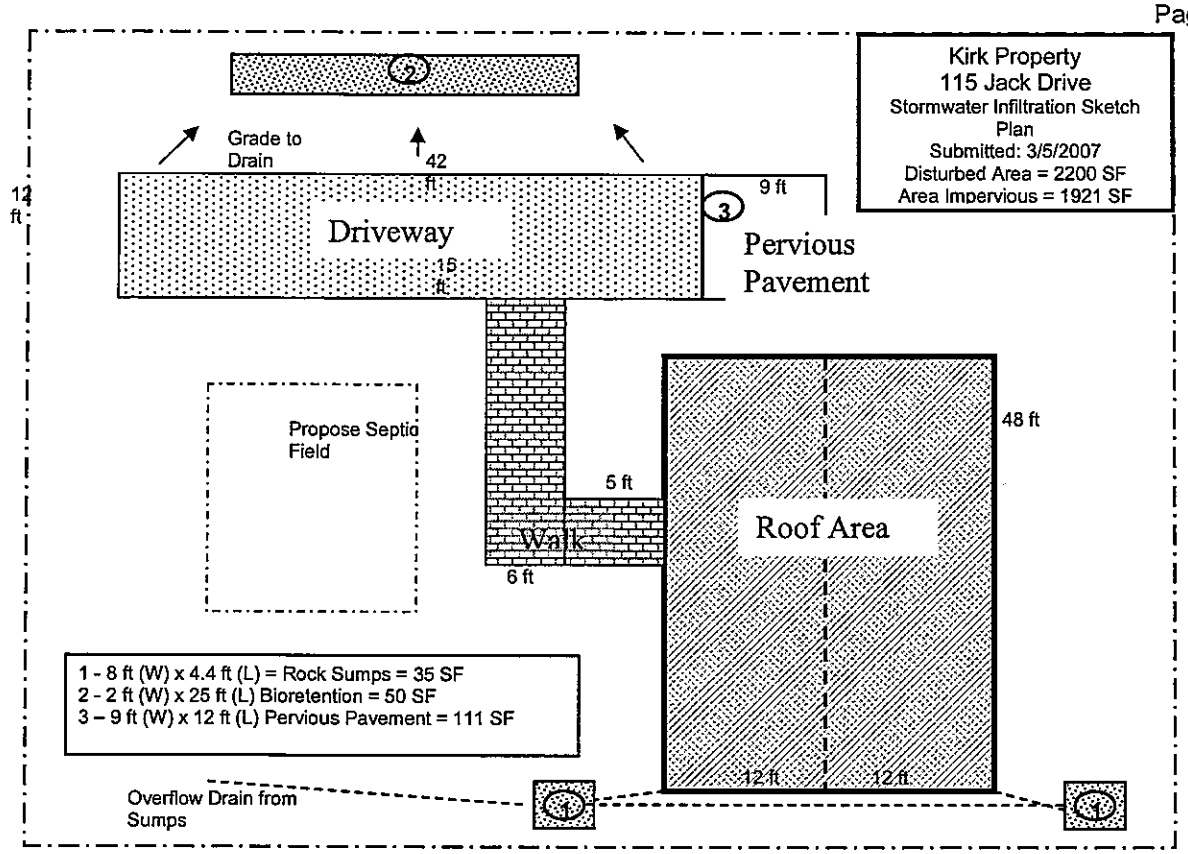
12) The location of all proposed utility lines and the associated "Limit of Disturbance".

13) The method of stormwater management in accordance with the requirements set forth in the municipality's Stormwater Management Regulations. The applicant shall include two (2) copies of the design criteria and method of stormwater management with the application.

14) Soil erosion and sedimentation control measures.

15) A registered Engineer's or other Qualified Professionals seal.

A simple example site plan is provided on the next below.



Step 4 – Submitting the SWM Plan

The following information shall be submitted with the application for a building permit or, if applicable, the Environmental Disturbance / Grading Permit:

- The Standardized SWM Permit Application
- A fully executed "Stormwater BMPs Operations and Maintenance Agreement"
- The SWM site plan.
- A copy of the "Guidance Sheet" for each type of BMP used.

Step 5 – Installing the Standardized BMPs

Insure that each SWM facility is installed as per the requirements of the "Guidance Sheet" for the type(s) of facilities proposed.

Step 6 – Understanding your maintenance responsibilities

In order to insure that the BMPs will continue to be protected and properly maintained, applicants will be required to enter into a "Stormwater Best Management Practices Operations and Maintenance Agreement". A copy of the agreement is provided in the Appendix C of this document.

Disturbed Area = 1000 SF or Less

Determination of SWM Facility Sizing AG 3/3/7

Note: Disturbed area is all area that is to be stripped of natural vegetation and converted to lawn, roof, pavement, sidewalk or driveway.

Bioretention Assumptions
k = 0.5 ft/day for silt loam
df = filter bed depth = 4'
hf = half of ponding depth = 0.25'
tf = filter drain time = 2 days

Rock Sump Assumptions
Assume 4' Sump Depth

Pourous Pavement Assumptions
n = porosity of gravel = 0.32
d = gravel depth = 2'
k = percolation = 0.5 in/hour
T = fill time = 2 hours

1			2					3	4	5
Area Impervious (Square Feet)	Area Impervious (acre)	Disturbed Area (acre)	Disturbed Area (Square Feet)	Percent Imperviuos (%)	Volumetric Runoff Coeficient (Rv)	Water Quality Volume (acre - feet)	Water Quality Volume (cubic feet)	Bioretention Surface Area (Square Feet)	Rock Sump Surface Foot Print (Square Feet)	Pourous Pavement Surface Area (Square Feet)
250	0.005739	0.02295684	1000	25.00%	0.2750	0.0005261	23	22	NA	32
300	0.006887	0.02295684	1000	30.00%	0.3200	0.0006122	27	25	NA	37
400	0.009183	0.02295684	1000	40.00%	0.4100	0.0007844	34	32	42.5	47
500	0.011478	0.02295684	1000	50.00%	0.5000	0.0009565	42	39	53.1	58
600	0.013774	0.02295684	1000	60.00%	0.5900	0.0011287	49	46	63.8	68
700	0.016070	0.02295684	1000	70.00%	0.6800	0.0013009	57	53	74.4	78
800	0.018365	0.02295684	1000	80.00%	0.7700	0.0014731	64	60	85.0	89
900	0.020661	0.02295684	1000	90.00%	0.8600	0.0016452	72	67	95.6	99
1000	0.022957	0.02295684	1000	100.00%	0.9500	0.0018174	79	75	106.3	109

Disturbed Area = 2500 SF or Less

Determination of SWM Facility Sizing AG 3/3/7

Note: Disturbed area is all area that is to be stripped of natural vegetation and converted to lawn, roof, pavement, sidewalk or driveway.

Bioretention Assumptions
k = 0.5 ft/day for silt loam
df = filter bed depth = 4'
hf = half of ponding depth = 0.25'
tf = filter drain time = 2 days

Rock Sump Assumptions
Assume 4' Sump Depth

Pourous Pavement Assumptions
n = porosity of gravel = 0.32
d = gravel depth = 2'
k = percolation = 0.5 in/hour
T = fill time = 2 hours

1			2					3	4	5
Area Impervious (Square Feet)	Area Impervious (acre)	Disturbed Area (acre)	Disturbed Area (Square Feet)	Percent Imperviuos (%)	Volumetric Runoff Coeficient (Rv)	Water Quality Volume (acre - feet)	Water Quality Volume (cubic feet)	Bioretention Surface Area (Square Feet)	Rock Sump Surface Foot Print (Square Feet)	Pourous Pavement Surface Area (Square Feet)
250	0.005739	0.0573921	2500	10.00%	0.1400	0.0006696	29	27	NA	40
300	0.006887	0.0573921	2500	12.00%	0.1580	0.0007557	33	31	NA	46
400	0.009183	0.0573921	2500	16.00%	0.1940	0.0009278	40	38	42.5	56
500	0.011478	0.0573921	2500	20.00%	0.2300	0.0011000	48	45	53.1	66
600	0.013774	0.0573921	2500	24.00%	0.2660	0.0012722	55	52	63.8	77
700	0.016070	0.0573921	2500	28.00%	0.3020	0.0014444	63	59	74.4	87
800	0.018365	0.0573921	2500	32.00%	0.3380	0.0016165	70	66	85.0	97
900	0.020661	0.0573921	2500	36.00%	0.3740	0.0017887	78	73	95.6	108
1000	0.022957	0.0573921	2500	40.00%	0.4100	0.0019609	85	80	106.3	118
1100	0.025253	0.0573921	2500	44.00%	0.4460	0.0021331	93	87	116.9	128
1200	0.027548	0.0573921	2500	48.00%	0.4820	0.0023052	100	95	127.5	139
1300	0.029844	0.0573921	2500	52.00%	0.5180	0.0024774	108	102	138.1	149
1400	0.032140	0.0573921	2500	56.00%	0.5540	0.0026496	115	109	148.8	160
1500	0.034435	0.0573921	2500	60.00%	0.5900	0.0028218	123	116	159.4	170
1600	0.036731	0.0573921	2500	64.00%	0.6260	0.0029940	130	123	170.0	180
1700	0.039027	0.0573921	2500	68.00%	0.6620	0.0031661	138	130	180.6	191
1800	0.041322	0.0573921	2500	72.00%	0.6980	0.0033383	145	137	191.3	201
1900	0.043618	0.0573921	2500	76.00%	0.7340	0.0035105	153	144	201.9	211
2000	0.045914	0.0573921	2500	80.00%	0.7700	0.0036827	160	151	212.5	222
2100	0.048209	0.0573921	2500	84.00%	0.8060	0.0038548	168	158	223.1	232
2200	0.050505	0.0573921	2500	88.00%	0.8420	0.0040270	175	165	233.8	243
2300	0.052801	0.0573921	2500	92.00%	0.8780	0.0041992	183	172	244.4	253
2400	0.055096	0.0573921	2500	96.00%	0.9140	0.0043714	190	179	255.0	263
2500	0.057392	0.0573921	2500	100.00%	0.9500	0.0045435	198	186	265.6	274

Disturbed Area = 5000 SF or Less

Determination of SWM Facility Sizing AG 3/3/7

Note: Disturbed area is all area that is to be stripped of natural vegetation and converted to lawn, roof, pavement, sidewalk or driveway.

Bioretention Assumptions
k = 0.5 ft/day for silt loam
df = filter bed depth = 4'
hf = half of ponding depth = 0.25'
tf = filter drain time = 2 days

Rock Sump Assumptions
Assume 4' Sump Depth

Pourous Pavement Assumptions
n = porosity of gravel = 0.32
d = gravel depth = 2'
k = percolation = 0.5 in/hour
T = fill time = 2 hours

1			2					3	4	5
Area Impervious (Square Feet)	Area Impervious (acre)	Disturbed Area (acre)	Disturbed Area (Square Feet)	Percent Imperviuos (%)	Volumetric Runoff Coeficient (Rv)	Water Quality Volume (acre - feet)	Water Quality Volume (cubic feet)	Bioretention Surface Area (Square Feet)	Rock Sump Surface Foot Print (Square Feet)	Pourous Pavement Surface Area (Square Feet)
250	0.005739	0.11478421	5000	5.00%	0.0950	0.0009087	40	37	NA	55
300	0.006887	0.11478421	5000	6.00%	0.1040	0.0009948	43	41	NA	60
400	0.009183	0.11478421	5000	8.00%	0.1220	0.0011670	51	48	42.5	70
500	0.011478	0.11478421	5000	10.00%	0.1400	0.0013391	58	55	53.1	81
600	0.013774	0.11478421	5000	12.00%	0.1580	0.0015113	66	62	63.8	91
700	0.016070	0.11478421	5000	14.00%	0.1760	0.0016835	73	69	74.4	101
800	0.018365	0.11478421	5000	16.00%	0.1940	0.0018557	81	76	85.0	112
900	0.020661	0.11478421	5000	18.00%	0.2120	0.0020279	88	83	95.6	122
1000	0.022957	0.11478421	5000	20.00%	0.2300	0.0022000	96	90	106.3	132
1100	0.025253	0.11478421	5000	22.00%	0.2480	0.0023722	103	97	116.9	143
1200	0.027548	0.11478421	5000	24.00%	0.2660	0.0025444	111	104	127.5	153
1300	0.029844	0.11478421	5000	26.00%	0.2840	0.0027166	118	111	138.1	164
1400	0.032140	0.11478421	5000	28.00%	0.3020	0.0028887	126	118	148.8	174
1500	0.034435	0.11478421	5000	30.00%	0.3200	0.0030609	133	125	159.4	184
1600	0.036731	0.11478421	5000	32.00%	0.3380	0.0032331	141	133	170.0	195
1700	0.039027	0.11478421	5000	34.00%	0.3560	0.0034053	148	140	180.6	205
1800	0.041322	0.11478421	5000	36.00%	0.3740	0.0035774	156	147	191.3	215
1900	0.043618	0.11478421	5000	38.00%	0.3920	0.0037496	163	154	201.9	226
2000	0.045914	0.11478421	5000	40.00%	0.4100	0.0039218	171	161	212.5	236
2100	0.048209	0.11478421	5000	42.00%	0.4280	0.0040940	178	168	223.1	247
2200	0.050505	0.11478421	5000	44.00%	0.4460	0.0042661	186	175	233.8	257
2300	0.052801	0.11478421	5000	46.00%	0.4640	0.0044383	193	182	244.4	267
2400	0.055096	0.11478421	5000	48.00%	0.4820	0.0046105	201	189	255.0	278
2500	0.057392	0.11478421	5000	50.00%	0.5000	0.0047827	208	196	265.6	288
2600	0.059688	0.11478421	5000	52.00%	0.5180	0.0049549	216	203	276.3	298
2800	0.064279	0.11478421	5000	56.00%	0.5540	0.0052992	231	217	297.5	319
3000	0.068871	0.11478421	5000	60.00%	0.5900	0.0056436	246	231	318.8	340
3250	0.074610	0.11478421	5000	65.00%	0.6350	0.0060740	265	249	345.3	366
3500	0.080349	0.11478421	5000	70.00%	0.6800	0.0065044	283	267	371.9	392
3750	0.086088	0.11478421	5000	75.00%	0.7250	0.0069349	302	284	398.4	418
4000	0.091827	0.11478421	5000	80.00%	0.7700	0.0073653	321	302	425.0	444
4250	0.097567	0.11478421	5000	85.00%	0.8150	0.0077958	340	320	451.6	469
4500	0.103306	0.11478421	5000	90.00%	0.8600	0.0082262	358	337	478.1	495
4750	0.109045	0.11478421	5000	95.00%	0.9050	0.0086566	377	355	504.7	521
5000	0.114784	0.11478421	5000	100.00%	0.9500	0.0090871	396	373	531.3	547

Disturbed Area = 10,000 SF or Less

Determination of SWM Facility Sizing AG 3/3/7

Note: Disturbed area is all area that is to be stripped of natural vegetation and converted to lawn, roof, pavement, sidewalk or driveway.

Bioretention Assumptions
k = 0.5 fl/day for silt loam
df = filter bed depth = 4'
hf = half of ponding depth = 0.25'
tf = filter drain time = 2 days

Rock Sump Assumptions
Assume 4' Sump Depth

Pourous Pavement Assumptions
n = porosity of gravel = 0.32
d = gravel depth = 2'
k = percolation = 0.5 in/hour
T = fill time = 2 hours

1			2					3	4	5
Area Impervious (Square Feet)	Area Impervious (acre)	Disturbed Area (acre)	Disturbed Area (Square Feet)	Percent Impervious (%)	Volumetric Runoff Coeficient (Rv)	Water Quality Volume (acre - feet)	Water Quality Volume (cubic feet)	Bioretention Surface Area (Square Feet)	Rock Sump Surface Foot Print (Square Feet)	Pourous Pavement Surface Area (Square Feet)
250	0.005739	0.22956841	10,000	2.50%	0.0725	0.0013870	60	57	NA	84
300	0.006887	0.22956841	10,000	3.00%	0.0770	0.0014731	64	60	NA	89
400	0.009183	0.22956841	10,000	4.00%	0.0860	0.0016452	72	67	42.5	99
500	0.011478	0.22956841	10,000	5.00%	0.0950	0.0018174	79	75	53.1	109
600	0.013774	0.22956841	10,000	6.00%	0.1040	0.0019896	87	82	63.8	120
700	0.016070	0.22956841	10,000	7.00%	0.1130	0.0021618	94	89	74.4	130
800	0.018365	0.22956841	10,000	8.00%	0.1220	0.0023339	102	96	85.0	141
900	0.020661	0.22956841	10,000	9.00%	0.1310	0.0025061	109	103	95.6	151
1000	0.022957	0.22956841	10,000	10.00%	0.1400	0.0026783	117	110	106.3	161
1100	0.025253	0.22956841	10,000	11.00%	0.1490	0.0028505	124	117	116.9	172
1200	0.027548	0.22956841	10,000	12.00%	0.1580	0.0030227	132	124	127.5	182
1300	0.029844	0.22956841	10,000	13.00%	0.1670	0.0031948	139	131	138.1	192
1400	0.032140	0.22956841	10,000	14.00%	0.1760	0.0033670	147	138	148.8	203
1500	0.034435	0.22956841	10,000	15.00%	0.1850	0.0035392	154	145	159.4	213
1600	0.036731	0.22956841	10,000	16.00%	0.1940	0.0037114	162	152	170.0	224
1700	0.039027	0.22956841	10,000	17.00%	0.2030	0.0038835	169	159	180.6	234
1800	0.041322	0.22956841	10,000	18.00%	0.2120	0.0040557	177	166	191.3	244
1900	0.043618	0.22956841	10,000	19.00%	0.2210	0.0042279	184	173	201.9	255
2000	0.045914	0.22956841	10,000	20.00%	0.2300	0.0044001	192	180	212.5	265
2100	0.048209	0.22956841	10,000	21.00%	0.2390	0.0045722	199	187	223.1	275
2200	0.050505	0.22956841	10,000	22.00%	0.2480	0.0047444	207	195	233.8	286
2300	0.052801	0.22956841	10,000	23.00%	0.2570	0.0049166	214	202	244.4	296
2400	0.055096	0.22956841	10,000	24.00%	0.2660	0.0050888	222	209	255.0	306
2500	0.057392	0.22956841	10,000	25.00%	0.2750	0.0052609	229	216	265.6	317
2600	0.059688	0.22956841	10,000	26.00%	0.2840	0.0054331	237	223	276.3	327
2800	0.064279	0.22956841	10,000	28.00%	0.3020	0.0057775	252	237	297.5	348
3000	0.068871	0.22956841	10,000	30.00%	0.3200	0.0061218	267	251	318.8	369
3250	0.074610	0.22956841	10,000	32.50%	0.3425	0.0065523	285	269	345.3	395
3500	0.080349	0.22956841	10,000	35.00%	0.3650	0.0069827	304	286	371.9	421
3750	0.086088	0.22956841	10,000	37.50%	0.3875	0.0074131	323	304	398.4	446
4000	0.091827	0.22956841	10,000	40.00%	0.4100	0.0078436	342	322	425.0	472
4250	0.097567	0.22956841	10,000	42.50%	0.4325	0.0082740	360	339	451.6	498
4500	0.103306	0.22956841	10,000	45.00%	0.4550	0.0087045	379	357	478.1	524
4750	0.109045	0.22956841	10,000	47.50%	0.4775	0.0091349	398	375	504.7	550
5000	0.114784	0.22956841	10,000	50.00%	0.5000	0.0095654	417	392	531.3	576

Guidance Sheet - Bioretention Areas

Description: Shallow stormwater basin or landscaped area that utilizes engineered soils and vegetation to capture and treat runoff.

KEY CONSIDERATIONS

DESIGN CRITERIA:

- Maximum contributing drainage area of 5 acres
- Often located in "landscaping islands"
- Treatment area consists of grass filter, sand bed, ponding area, organic/mulch layer, planting soil, and vegetation
- Typically requires 5 feet of head

ADVANTAGES / BENEFITS:

- Applicable to small drainage areas
- Good for highly impervious areas, particularly parking lots
- Good retrofit capability
- Relatively low maintenance requirements
- Can be planned as an aesthetic feature

DISADVANTAGES / LIMITATIONS:

- Requires extensive landscaping
- Not recommended for areas with steep slopes

MAINTENANCE REQUIREMENTS:

- Inspect and repair/replace treatment area components

POLLUTANT REMOVAL

80%	**Total Suspended Solids**
60/50%	**Nutrients** - Total Phosphorus / Total Nitrogen removal
M	**Metals** - Cadmium, Copper, Lead, and Zinc removal
No data	**Pathogens** - Coliform, Streptococci, E.Coli removal

STORMWATER MANAGEMENT SUITABILITY

- [x] **Water Quality**
- [ ] **Channel Protection**
- [ ] **Extreme Flood Protection**

Accepts Hotspot Runoff: *Yes (requires impermeable liner)*

ϑ In certain situations

IMPLEMENTATION CONSIDERATIONS

M	**Land Requirement**
M	**Capital Cost**
L	**Maintenance Burden**

Residential Subdivision Use: *Yes*

High Density/Ultra-Urban: *Yes*

Drainage Area: *5 acres max.*

Soils: *Planting soils must meet specified criteria; No restrictions on surrounding soils*

Other Considerations:

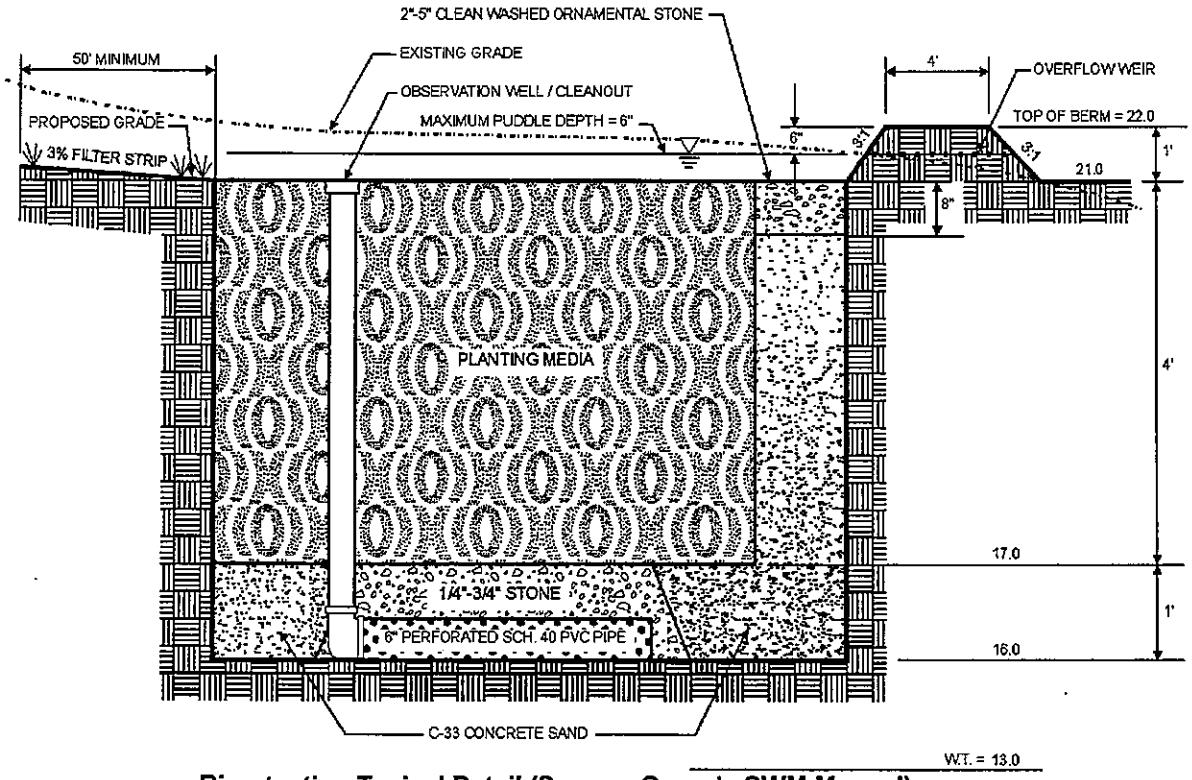
- *Use of native plants is recommended*

L=Low M=Moderate H=High

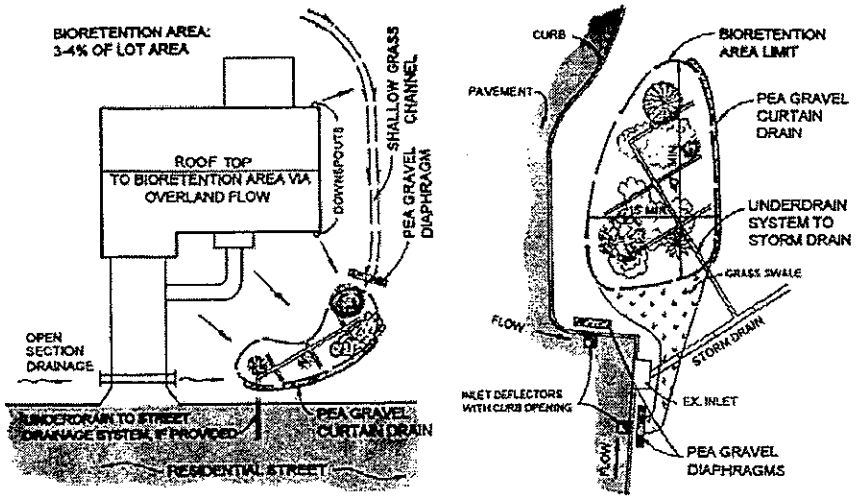
General Description

Bioretention areas (also referred to as *bioretention filters* or *rain gardens*) are structural stormwater controls that capture and temporarily store the water quality volume (WQ_v) using soils and vegetation in shallow basins or landscaped areas to remove pollutants from stormwater runoff.

Bioretention areas are engineered facilities in which runoff is conveyed as sheet flow to the "treatment area," which consists of a grass buffer strip, ponding area, organic or mulch layer, planting soil, and vegetation. An optional sand bed can also be included in the design to provide aeration and drainage of the planting soil. The filtered runoff is typically collected and returned to the conveyance system, though it can also be exfiltrated into the surrounding soil in areas where appropriate.



Bioretention Typical Detail (Source: Georgia SWM Manual)



Application and Site Feasibility Criteria

Bioretention areas are suitable for single-family residential lots of 1 acre or less. Because of its ability to be incorporated in landscaped areas, the use of bioretention is extremely flexible.

The following criteria should be evaluated to ensure the suitability of a bioretention area for meeting stormwater management objectives on a site or development.

Physical Feasibility - Physical Constraints at Project Site

- Site Slope – No more than 6% slope
- Minimum Head – Elevation difference needed at a site from the inflow to the outflow: 5 feet
- Minimum Depth to Water Table – A separation distance of 2 feet recommended between the bottom of the bioretention facility and the elevation of the seasonally high water table.
- Soils – No restrictions; engineered media required

Other Constraints / Considerations

- Aquifer Protection – Do not allow exfiltration of filtered hotspot runoff into groundwater

Planning and Design Criteria

*The following criteria are to be considered **minimum** standards for the design of a bioretention facility **for a single family residential lot**. Consult with the local review authority to determine if there are any variations to these criteria or additional standards that must be followed.*

A. LOCATION AND SITING

- Residential Bioretention areas should have a maximum contributing drainage area of 0.25 acres or less; multiple bioretention areas can be used.

- Bioretention systems are designed for intermittent flow and must be allowed to drain and reaerate between rainfall events. They should not be used on sites with a continuous flow from groundwater, sump pumps, or other sources.

- Bioretention area locations should be integrated into the site planning process, and aesthetic considerations should be taken into account in their siting and design. Elevations must be carefully worked out to ensure that the desired runoff flow enters the facility with no more than the maximum design depth.

B. GENERAL DESIGN

- The Standardized bioretention area for a single residential lot consists of:

  (1) Grass filter strip (lawn areas) between the contributing drainage area and the ponding area should where possible be a minimum of 15' in length.
  (2) Ponding area containing vegetation with a planting soil bed,
  (3) Organic/mulch layer must be four (4') in depth.
  (4) Gravel and perforated pipe underdrain system to collect runoff that has filtered through the soil layers (bioretention areas can optionally be designed to infiltrate into the soil).

- A bioretention area design will also include some of the following:

  - Optional **sand filter layer** to spread flow, filter runoff, and aid in aeration and drainage of the planting soil.
  - **Stone diaphragm** at the beginning of the grass filter strip to reduce runoff velocities and spread flow into the grass filter.

C. PHYSICAL SPECIFICATIONS / GEOMETRY

- The planting soil filter bed is sized using a Darcy's Law equation with a filter bed drain time of 48 hours and a coefficient of permeability (k) of 0.5 ft/day.
- The ponding depth of the bioretention areas is 6 inches.
- The planting soil bed must be at least 4 feet in depth. Planting soils should be sandy loam, loamy sand, or loam texture with a clay content ranging from 10 to 25%. The soil must have an infiltration rate of at least 0.5 inches per hour and a pH between 5.5 and 6.5. In addition, the planting soil should have a 1.5 to 3% organic content and a maximum 500 ppm concentration of soluble salts.
- Water should be directed as sheet flow over lawn area to the bioretention area.
- The mulch layer should consist of 2 to 4 inches of commercially available fine shredded hardwood mulch or shredded hardwood chips.
- The sand bed should be 12 to 18 inches thick. Sand should be clean and have less than 15% silt or clay content.
- Pea gravel for the diaphragm and curtain, where used, should be ASTM D 448 size No. 6 ($^1/_8$" to ¼").
- The underdrain collection system is equipped with a 6-inch perforated PVC pipe (AASHTO M 252) in an 8-inch gravel layer. The pipe should have 3/8-inch perforations, spaced at 6-inch centers, with a minimum of 4 holes per row. The pipe is spaced at a maximum of 10 feet on center and a minimum grade of 0.5% must be maintained. A permeable filter fabric is placed between the gravel layer and the planting soil bed.

D. PRETREATMENT

- Adequate pretreatment is provided when all of the following are provided: (a) water flows over grass filter strip (lawn area) prior to entering the bioretention area.

E. OUTLET STRUCTURES

- Outlet pipe is to be provided from the underdrain system to the facility discharge. Due to the slow rate of filtration, outlet protection is generally unnecessary.

F. EMERGENCY SPILLWAY

- An overflow structure and nonerosive overflow channel must be provided to safely pass flows from the bioretention area that exceed the storage capacity to a stabilized downstream area or watercourse. If the system is located off-line, the overflow should be set above the shallow ponding limit.

G. MAINTENANCE ACCESS

- Adequate access must be provided for all bioretention facilities for inspection, maintenance, and landscaping upkeep, including appropriate equipment and vehicles.

H. SAFETY FEATURES

- Bioretention areas generally do not require any special safety features. Fencing of bioretention facilities is not generally desirable.

I. LANDSCAPING

- Landscaping is critical to the performance and function of bioretention areas.
- A dense and vigorous vegetative cover should be established over the contributing pervious drainage areas before runoff can be accepted into the facility.

- The bioretention area should be vegetated to resemble a terrestrial forest ecosystem, with a mature tree canopy, subcanopy of understory trees, scrub layer, and herbaceous ground cover. Three species each of both trees and scrubs are recommended to be planted.

- The tree-to-shrub ratio should be 2:1 to 3:1. On average, the trees should be spaced 8 feet apart. Plants should be placed at regular intervals to replicate a natural forest. Woody vegetation should not be specified at inflow locations.

- After the trees and shrubs are established, the ground cover and mulch should be established.

- Choose plants based on factors such as whether native or not, resistance to drought and inundation, cost aesthetics, maintenance, etc. Planting recommendations for bioretention facilities are as follows:
  - Native plant species should be specified over non-native species.
  - Vegetation should be selected based on a specified zone of hydric tolerance.
  - A selection of trees with an understory of shrubs and herbaceous materials should be provided.

The following are some native plants suitable for rain gardens for the Northeast Region. They are also attractive to butterflies, birds, and other wildlife. Be sure to choose species appropriate for the degree of sun or shade on the site.

Wildflowers, Ferns, Grasses, and Sedges:

- *Asclepias incarnata,* Swamp milkweed
- *Chelone glabra,* White turtlehead
- *Eupatorium maculatum,* Joe-pye weed
- *Lobelia cardinalis,* Cardinal flower
- *Lobelia syphilitica,* Blue lobelia
- *Monarda didyma,* Oswego tea
- *Vernonia noveboracensis,* Common ironweed
- *Athyrium filix-femina,* Lady fern
- *Osmunda regalis,* Royal fern
- *Osmunda cinnamomea,* Cinnamon fern
- *Carex pendula,* Drooping sedge
- *Carex stipata,* Tussock sedge

Trees and Shrubs:

- *Amelanchier laevis,* Shadbush
- *Asimina triloba,* Pawpaw
- *Betula nigra,* River birch
- *Cephalanthus occidentalis,* Buttonbush
- *Clethra alnifolia,* Sweet pepperbush
- *Cornus amomum,* Silky dogwood
- *Fothergilla gardenii,* Dwarf fothergilla
- *Ilex verticillata,* Winterberry holly
- *Lindera benzoin,* Spicebush
- *Liquidambar styraciflua,* Sweet gum
- *Sambucus canadensis,* American elderberry
- *Viburnum dentatum,* Arrowwood

Design Basis

The required planting soil filter bed area is computed using the following equation (based on Darcy's Law):

$$A_f = (WQv)\,(d_f) / [\,(k)\,(h_f + d_f)\,(t_f)]$$

where:

- A_f = surface area of ponding area (ft^2)
- WQ_v = water quality volume (or total volume to be captured in CF)
- d_f = filter bed depth (4 feet minimum)
- k = coefficient of permeability of filter media (ft/day) (use 0.5 ft/day for silt-loam)
- h_f = average height of water above filter bed (ft) (typically 3 inches, which is half of the 6-inch ponding depth)
- t_f = design filter bed drain time (days) (2.0 days or 48 hours is recommended maximum)

An overflow must be provided to bypass and/or convey larger flows to the downstream drainage system or stabilized watercourse. Nonerosive velocities need to be ensured at the outlet point.

A landscaping plan for the bioretention area should be prepared to indicate how it will be established with vegetation.

Inspection and Maintenance Requirements

Typical Maintenance Activities for Bioretention Areas
(Source: EPA, 1999)

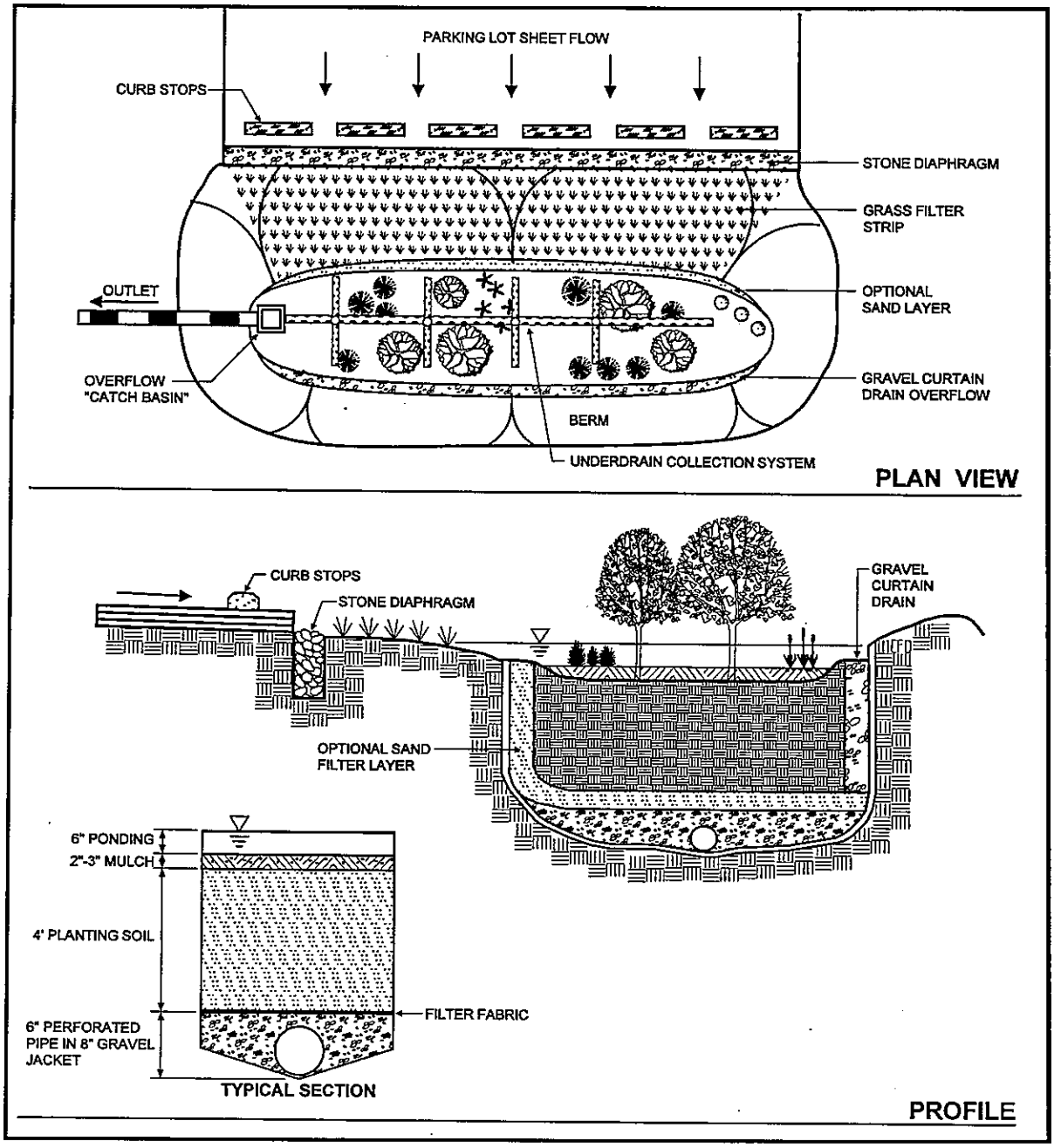
Activity	Schedule
• Pruning and weeding to maintain appearance. • Mulch replacement when erosion is evident. • Remove trash and debris.	As needed
• Inspect inflow points for clogging (off-line systems). Remove any sediment. • Inspect filter strip/grass channel for erosion or gullying. Re-seed or sod as necessary. • Trees and shrubs should be inspected to evaluate their health and remove any dead or severely diseased vegetation.	Semi-annually
• The planting soils should be tested for pH to establish acidic levels. If the pH is below 5.2, limestone should be applied. If the pH is above 7.0 to 8.0, then iron sulfate plus sulfur can be added to reduce the pH.	Annually
• Replace mulch over the entire area. • Replace pea gravel diaphragm if warranted.	2 to 3 years

Additional Maintenance Considerations and Requirements

- The surface of the ponding area may become clogged with fine sediment over time. Core aeration or cultivating of unvegetated areas may be required to ensure adequate filtration.

Regular inspection and maintenance is critical to the effective operation of bioretention facilities as designed. Maintenance responsibility for a bioretention area should be vested with a responsible authority by means of a legally binding and enforceable maintenance agreement that is executed as a condition of plan approval.

Example Schematic

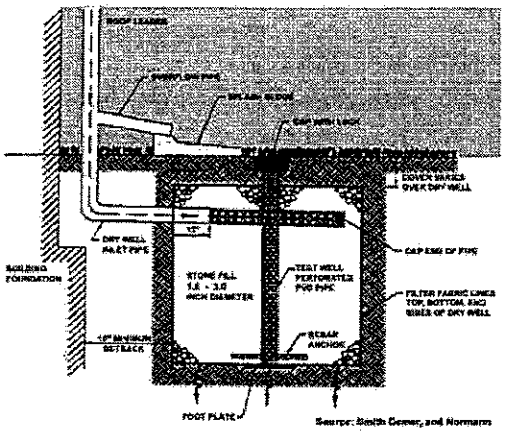


Schematic of a Typical On-line Bioretention Area

(Source: Claytor and Schueler, 1996)

This Guidance document is based upon information adapted from the Georgia Stormwater Manual and the Brooklyn Botanic Garden web site.

Guidance Sheet - Rock Sumps



Description: A Dry Well, or Seepage Pit, is a variation on an Infiltration system that is designed to temporarily store and infiltrate rooftop runoff.

(Source: PA BMP Manual)

KEY CONSIDERATIONS

- Maintain a minimum 2-foot separation to bedrock and seasonally high water table, provide distributed infiltration area (5:1 impervious area to infiltration area - maximum), site on natural, uncompacted soils with acceptable infiltration capacity, and follow other guidelines described in Protocol 2: Infiltration Systems Guidelines
- Maintain minimum distance from building foundation (typically 10 feet)
- Provide adequate overflow outlet for large storms
- Depth of Dry Well aggregate should be between 48 inches
- At least one observation well; clean out is recommended
- Wrap aggregate with nonwoven geotextile
- Maximum drain-down time is 72 hours

STORMWATER MANAGEMENT SUITABILITY

- ☑ **Water Quality**
- ☑ **Channel/Flood Protection**

SPECIAL APPLICATIONS

- ☐ **Pretreatment**
- ☑ **High Density/Ultra-Urban**
- ☑ **Other: Overflow Parking, Driveways & related uses**

Residential Subdivision Use: *Yes*
(in common areas that are maintained)

☑ in certain situations

General Description

A Dry Well, sometimes called a Seepage Pit, is a subsurface storage facility that temporarily stores and infiltrates stormwater runoff from the roofs of structures. Roof leaders connect directly into the Dry Well, which may be either an excavated pit filled with uniformly graded aggregate wrapped in geotextile or a prefabricated storage chamber or pipe segment. Dry Wells discharge the stored runoff via infiltration into the surrounding soils. In the event that the Dry Well is overwhelmed in an intense storm event, an overflow mechanism (surcharge pipe, connection to larger infiltration area, etc.) will ensure that additional runoff is safely conveyed downstream.

By capturing runoff at the source, Dry Wells can dramatically reduce the increased volume of stormwater generated by the roofs of structures. Though roofs are generally not a significant source of runoff pollution, they are still one of the most important sources of new or increased runoff volume from developed areas. By decreasing the volume of stormwater runoff, Dry Wells can also reduce runoff rate and improve water quality. As with other infiltration practices, Dry Wells may not be appropriate for "hot spots" or other areas where high pollutant or sediment loading is expected without additional design considerations. Dry Wells are not recommended within a specified distance to structures or subsurface sewage disposal systems.

Design Criteria and Specifications

The use of a single stage rock sump is one of several alternatives that may be appropriate for small project area developments. Site parameters which must be considered when determining the suitability of a sump for stormwater control include the following:

- Soil type
- Slope
- Slope Stability
- Discharge location
- Basement elevation
- Offsite stormwater conveyance systems
- Offsite detention systems

Where it is determined that a single stage rock sump is appropriate, the following procedure is designed to provide a fast, simple method to determine the rock volume and orifice size required to provide adequate stormwater control for small projects. In order to develop a practical solution for this type of design problem, several qualifying assumptions are necessary to set the limits for which the procedure is applicable. Those limits were designed to incorporate the type of situation most often encountered. In general, the following conditions must be satisfied in order for the use of single stage rock sumps to be appropriate:

- The project area tributary to the proposed sump is less than 5000 square feet, and consists entirely of impervious (paved or roofed areas) surfaces, i.e., RCN = 98;

- To minimize the sump size, runoff from impervious surfaces may be divided and conveyed to the separate sumps. If runoff from impervious surfaces is not divided, the sump must be designed for the entire area that will be tributary to the facility;

- The pre-development area to be altered must have an existing time of concentration (Tc) of six (6) minutes or less; and

- The single stage rock sump must be designed according to the parameters shown in the attached drawing.

Prior to using the following procedure, the designer must verify that all of the above criteria apply to the subject project. Should any of the conditions not apply, the use of the procedure outlined herein is inappropriate and may result in either the over-design or under-design of the rock sump facility.

DESIGN SIZING

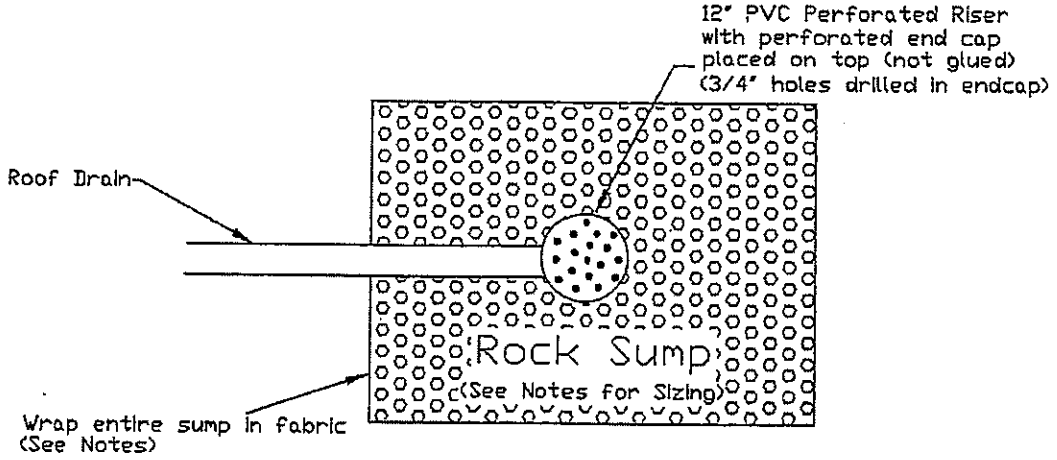
1. Determine the area of the impervious surfaces that will be collected and conveyed to the sump.

2. Enter the sizing table and determine the size of the release orifice and volume of the sump.

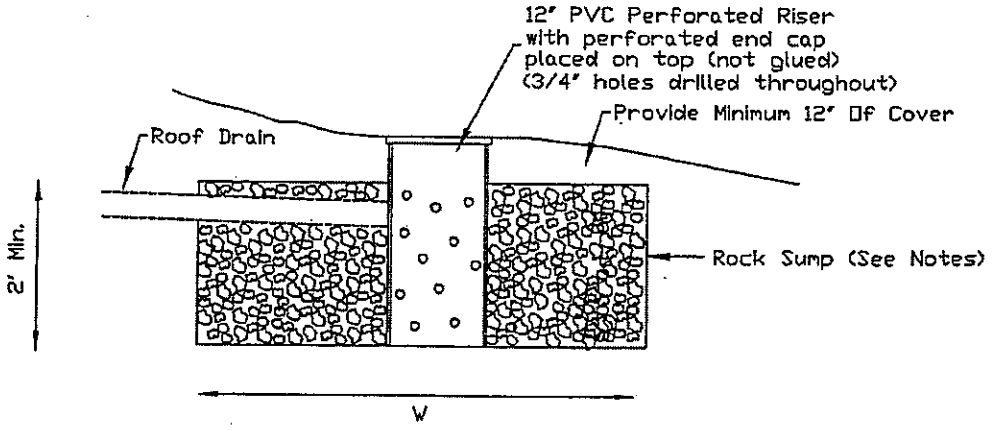
3. Determine the sump dimensions based on the site topography and surface features.

4. Design the sump in accordance with the parameters shown in the attached drawing.

NOTE: If the development will result in an increase in impervious surface of less than 400 square feet, the infiltration sump design (below) should be used. The sump volume should be based on 40 cubic feet of stone for each 100 square feet of impervious surface.



PLAN VIEW



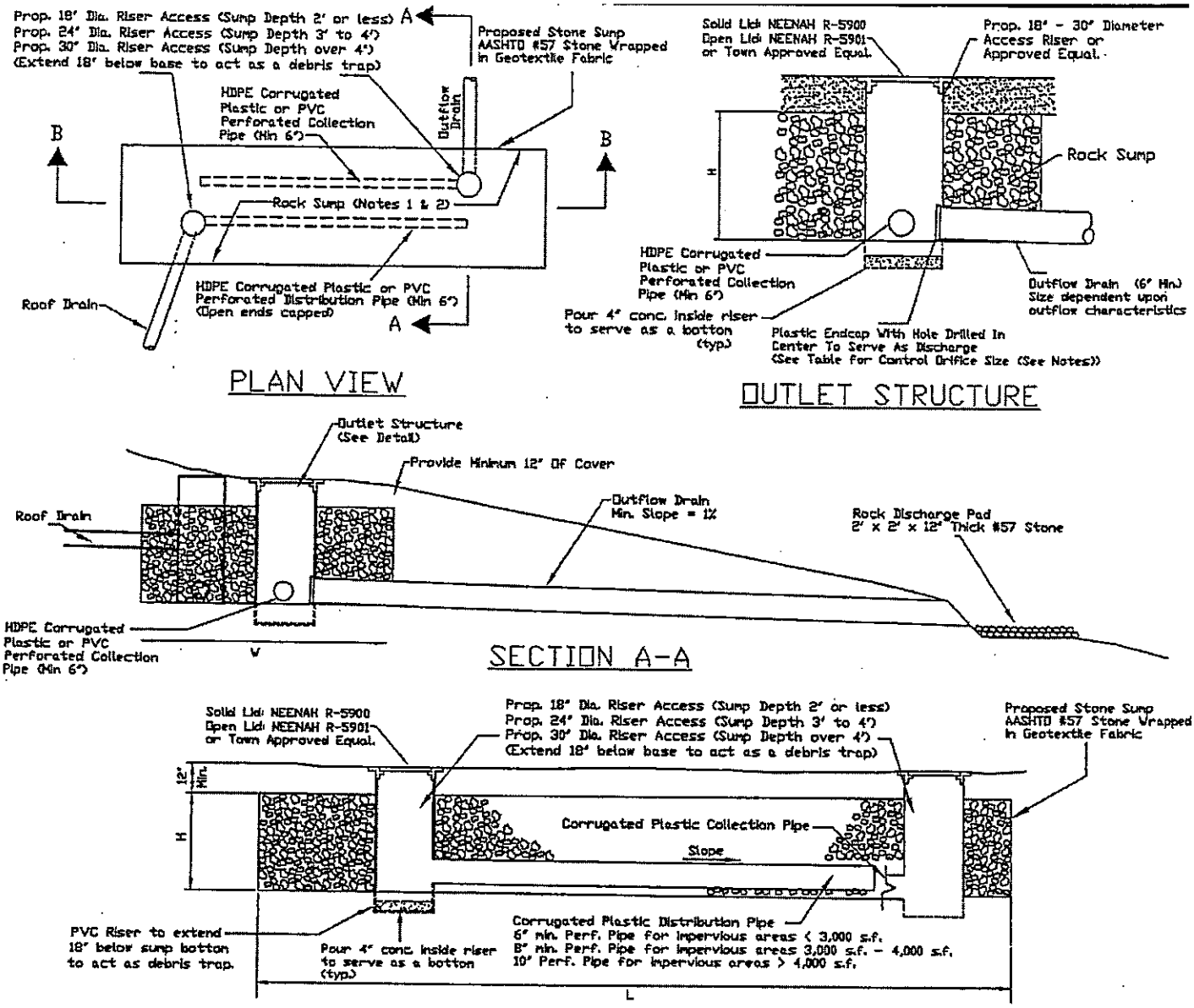
SECTION

Notes:

1. The Rock Sump shall be designed as follows:
   40 c.f. of Rock per 100 s.f. of Impervious area
2. Rock Sump shall be constructed of AASHTO #57 Limestone or 2B Gravel.
3. Wrap sump on all sides with PennDOT Class 2, Type B Non-woven Geotextile Material.
4. Dimensions and ratios shall vary as per design volume required.
5. Dry sumps in fill areas not permitted.
6. Cleanouts shall be located just before any horizontal bends.
7. When feasible, the Rock Sump should be located such that the top elevation of the riser pipe is below the basement floor elevation.

THIS DETAIL MAY BE UTILIZED FOR TOTAL IMPERVIOUS AREAS < 400 S.F.

Figure S1 - Rock Sump Detail (< 400 SF of impervious area)
(Detailed from Town of McCandless / Partridge Venture Engineering)



Notes:

1. Design Parameters (volume and outlet control works) shall be based upon the Table of values as shown on Detail SW-5, (400 S.F. < Impervious Area < 5000 s.f.)
2. Rock Sump shall be constructed of AASHTO #57 Limestone or 2B Gravel.
3. Wrap sump on all sides with PennDOT Type B Non-woven Geotextile Material.
4. Dimensions and ratios of L (Length), W (Width) and H (Height) shall vary as per design volume required.
5. Minimum ratio L to W is 3:1; (ie. L = 3W).
6. Dry sumps in fill areas not permitted.
7. Dimensions L (Length) shall be oriented to be parallel to the grade contour alignment.
8. No 90° elbows permitted on cleanout installations.
9. Cleanouts shall be located just before any horizontal bends.
10. All pipe and fittings shall be ASTM D2729.
11. When feasible, the Rock Sump should be located such that the outflow elevation is below the basement floor elevation.

THIS DETAIL MAY BE UTILIZED FOR TOTAL IMPERVIOUS AREAS > 400 S.F. & < 5,000 S.F.

Figure S2 - Rock Sump Detail (> 400 SF & < 5000 SF of impervious area)

(Detailed from Town of McCandless / Partridge Venture Engineering)

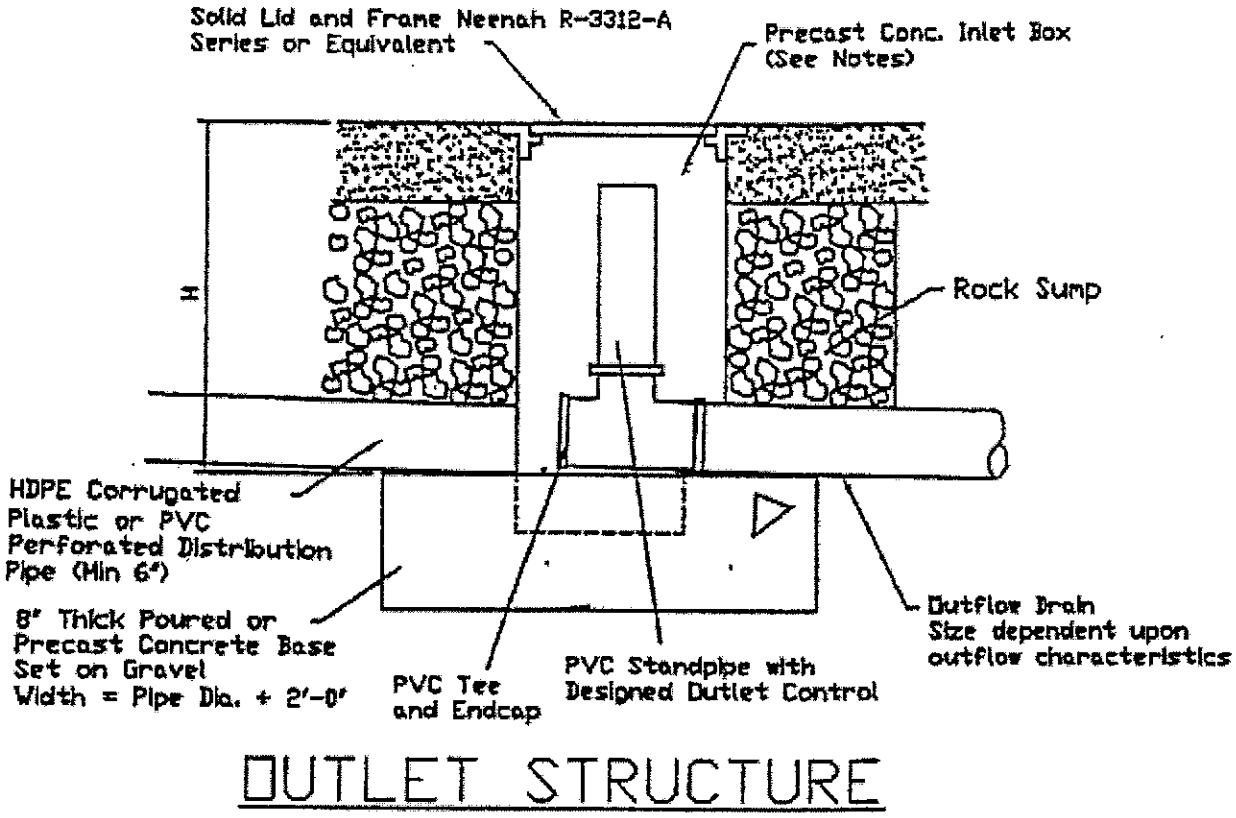


Figure S3 – Sump Outlet Structure
(Information from Town of McCandless / Partridge Venture Engineering)

DESIGN PARAMETERS
RESIDENTIAL ON-LOT SUMP
(TOTAL IMPERVIOUS AREA < 5,000 S.F.)

IMPERVIOUS AREA (SQ. FT.)	DEPTH OF SUMP (FT.)					SUMP VOLUME REQUIRED (CU. FT.)	
	1	2	3	4	5		
	DIAMETER OF OUTLET ORIFICE (IN)					NET	ROCK
400	11/16	9/16	1/2	1/2	1/2	68	170
600	13/16	11/16	5/8	9/16	9/16	102	255
800	15/16	13/16	11/16	5/8	5/8	136	340
1000	1-1/16	7/8	13/16	3/4	11/16	170	425
1200	1-3/16	1-0	7/8	13/16	3/4	204	510
1400	1-1/4	1-1/16	15/16	7/8	13/16	238	595
1600	1-3/8	1-1/8	1-0	15/16	7/8	272	680
1800	1-7/16	1-3/16	1-1/16	1-0	15/16	306	765
2000	1-1/2	1-1/4	1-1/8	1-1/16	1-0	340	850
2200	1-9/16	1-5/16	1-3/16	1-1/8	1-1/16	374	935
2400	1-5/8	1-3/8	1-1/4	1-3/16	1-1/8	408	1020
2600	1-11/16	1-7/16	1-5/16	1-1/4	1-1/8	442	1105
2800	1-3/4	1-1/2	1-3/8	1-1/4	1-3/16	476	1190
3000	1-13/16	1-9/16	1-3/8	1-5/16	1-1/4	510	1275
3200	1-7/8	1-5/8	1-7/16	1-3/8	1-1/4	544	1360
3400	1-15/16	1-5/8	1-1/2	1-3/8	1-5/16	578	1445
3600	2-0	1-11/16	1-9/16	1-7/16	1-3/8	612	1530
3800	2-1/16	1-3/4	1-9/16	1-7/16	1-3/8	646	1615
4000	2-1/8	1-13/16	1-5/8	1-1/2	1-7/16	680	1700
4200	2-3/16	1-13/16	1-11/16	1-9/16	1-7/16	714	1785
4400	2-1/4	1-7/8	1-11/16	1-9/16	1-1/2	748	1870
4600	2-5/16	1-15/16	1-3/4	1-5/8	1-9/16	782	1955
4800	2-5/16	1-15/16	1-3/4	1-5/8	1-9/16	816	2040
5000	2-3/8	2-0	1-13/16	1-11/16	1-5/8	850	2125

Table S1
(Information from Town of McCandless / Partridge Venture Engineering)

Design Basis

The sump designs are based upon documents and detail sheets provided by Partridge Venture Engineering.

Determine the square footage for the Standardized Rock Sump Foot Print from the "Determination of SWM Facility Sizing" table (Disturbed Area Table).

Note that the square footage of the "sump foot print" for the Standardized Design provided in the Disturbed Area Table is based upon an assumed sump rock depth of 4'.

Different sump rock depths may be used. These may be determined by multiplying the "sump foot print" by the assumed rock depth of four (4') feet, to determine the cubic feet of rock required for the sump. Then use Table S1 to select determine the "diameter of the outlet orifice" need for the actual depth proposed.

To determine the sump foot print needed for the actual depth proposed, multiply the cubic feet of rock required by the actual depth of the sump proposed.

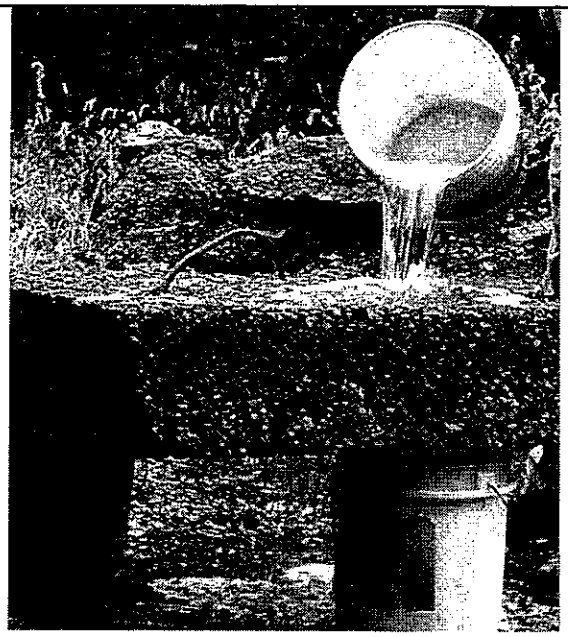
Inspection and Maintenance Requirements

As with all infiltration practices, Dry Wells require regular and effective maintenance to ensure prolonged functioning. The following represent minimum maintenance requirements for Dry Wells:

Activity	Schedule
• Initial inspection	By Building Inspector to Insure Proper Sizing
• Ensure that sediment is not directed to the sump	As needed
• Regularly clean out gutters and ensure proper connections to facilitate the effectiveness of the dry well.	As needed, based on inspection
• Evaluate the drain-down time of the Dry Well to ensure the maximum time of 72 hours is not being exceeded. If drain-down times are exceeding the maximum, drain the Dry Well via pumping and clean out perforated piping, if included. If slow drainage persists, the system may need replacing.	As needed, based on inspection
• Reconstruct sump if its no longer functioning as originally designed	As needed, based on inspection
• Replace filter screen that intercepts roof runoff as necessary. If an intermediate sump box exists, clean it out at least once per year.	Annually

This Guidance document is based upon information abstracted from the Georgia Stormwater Manual, the PA SW BMP Manual and the Town of McCandless. .

Guidance Sheet - Porous Pavements



Description: Porous concrete is the term for a mixture of coarse aggregate, Portland cement and water that allow for rapid infiltration of water and overlays a stone aggregate reservoir. This reservoir provides temporary storage as runoff infiltrates into underlying permeable soils and/or out through an underdrain system.

(Photograph Source: Pittsburgh Mobile Concrete)

KEY CONSIDERATIONS

- Soil infiltration rate of 0.5 in/hr or greater required
- Pour the concrete using a volumetric (mobile) mixer
- Excavated area filled with stone media; gravel and sand filter layers with observation well
- Pre-treat runoff if sediment present
- Provides reduction in runoff volume
- Somewhat higher cost when compared to conventional pavements
- Potential for high failure rate if poorly designed, poorly constructed, not adequately maintained or used in unstabilized areas
- Potential for groundwater contamination

STORMWATER MANAGEMENT SUITABILITY

- ☑ **Water Quality**
- ☑ **Channel/Flood Protection**

SPECIAL APPLICATIONS

- ☐ **Pretreatment**
- ☑ **High Density/Ultra-Urban**
- ☑ **Other: Overflow Parking, Driveways & related uses**

Residential Subdivision Use: *Yes*
(in common areas that are maintained)

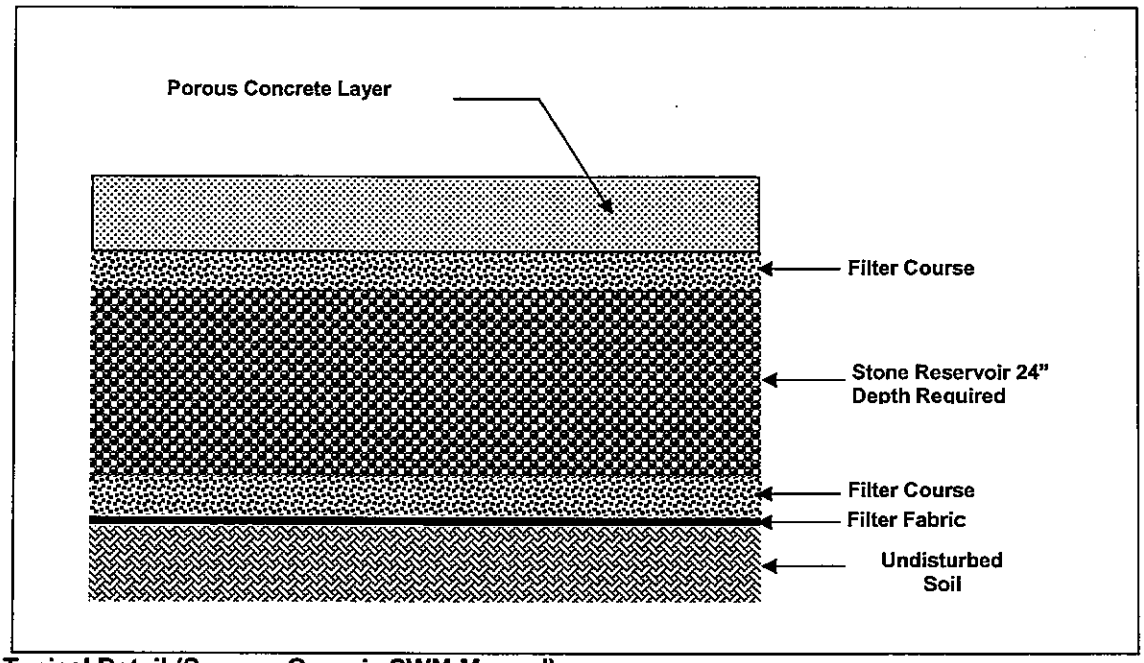
☑ in certain situations

General Description – Porous Concrete

Porous concrete (also referred to as *enhanced porosity concrete, porous concrete, portland cement pervious pavement* and *pervious pavement*) is a subset of a broader family of pervious pavements including porous asphalt, and various kinds of grids and paver systems. Porous concrete is thought to have a greater ability than porous asphalt to maintain its porosity in hot weather and thus is provided as a limited application control. Although, porous concrete has seen growing use, there is still very limited practical experience with this measure.

Porous concrete consists of a specially formulated mixture of Portland cement, uniform, open graded course aggregate, and water. The concrete layer has a high permeability often many times that of the underlying permeable soil layer, and allows rapid percolation of rainwater through the surface and into the layers beneath. The void space in porous concrete is in the 15% to 22% range compared to three to five percent for conventional pavements. The permeable surface is placed over a layer of open-graded gravel and crushed stone. The void spaces in the stone act as a storage reservoir for runoff.

Porous concrete is designed primarily for stormwater quality, i.e. the removal of stormwater pollutants. However, they can provide limited runoff quantity control, particularly for smaller storm events. For some smaller sites, trenches can be designed to capture and infiltrate the channel protection volume (Cp_v) in addition to WQ_v. Porous concrete will need to be used in conjunction with another structural control to provide overbank and extreme flood protection, if required.



Typical Detail (Source: Georgia SWM Manual)

Modifications or additions to the standard design have been used to pass flows and volumes in excess of the water quality volume, or to increase storage capacity or treatment. These include:

- Placing a perforated pipe near the top of the crushed stone reservoir to pass excess flows after the reservoir is filled
- Providing surface detention storage in a parking lot, adjacent swale, or detention pond with suitable overflow conveyance
- Connecting the stone reservoir layer to a stone filled trench
- Adding a sand layer and perforated pipe beneath the stone layer for filtration of the water quality volume
- Placing an underground detention tank or vault system beneath the layers

The infiltration rate of the soils in the subgrade should be adequate to support drawdown of the entire runoff capture volume within 24 to 48 hours. Special care must be taken during construction to avoid undue compaction of the underlying soils which could affect the soils' infiltration capability.

Slopes should be flat or gentle to facilitate infiltration versus runoff and the seasonally high water table or bedrock should be a minimum of two feet below the bottom of the gravel layer if infiltration is to be relied on to remove the stored volume.

Porous concrete has the positive characteristics of volume reduction due to infiltration, groundwater recharge, and an ability to blend into the normal urban landscape relatively unnoticed. It also allows a

reduction in the cost of other stormwater infrastructure, a fact that may offset the greater placement cost somewhat.

A drawback is the cost and complexity of porous concrete systems compared to conventional pavements. Porous concrete systems require a very high level of construction workmanship to ensure that they function as designed. They experience a high failure rate if they are not designed, constructed and maintained properly.

Design Criteria and Specifications

- Porous concrete systems can be used where the underlying in-situ subsoils have an infiltration rate greater than 0.5 inches per hour. Therefore, porous concrete systems are not suitable on sites with hydrologic group D and many group C soils, or soils with a high (>30%) clay content. In areas where poor infiltration is expected the gravel bed should be properly graded and an overflow provided to drain the bed so that water will not be trapped in the pervious concrete. During construction and preparation of the subgrade, special care must be taken to avoid compaction of the soils.

- Pour the concrete using volumetric (mobile) mixer.

- Porous concrete systems should typically be used in applications where the pavement receives tributary runoff only from impervious areas. Actual pervious surface area sizing will depend on achieving a 24 hour minimum and 48 hour maximum draw down time for the design storm volume.

- If runoff is coming from adjacent pervious areas, it is important that those areas be fully stabilized to reduce sediment loads and prevent clogging of the porous paver surface. Pretreatment using filter strips or vegetated swales for removal of course sediments is recommended. (see sections 3.3.1 and 3.3.2)

- Porous concrete systems should not be used on slopes greater than 5% with slopes of no greater than 2% recommended. For slopes greater than 1% barriers perpendicular to the direction of drainage should be installed in sub-grade material to keep it from washing away, or filter fabric should be placed at the bottom and sides of the aggregate to keep soil from migrating into the aggregate and reducing porosity.

- A minimum of four feet of clearance is recommended (may be reduced to two feet in coastal areas) between the bottom of the gravel base course and underlying bedrock or the seasonally high groundwater table.

- Porous concrete systems should be sited at least 10 feet down-gradient from buildings and 100 feet away from drinking water wells.

- To protect groundwater from potential contamination, runoff from designated hotspot land uses or activities must not be infiltrated. Porous concrete should not be used for manufacturing and industrial sites, where there is a potential for high concentrations of soluble pollutants and heavy metals. In addition, porous concrete should not be considered for areas with a high pesticide concentration. Porous concrete is also not suitable in areas with karst geology without adequate geotechnical testing by qualified individuals and in accordance with local requirements.
- Porous concrete system designs must use some method to convey larger storm event flows to the conveyance system. One option is to use storm drain inlets set slightly above the elevation of the pavement. This would allow for some ponding above the surface, but would accept bypass flows that are too large to be infiltrated by the porous concrete system, or if the surface clogs.

- For the purpose of sizing downstream conveyance and structural control system, porous concrete surface areas can be assumed to 35% impervious. In addition, credit can be taken for the runoff volume infiltrated from other impervious areas using the methodology in Section 3.1.

- For treatment control, the design volume should be, at a minimum, equal to the water quality volume. The water quality storage volume is contained in the surface layer, the aggregate reservoir, and the sub-grade above the seasonal high water table – if the sub-grade is sandy. The

storm duration (fill time) is normally short compared to the infiltration rate of the sub-grade, a duration of two hours can be used for design purposes. The total storage volume in a layer is equal to the percent of voids times the volume of the layer. Alternately storage may be created on the surface through temporary ponding, though this would tend to accelerate clogging if course sediment or mud settles out on the surface.

- The cross-section typically consists of four layers, as shown on the Typical Detail. The aggregate reservoir can sometimes be avoided or minimized if the sub-grade is sandy and there is adequate time to infiltrate the necessary runoff volume into the sandy soil without by-passing the water quality volume. Descriptions of each of the layers is presented below:

  Porous Concrete Layer – The porous concrete layer consists of an open-graded concrete mixture usually ranging from depths of 2 to 4 inches depending on required bearing strength and pavement design requirements. Porous concrete can be assumed to contain 18 percent voids (porosity = 0.18) for design purposes. The omission of the fine aggregate provides the porosity of the porous pavement. To provide a smooth riding surface and to enhance handling and placement a coarse aggregate of 3/8 inch maximum size is normally used. Use No. 89 coarse aggregate (3/8 to No. 50) per ASTM D 448.

  Top Filter Layer – Consists of a 0.5 inch diameter crushed stone to a depth of 1 to 2 inches. This layer serves to stabilize the porous asphalt layer. Can be combined with reservoir layer using suitable stone.

  Reservoir Layer – The reservoir gravel base course consists of washed, bank-run gravel, 1.5 to 2.5 inches in diameter with a void space of about 40% (Clean Washed No. 2B Stone). **The depth of this layer shall be two (2') feet.** A porosity value (void space/total volume) of 0.32 was assumed.

  Bottom Filter Layer – The surface of the subgrade should be an 6 inch layer of sand (ASTM C-33 concrete sand) or a 2 inch thick layer of 0.5 inch crushed stone, and be completely flat to promote infiltration across the entire surface. This layer serves to stabilize the reservoir layer, to protect the underlying soil from compaction, and act as the interface between the reservoir layer and the filter fabric covering the underlying soil.

  Filter Fabric – It is very important to line the entire trench area, including the sides, with filter fabric prior to placement of the aggregate. The filter fabric serves a very important function by inhibiting soil from migrating into the reservoir layer and reducing storage capacity. Fabric should be MIRFI # 14 N or equivalent.

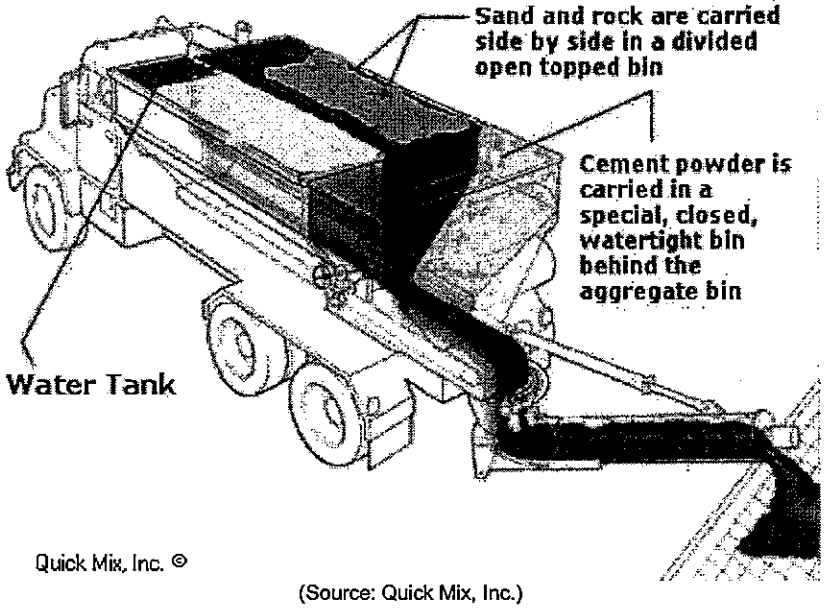
  Underlying Soil – The underlying soil should have an infiltration capacity of at least 0.5 in/hr, but preferably greater than 0.50 in/hr.

- The pit excavation should be limited to the width and depth specified in the design. Excavated material should be placed away from the open trench as not to jeopardize the stability of the trench sidewalls. The bottom of the excavated trench should not be loaded so as to cause compaction, and should be scarified prior to placement of sand. The sides of the trench shall be trimmed of all large roots. The sidewalls shall be uniform with no voids and scarified prior to backfilling. All infiltration trench facilities should be protected during site construction, and should be constructed after upstream areas have been stabilized.

- An observation well consisting of perforated PVC pipe 4 to 6 inches in diameter may be placed at the downstream end of the facility and protected. The well should be used to determine actual infiltration rates.

Volumetric (Mobile) Concrete Mixers

The Mobile Concrete Mixer is a combination materials transporter and mobile concrete mixing plant, mounted on a transport vehicle, usually a truck or trailer, which carries sufficient unmixed material, sand, cement, coarse aggregates, water (and any other chemicals that may be used for special mix designs) to the job to produce fresh concrete, mixed to design specifications.



(Source: Quick Mix, Inc.)

Sand and stone are accurately proportioned by adjusting gates to the correct height. The settings are based on actual calibration of the gate settings done with the specific aggregates being used.

(Source: Pittsburgh Mobile Concrete)

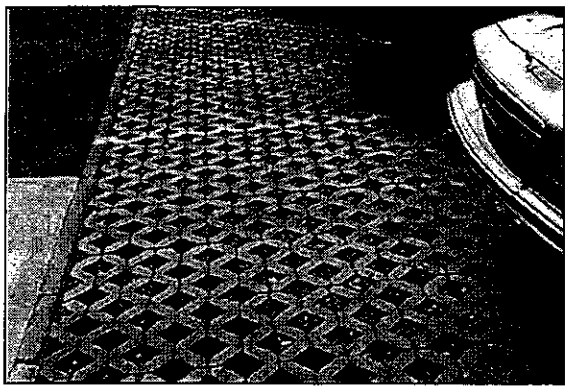
The three basic dry ingredients (sand, stone, and cement powder) simultaneously drop off the main conveyor into the charging end of the mixer at the rear of the unit. At this point, a predetermined metered flow of water also enters the mixer. Action of the combined auger and paddle mixer rapidly, thoroughly, and continuously mixes the ingredients and water to produce a continuous discharge of uniform quality concrete.

The materials blending action is continuous, and may proceed until the ingredient bins are empty. On the other hand, mixing and delivery may be stopped at any time and then started again at the will of the

operator. This permits production to be balanced to the demands of the placing and finishing crews and other job requirements

General Description Modular Paver Systems

Modular porous pavers are structural units, such as concrete blocks, bricks, or reinforced plastic mats, with regularly interdispersed void areas used to create a load-bearing pavement surface. The void areas are filled with pervious materials (gravel, sand, or grass turf) to create a system that allows for the infiltration of stormwater runoff. Porous paver systems provide water quality benefits in addition to groundwater recharge and a reduction in stormwater volume. The use of porous paver systems results in a reduction of the effective impervious area on a site.



There are many different types of modular porous pavers available from different manufacturers, including both pre-cast and mold in-place concrete blocks, concrete grids, interlocking bricks, and plastic mats with hollow rings or hexagonal cells

Modular porous pavers are typically placed on a gravel (stone aggregate) base course. Runoff infiltrates through the porous paver surface into the gravel base course, which acts as a storage reservoir as it exfiltrates to the underlying soil. The infiltration rate of the soils in the subgrade must be adequate to support drawdown of the entire runoff capture volume within 24 to 48 hours. Special care must be taken during construction to avoid undue compaction of the underlying soils, which could affect the soils' infiltration capability.

A drawback is the cost and complexity of modular porous paver systems compared to conventional pavements. Porous paver systems require a higher level of construction workmanship to ensure that they function as designed. In addition, there is the difficulty and cost of rehabilitating the surfaces should they become clogged.

The system must be installed based upon the manufactures recommendations. **The gravel layer required for the Standardized Single Lot Residential Facility is a minimum of two (2') feet in depth.**

Design Basis

For the Standardized BMP for a single residential lot, the minimum surface area of the porous pavement was determined from the following equation:

$$A = WQ_v/(n_g d_g + kT/12)$$

Where:

A = Surface Area Porous Pavement (SF)
WQv = Water Quality Volume in CF
n_g = 0.32 = porosity of the gravel
d_g = 2' = depth or gravel layer (feet)
k = percolation = 0.5 inches/hour assumed
T= Fill Time = 2 hours (time for the practice to fill with water), in hours

Inspection and Maintenance Requirements

Typical Maintenance Activities for Porous Concrete Systems

Activity	Schedule
• Initial inspection	Monthly for three months after installation
• Ensure that the porous paver surface is free of sediment	Monthly
• Ensure that the contributing and adjacent area is stabilized and mowed, with clippings removed	As needed, based on inspection
• Vacuum sweep porous concrete surface followed by high pressure hosing to keep pores free of sediment	Four times a year
• Inspect the surface for deterioration or spalling • Check to make sure that the system dewaters between storms	Annually
• Spot clogging can be handled by drilling half-inch holes through the pavement every few feet • Rehabilitation of the porous concrete system, including the top and base course as needed	Upon failure

To ensure proper maintenance of porous pavement, a carefully worded maintenance agreement is essential. It should include specific the specific requirements and establish the responsibilities of the property owner and provide for enforcement.

This Guidance document is based upon information abstracted from the Georgia Stormwater Manual and the Quick Mix, Inc. web site.

STANDARD PROCEDURES
EROSION AND SEDIMENTATION CONTROLS
FOR INDIVIDUAL RESIDENTIAL LOTS

General

Erosion and Sedimentation from individual residential lots can most often be controlled by silt fence along the lower perimeter of all disturbed areas and the installation of a rock construction entrance where construction traffic will enter and exit the site. Standard Construction Detail, Sheet ES-1, shows the typical erosion controls that should be placed on high and low side lots. If the scope of the work requires additional measures on the site, an individual plan must be submitted and approved by the Township of Ross. In all cases, the Contractor is responsible for complying with the provisions of PA DEP Chapter 102.

Temporary Erosion Controls

Silt fence must be installed along the lower perimeter of all disturbed areas and will function as the primary control for the site. A stone construction entrance must be installed at the driveway entrance to the site to help prevent mud from being tracked out onto the roadway. When at all possible, construction vehicles should be restricted to paved surfaces.

All uncompleted disturbed areas on which activity will cease for more than twenty (20) days should be seeded and stabilized. After construction is complete and all areas are stabilized, all temporary control measures may be removed and all monitoring will cease. Stabilization is defined as the establishment of a uniform 70% perennial vegetal cover.

Staging Schedule

In general, the following staging schedule should be followed for small projects"

1. Install the silt fence in accordance with the standard detail shown on Detail Sheet ES-2 along the lower perimeter of all disturbed areas.

2. Install the rock construction entrance in accordance with the standard detail shown on Detail Sheet ES-2 at the entrance to the site. The stone base for the driveway should also be installed as soon as it is graded in order to prevent erosion.

3. Grub the construction area and remove the topsoil, stockpiling it at the area designated on the plans.

4. Construct the site improvements.

5. Seed and mulch all disturbed areas.

6. Remove all E & S Controls once the site is stabilized. An area will not be considered stabilized until a uniform 70% perennial vegetal cover is established over the disturbed area.

Maintenance Schedule

It shall be the sole responsibility of the contractor to execute the control of inspection, maintenance, and repair of various sediment control facilities according to the guidelines prescribed below.

All control measures must be inspected on a weekly basis, and in all cases immediately following each runoff event. All necessary repairs should be carried out immediately after their identification. Materials cleaned from the BMP's shall be disposed of by spreading them in the topsoil stockpile area.

Silt Fence

Maintenance checks shall include inspecting silt fence for undercutting, tears, collapse offence, and depths of sediment accumulation. All repairs of damaged fence must be performed immediately to ensure that the fence meets design specifications. Sediment should be removed periodically, and in all cases

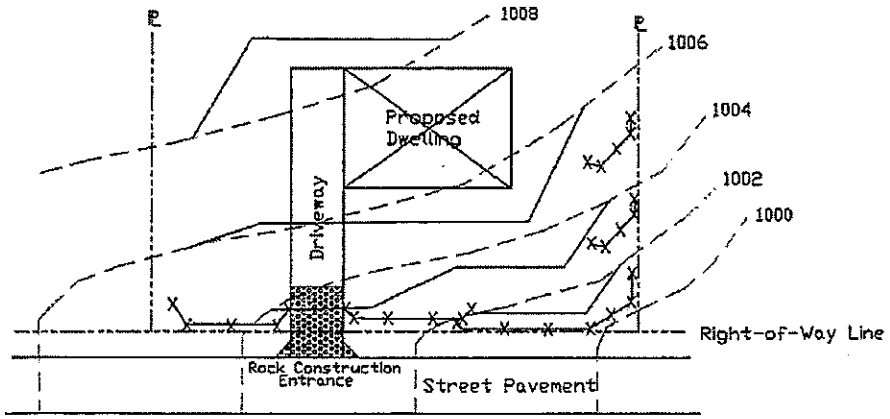
should accumulation attain depths equal to half the height of fence. Sediment deposits removed from the silt fence must be disposed of by spreading the material within the topsoil stockpile area. Undercutting of the toe shall be immediately repaired by installing a rock filter outlet.

Construction Entrance

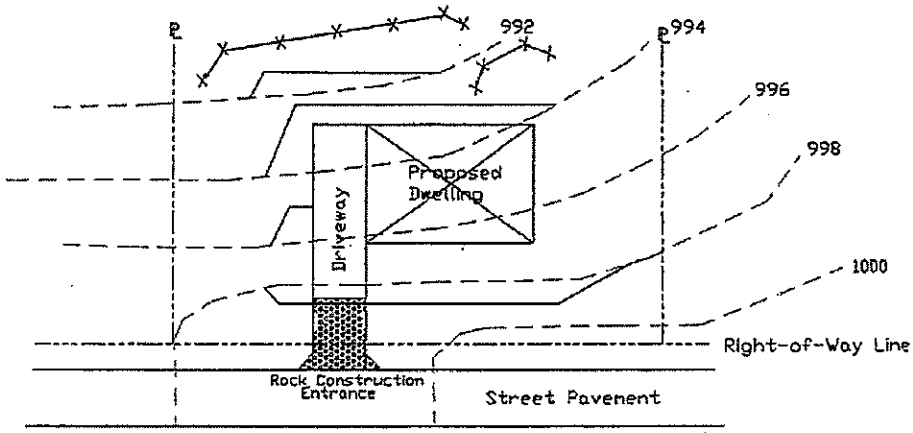
The stabilized construction entrance should be maintained so as to ensure a constant rock thickness. This will be achieved by the placement of additional rock to the specified dimension as required. A stockpile of rock must be maintained on-site for this purpose. At the completion of each work day, all sediment deposited on the public roadways must be removed and returned to the construction site. Washing of the roadway with water will be unacceptable.

Vegetation

All areas to be stabilized by vegetation should be inspected for rills and gullies, bare soil patches or accumulation of sediment at the toe of slopes. Eroded areas shall be regraded, and substandard vegetated areas shall be re-seeded and mulched as specified in the plans.



TYPICAL HIGH-SIDE ON-LOT CONTROL



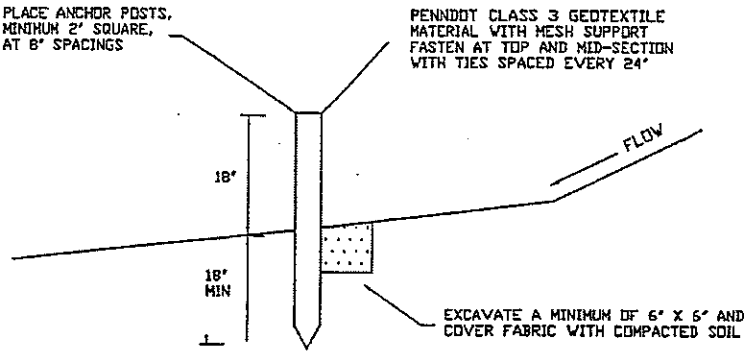
TYPICAL LOW-SIDE ON-LOT CONTROL

LEGEND

Finished Grade
Existing Grade
Silt Fence

Detail ES-1

(Detail from Town of McCandless / Partridge Venture Engineering)



INSTALLATION:

A TRENCH WILL BE PLOWED OR OTHERVISE EXCAVATED TO THE REQUIRED DEPTH WITH LITTLE, IF ANY, DISTURBANCE TO THE DOWNSLOPE SIDE OF THE TRENCH. THE BOTTOM OF THE TRENCH AND THE FENCE TOP WILL BE PLACED ON A LEVEL GRADE. WHEN IT IS NECESSARY TO CROSS SMALL DEPRESSIONS, THE TRENCH BOTTOM AND FENCE TOP EDGE MAY DEVIATE SLIGHTLY FROM LEVEL GRADE. GRADES IN SUCH SECTIONS WILL NOT EXCEED 1% NOR WILL THE DEVIATION EXTEND FOR MORE THAN 25 FEET.

SUPPORT STAKES WILL BE DRIVEN TO THE REQUIRED DEPTH BELOW THE EXISTING GROUND SURFACE AT SPECIFIED INTERVALS AS ILLUSTRATED.

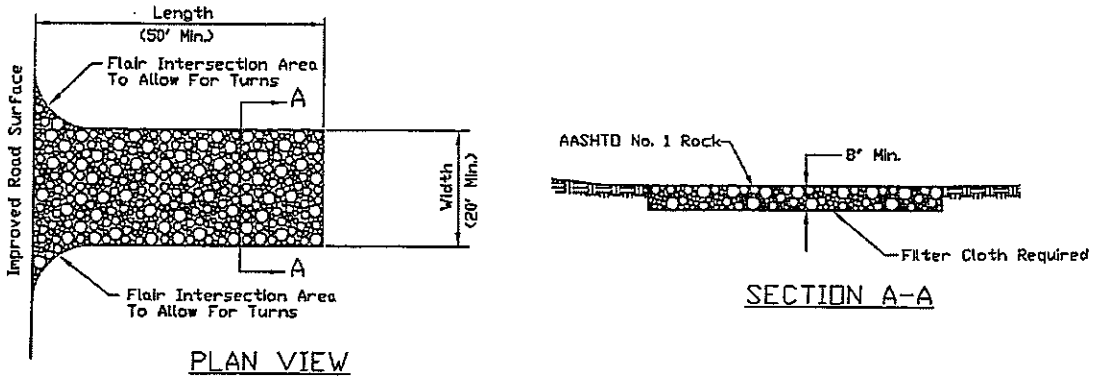
STRETCH AND FASTEN FABRIC TO THE UPSLOPE SIDE OF THE SUPPORT STAKES.

WHERE ENDS OF FABRIC COME TOGETHER, THEY WILL BE OVERLAPPED, FOLDED, AND STAPLED TO PREVENT SEDIMENT BYPASS. AT THE ENDS OF EACH LINE OF SILT FENCE, OR EVERY 100 FEET, WHICHEVER IS S SHORTER, EXTEND THE FENCE UPSLOPE AT A 90 DEGREE ANGLE FOR 4 FEET TO PREVENT ENDFLOW.

THE TOE ANCHOR WILL BE BACKFILLED AND COMPACTED TO A DENSITY EQUAL TO SURROUNDING SOILS.

SILT FENCE

NO SCALE



PLAN VIEW

SECTION A-A

MAINTENANCE: The structure's thickness will be constantly maintained to the specified dimensions by adding rock. A stockpile of rock material will be maintained on the site for this purpose. At the end of each construction day, all sediment deposited on public roadways will be removed and returned to the

ROCK CONSTRUCTION ENTRANCE DETAIL

NO SCALE

Detail ES-2

(Detail from Town of McCandless / Partridge Venture Engineering)

Enacted into an Ordinance, this 16 day of September, 2008 by the Council of the Borough of Etna.

By: Peter Ramage
Peter Ramage,
Chairman of Council

ATTEST:

Mary Ellen Ramage
Mary Ellen Ramage,
Secretary-Manager

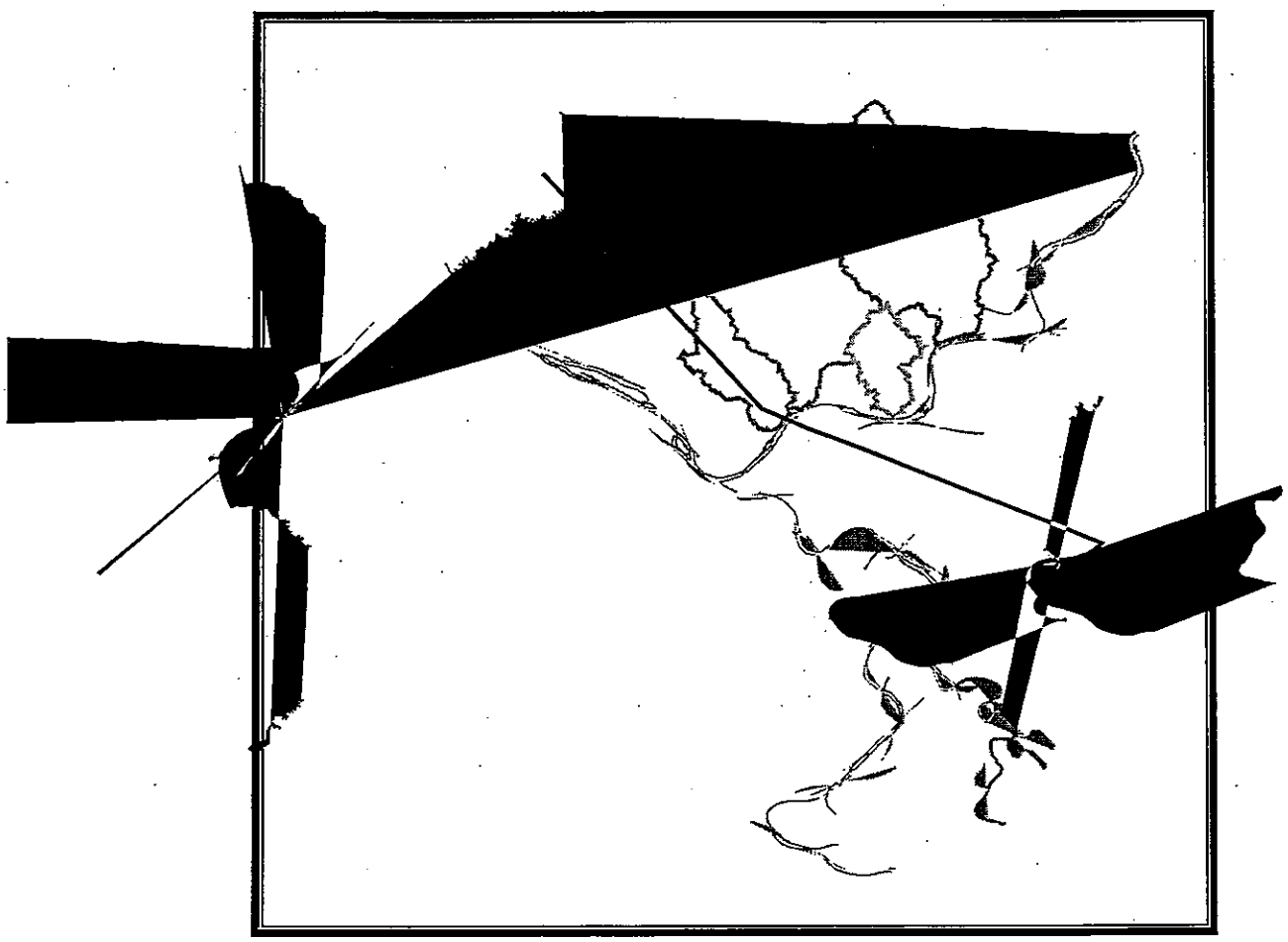
Examined and approved by me, this 16 day of September, 2008.

By: Thomas J. Rengers
Thomas Rengers, Mayor

Ordinance Appendix F

Small Project Standardized SWM Planning Guidance

Small Project
Standardized Stormwater Management Planning Guidance



Act 167 Stormwater Management Plan Update
Girtys Runs, Pine Creek, Squaw Run and Deer Creek Watersheds
Allegheny County, Pennsylvania

Prepared By
Art Gazdik, P.E.

April 28, 2008

Standardized Stormwater Management Planning Guidance For Small Projects

Applicability

These criteria may be used to develop a stormwater management (SWM) plan for a small projects, having a disturbed area of less than 5000 square feet, in an area where a comprehensive subdivision SWM plan has not been planned or constructed. It is not to be used to plan for multiple lots without the written approval of the Municipal Engineer.

This guidance may not be appropriate for all locations (e.g., in areas on or adjacent to steep slopes, in areas on or adjacent to fill slopes, in areas having unsuitable soil conditions (e.g., clayey soils) or in areas having a high water table). The Municipal Building Inspector or Engineer may require that a more detailed stormwater management plan be prepared by a qualified design professional if, in their opinion, unusual site conditions exist.

These standardized SWM facilities, if properly sized and installed, should provide the water quality volume, infiltration volume and extended detention protections required by the municipality's SWM Ordinance. These standardized facilities are not specifically sized to provide for the peak flow reduction requirement, if any, but will generally provide peak flow control of storm events that do not exceed a 10 year – 24 hour return period.

What are the Standardized SWM facilities?

The Standardized SWM facilities (Standardized BMPs) are a set of three methods, or best management practices (BMPs), that have been selected because of their potential for being sited on individual residential lots. Each of the methods has been sized using a specific set of design assumptions. A list of the Standardized SWM facilities and the basic design assumptions used are outlined below. A more detailed set of the design assumptions used to size the Standardized SWM facilities is provided later in this Guide. It is the Applicant's responsibility to verify that the assumptions are appropriate for the subject property. Construction details and more detailed information about the design installation and maintenance requirements for of each of the facilities are also provided later in this document.

SWM Facility Name	Basic Design Assumptions		
Bioretention	4' Filter Bed Depth	0.5' Ponding Depth	Drain Time = 2 Days
Rock Sump	4' Rock Depth		
Porous Pavement	2' Gravel Depth	0.32 Gravel Porousity	Fill Time = 2 Hours

What is required?

A. Install "Stormwater Management Facilities (BMPs)" to reduce downstream flooding and protect the water quality of our streams.

B. Install erosion and sedimentation control devices during construction to keep silt and sediment from washing into the storm sewers, ditches or streams on or adjacent to the site.

C. Properly record a maintenance agreement to insure the continued maintenance and protection of the SWM facilities.

When is it required?

Applicants will be required to file a SWM plan with their building permit or land disturbance / grading permit application as per the municipality's requirements.

Are professional services required?

Yes, the SWM facilities must be designed by a licensed professional engineer or other Qualified Professional experienced in the design of stormwater management.

Are the Standardized SWM facilities in this Guide required?

No, any SWM facilities meeting the municipality's Stormwater Management Regulations will be acceptable.

How should this Guide be used?

Step 1 – Determine the Impervious Area and the Disturbed Area

Calculate the following:

1. The total area in square feet of roofs, driveways, sidewalks, paved areas and any other impervious surfaces proposed for the lot.
2. The total area in square feet of the lot that is to be disturbed. "Disturbed Area" is all area that is to be stripped of natural vegetation and converted to lawn, roof, pavement, sidewalk or driveway.

Step 2 – Determine the required surface area of the Standardized BMPs

Go to the Determination of SWM Facility Sizing Tables (Disturbed Area Table) and find the table that is titled with a "Disturbed Area = [Value] SF" where [Value] is equal to or greater than the proposed "Disturbed Area" for the lot. For example, if the lot will have a disturbed area of 2200 SF, use the table titled "Disturbed Area = 2500 SF or Less" as shown below.

Using the correct Disturbed Area Table, determine the sizing of the standardized SWM facility or facilities to be used, using the area in square feet of **all** impervious surface tributary to the SWM facility or facilities. This area is referred to as "Area Impervious" on the Table and is found in Column "1".

Go down Column "1" to the "Area Impervious" value that is greater than or equal to the impervious area tributary to the SWM facilities. For example, if it is determined that the total area of all roof and pavements tributary to the SWM facilities will be 1921 square feet (SF), use a value of 2000 square feet to determine the SWM facility sizing for the three standardized best management practices provided in Columns 3, 4 and 5 of the table. NOTE: If runoff from existing impervious areas will also be tributary to the SWM facilities, that area must also be included in the calculations.

For this example where the Disturbed Area is 2200 SF and the Area Impervious is 1921 SF, the surface area (foot print size) of the Standardized BMP Options provided are:

Column 3 - Bioretention Surface Area = 151 SF
Column 4 – Rock Sump Foot Print = 212.5 SF
Column 5 – Porous Pavement Surface Area = 222 SF

Disturbed Area = 2500 SF or Less

Determination of SWM Facility Sizing — AG 3/3/7

Note: Disturbed area is all area that is to be stripped of natural vegetation and converted to lawn, roof, pavement, sidewalk or driveway

Bioretention Assumptions
k = 0.5 ft/day for silt loam
df = filter bed depth = 4'
hf = half of ponding depth = 0.25'
tf = filter drain time = 2 days

Rock Sump Assumptions
Assume 4' Sump Depth

Pourous Pavement Assumptions
n = porosity of gravel = 0.32
d = gravel depth = 2'
k = percolation = 0.5 in/hour
T = fill time = 2 hours

1			2					3	4	5
Area Impervious (Square Feet)	Area Impervious (acre)	Disturbed Area (acre)	Disturbed Area (Square Feet)	Percent Impervious (%)	Volumetric Runoff Coeficient (Rv)	Water Quality Volume (acre - feet)	Water Quality Volume (cubic feet)	Bioretention Surface Area (Square Feet)	Rock Sump Surface Foot Print (Square Feet)	Pourous Pavement Surface Area (Square Feet)
250	0.005739	0.0573921	2500	10.00%	0.1400	0.0006696	29	27	26.6	40
300	0.006887	0.0573921	2500	12.00%	0.1580	0.0007557	33	31	31.9	46
400	0.009183	0.0573921	2500	16.00%	0.1940	0.0009278	40	38	42.5	56
500	0.011478	0.0573921	2500	20.00%	0.2300	0.0011000	48	45	53.1	66
600	0.013774	0.0573921	2500	24.00%	0.2660	0.0012722	55	52	63.8	77
700	0.016070	0.0573921	2500	28.00%	0.3020	0.0014444	63	59	74.4	87
800	0.018365	0.0573921	2500	32.00%	0.3380	0.0016165	70	66	85.0	97
900	0.020661	0.0573921	2500	36.00%	0.3740	0.0017887	78	73	95.6	108
1000	0.022957	0.0573921	2500	40.00%	0.4100	0.0019609	85	80	106.3	118
1100	0.025253	0.0573921	2500	44.00%	0.4460	0.0021331	93	87	116.9	128
1200	0.027548	0.0573921	2500	48.00%	0.4820	0.0023052	100	95	127.5	139
1300	0.029844	0.0573921	2500	52.00%	0.5180	0.0024774	108	102	138.1	149
1400	0.032140	0.0573921	2500	56.00%	0.5540	0.0026496	115	109	148.8	160
1500	0.034435	0.0573921	2500	60.00%	0.5900	0.0028218	123	116	159.4	170
1600	0.036731	0.0573921	2500	64.00%	0.6260	0.0029940	130	123	170.0	180
1700	0.039027	0.0573921	2500	68.00%	0.6620	0.0031661	138	130	180.6	191
1800	0.041322	0.0573921	2500	72.00%	0.6980	0.0033383	145	137	191.3	201
1900	0.043618	0.0573921	2500	76.00%	0.7340	0.0035105	153	144	201.9	211
2000	0.045914	0.0573921	2500	80.00%	0.7700	0.0036827	160	151	212.5	222
2100	0.048209	0.0573921	2500	84.00%	0.8060	0.0038548	168	158	223.1	232
2200	0.050505	0.0573921	2500	88.00%	0.8420	0.0040270	175	165	233.8	243
2300	0.052801	0.0573921	2500	92.00%	0.8780	0.0041992	183	172	244.4	253
2400	0.055096	0.0573921	2500	96.00%	0.9140	0.0043714	190	179	255.0	263
2500	0.057392	0.0573921	2500	100.00%	0.9500	0.0045435	198	186	265.6	274

Figure -Example Table "Determination of SWM Facility Sizing (Disturbed Area Table)

Applicants may use a single option to satisfy the SWM requirements or a combination of options.

For example, a single type of facility, say Bioretention, could be installed as set forth below:

SWM Facility Type	Total Required	Actual SF Installed	Percentage of SWM Requirement
	(SF)	(SF)	(%)
Bioretention	151	151	100%
Rock Sump	212.5	0	0%
Porous Pavement	222	0	0%
			100%

or multiple SWM facility types could be proposed:

SWM Facility Type	Total Required	Actual SF Installed	Percentage of SWM Requirement
	(SF)	(SF)	(%)
Bioretention	151	50	33%
Rock Sump	212.5	35	16%
Porous Pavement	222	111	50%
			100%

Step 3 – Preparing the SWM Site Plan

Applicants shall submit three (3) copies of a plot plan survey or site plan drawn on a single sheet no larger that 8 1/2" x 14" (or folded to 8 1/2" x 11") containing all of the following information. (Submission of one plan showing existing conditions and a second plan(s) showing proposed work generally will not be acceptable.)

1) Name and address of owner(s).

2) Lot number, name of subdivision, size of lot, street address, scale, date.

3) North arrow.

4) All existing and proposed structures, including accessory structures, additions, driveways, decks, patios, utilities, storm sewers, sanitary sewers including laterals, fresh-air vents and cleanouts, storm water sumps, swimming pools and sports courts with all dimensions. When the existing sewer lateral is within the limit of disturbance, the site plan must show its exact location based on existing records. When no such records exist, laterals shall be located using underground pipe locator equipment.

5) Setback distances from all property lines. Building lines must be shown.

6) The distance and direction to the nearest intersection.

7) Existing topography by two-foot (2') contours and all proposed grading clearly delineated to distinguish between existing and proposed grades and the datum upon which the grades are based.

8) The limits, type and degree of risk as shown on any Hazard Maps that the municipality has available.

9) Shading, coloring, cross-hatching, etc. between contour lines to clearly distinguish the areas of Steep Slopes (15% - 25%) and Very Steep Slopes (25%+).

10) The PRECISE "Limit of Disturbance" and the area thereof.

11) All right-of-ways, easements, streams or ponds.

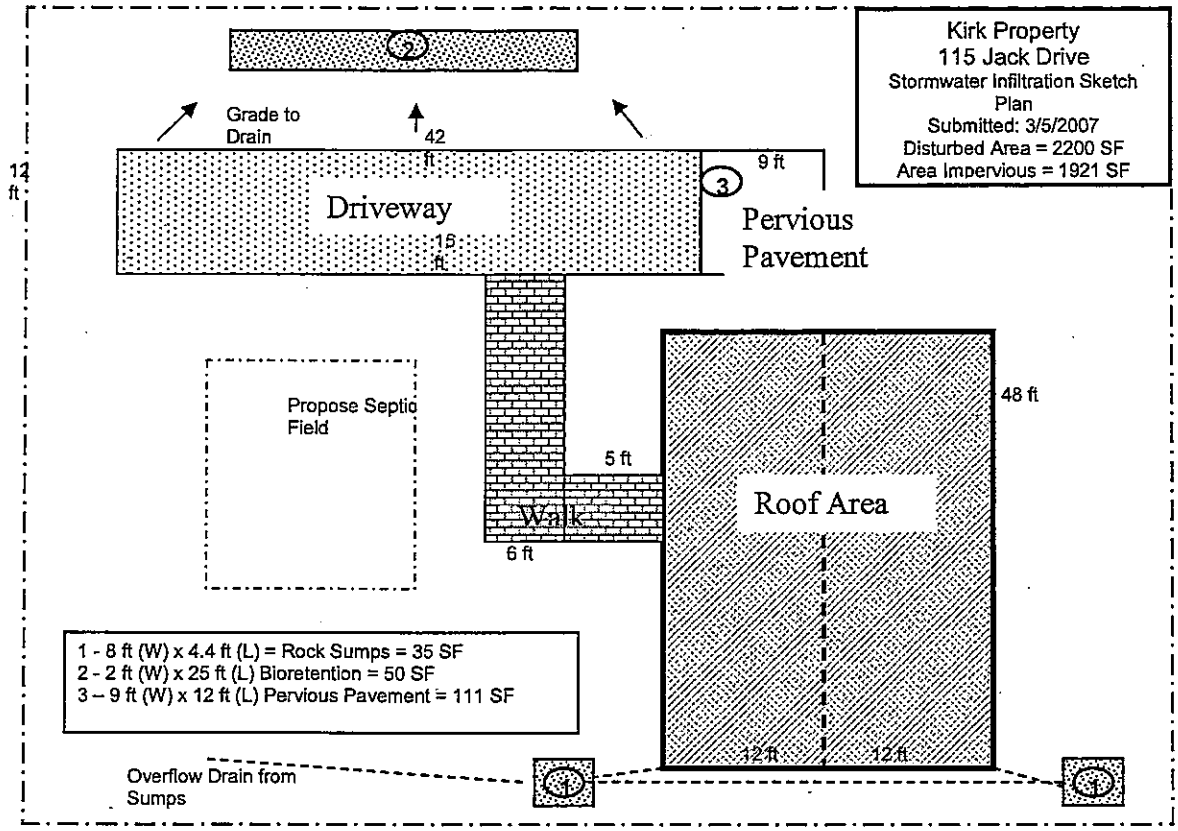
12) The location of all proposed utility lines and the associated "Limit of Disturbance".

13) The method of stormwater management in accordance with the requirements set forth in the municipality's Stormwater Management Regulations. The applicant shall include two (2) copies of the design criteria and method of stormwater management with the application.

14) Soil erosion and sedimentation control measures.

15) A registered Engineer's or other Qualified Professionals seal.

A simple example site plan is provided on the next below.



Step 4 – Submitting the SWM Plan

The following information shall be submitted with the application for a building permit or, if applicable, the Environmental Disturbance / Grading Permit:

- The Standardized SWM Permit Application
- A fully executed "Stormwater BMPs Operations and Maintenance Agreement"
- The SWM site plan.
- A copy of the "Guidance Sheet" for each type of BMP used.

Step 5 – Installing the Standardized BMPs

Insure that each SWM facility is installed as per the requirements of the "Guidance Sheet" for the type(s) of facilities proposed.

Step 6 – Understanding your maintenance responsibilities

In order to insure that the BMPs will continue to be protected and properly maintained, applicants will be required to enter into a "Stormwater Best Management Practices Operations and Maintenance Agreement". A copy of the agreement is provided in the Appendix C of this document.

Disturbed Area = 1000 SF or Less

Determination of SWM Facility Sizing AG 3/3/7

Note: Disturbed area is all area that is to be stripped of natural vegetation and converted to lawn, roof, pavement, sidewalk or driveway.

Bioretention Assumptions
k = 0.5 ft/day for silt loam
df = filter bed depth = 4'
hf = half of ponding depth = 0.25'
tf = filter drain time = 2 days

Rock Sump Assumptions
Assume 4' Sump Depth

Pourous Pavement Assumptions
n = porosity of gravel = 0.32
d = gravel depth = 2'
k = percolation = 0.5 in/hour
T = fill time = 2 hours

1			2					3	4	5
Area Impervious (Square Feet)	Area Impervious (acre)	Disturbed Area (acre)	Disturbed Area (Square Feet)	Percent Imperviuos (%)	Volumetric Runoff Coeficient (Rv)	Water Quality Volume (acre - feet)	Water Quality Volume (cubic feet)	Bioretention Surface Area (Square Feet)	Rock Sump Surface Foot Print (Square Feet)	Pourous Pavement Surface Area (Square Feet)
250	0.005739	0.02295684	1000	25.00%	0.2750	0.0005261	23	22	NA	32
300	0.006887	0.02295684	1000	30.00%	0.3200	0.0006122	27	25	NA	37
400	0.009183	0.02295684	1000	40.00%	0.4100	0.0007844	34	32	42.5	47
500	0.011478	0.02295684	1000	50.00%	0.5000	0.0009565	42	39	53.1	58
600	0.013774	0.02295684	1000	60.00%	0.5900	0.0011287	49	46	63.8	68
700	0.016070	0.02295684	1000	70.00%	0.6800	0.0013009	57	53	74.4	78
800	0.018365	0.02295684	1000	80.00%	0.7700	0.0014731	64	60	85.0	89
900	0.020661	0.02295684	1000	90.00%	0.8600	0.0016452	72	67	95.6	99
1000	0.022957	0.02295684	1000	100.00%	0.9500	0.0018174	79	75	106.3	109

Disturbed Area = 2500 SF or Less

Determination of SWM Facility Sizing AG 3/3/7

Note: Disturbed area is all area that is to be stripped of natural vegetation and converted to lawn, roof, pavement, sidewalk or driveway.

Bioretention Assumptions
k = 0.5 ft/day for silt loam
df = filter bed depth = 4'
hf = half of ponding depth = 0.25'
tf = filter drain time = 2 days

Rock Sump Assumptions
Assume 4' Sump Depth

Pourous Pavement Assumptions
n = porosity of gravel = 0.32
d = gravel depth = 2'
k = percolation = 0.5 in/hour
T = fill time = 2 hours

1			2					3	4	5
Area Impervious (Square Feet)	Area Impervious (acre)	Disturbed Area (acre)	Disturbed Area (Square Feet)	Percent Imperviuos (%)	Volumetric Runoff Coeficient (Rv)	Water Quality Volume (acre - feet)	Water Quality Volume (cubic feet)	Bioretention Surface Area (Square Feet)	Rock Sump Surface Foot Print (Square Feet)	Pourous Pavement Surface Area (Square Feet)
250	0.005739	0.0573921	2500	10.00%	0.1400	0.0006696	29	27	NA	40
300	0.006887	0.0573921	2500	12.00%	0.1580	0.0007557	33	31	NA	46
400	0.009183	0.0573921	2500	16.00%	0.1940	0.0009278	40	38	42.5	56
500	0.011478	0.0573921	2500	20.00%	0.2300	0.0011000	48	45	53.1	66
600	0.013774	0.0573921	2500	24.00%	0.2660	0.0012722	55	52	63.8	77
700	0.016070	0.0573921	2500	28.00%	0.3020	0.0014444	63	59	74.4	87
800	0.018365	0.0573921	2500	32.00%	0.3380	0.0016165	70	66	85.0	97
900	0.020661	0.0573921	2500	36.00%	0.3740	0.0017887	78	73	95.6	108
1000	0.022957	0.0573921	2500	40.00%	0.4100	0.0019609	85	80	106.3	118
1100	0.025253	0.0573921	2500	44.00%	0.4460	0.0021331	93	87	116.9	128
1200	0.027548	0.0573921	2500	48.00%	0.4820	0.0023052	100	95	127.5	139
1300	0.029844	0.0573921	2500	52.00%	0.5180	0.0024774	108	102	138.1	149
1400	0.032140	0.0573921	2500	56.00%	0.5540	0.0026496	115	109	148.8	160
1500	0.034435	0.0573921	2500	60.00%	0.5900	0.0028218	123	116	159.4	170
1600	0.036731	0.0573921	2500	64.00%	0.6260	0.0029940	130	123	170.0	180
1700	0.039027	0.0573921	2500	68.00%	0.6620	0.0031661	138	130	180.6	191
1800	0.041322	0.0573921	2500	72.00%	0.6980	0.0033383	145	137	191.3	201
1900	0.043618	0.0573921	2500	76.00%	0.7340	0.0035105	153	144	201.9	211
2000	0.045914	0.0573921	2500	80.00%	0.7700	0.0036827	160	151	212.5	222
2100	0.048209	0.0573921	2500	84.00%	0.8060	0.0038548	168	158	223.1	232
2200	0.050505	0.0573921	2500	88.00%	0.8420	0.0040270	175	165	233.8	243
2300	0.052801	0.0573921	2500	92.00%	0.8780	0.0041992	183	172	244.4	253
2400	0.055096	0.0573921	2500	96.00%	0.9140	0.0043714	190	179	255.0	263
2500	0.057392	0.0573921	2500	100.00%	0.9500	0.0045435	198	186	265.6	274

Disturbed Area = 5000 SF or Less

Determination of SWM Facility Sizing AG 3/3/7

Note: Disturbed area is all area that is to be stripped of natural vegetation and converted to lawn, roof, pavement, sidewalk or driveway.

Bioretention Assumptions
k = 0.5 ft/day for silt loam
df = filter bed depth = 4'
hf = half of ponding depth = 0.25'
tf = filter drain time = 2 days

Rock Sump Assumptions
Assume 4' Sump Depth

Pourous Pavement Assumptions
n = porosity of gravel = 0.32
d = gravel depth = 2'
k = percolation = 0.5 in/hour
T = fill time = 2 hours

1			2					3	4	5
Area Impervious (Square Feet)	Area Impervious (acre)	Disturbed Area (acre)	Disturbed Area (Square Feet)	Percent Imperviuos (%)	Volumetric Runoff Coeficient (Rv)	Water Quality Volume (acre - feet)	Water Quality Volume (cubic feet)	Bioretention Surface Area (Square Feet)	Rock Sump Surface Foot Print (Square Feet)	Pourous Pavement Surface Area (Square Feet)
250	0.005739	0.11478421	5000	5.00%	0.0950	0.0009087	40	37	NA	55
300	0.006887	0.11478421	5000	6.00%	0.1040	0.0009948	43	41	NA	60
400	0.009183	0.11478421	5000	8.00%	0.1220	0.0011670	51	48	42.5	70
500	0.011478	0.11478421	5000	10.00%	0.1400	0.0013391	58	55	53.1	81
600	0.013774	0.11478421	5000	12.00%	0.1580	0.0015113	66	62	63.8	91
700	0.016070	0.11478421	5000	14.00%	0.1760	0.0016835	73	69	74.4	101
800	0.018365	0.11478421	5000	16.00%	0.1940	0.0018557	81	76	85.0	112
900	0.020661	0.11478421	5000	18.00%	0.2120	0.0020279	88	83	95.6	122
1000	0.022957	0.11478421	5000	20.00%	0.2300	0.0022000	96	90	106.3	132
1100	0.025253	0.11478421	5000	22.00%	0.2480	0.0023722	103	97	116.9	143
1200	0.027548	0.11478421	5000	24.00%	0.2660	0.0025444	111	104	127.5	153
1300	0.029844	0.11478421	5000	26.00%	0.2840	0.0027166	118	111	138.1	164
1400	0.032140	0.11478421	5000	28.00%	0.3020	0.0028887	126	118	148.8	174
1500	0.034435	0.11478421	5000	30.00%	0.3200	0.0030609	133	125	159.4	184
1600	0.036731	0.11478421	5000	32.00%	0.3380	0.0032331	141	133	170.0	195
1700	0.039027	0.11478421	5000	34.00%	0.3560	0.0034053	148	140	180.6	205
1800	0.041322	0.11478421	5000	36.00%	0.3740	0.0035774	156	147	191.3	215
1900	0.043618	0.11478421	5000	38.00%	0.3920	0.0037496	163	154	201.9	226
2000	0.045914	0.11478421	5000	40.00%	0.4100	0.0039218	171	161	212.5	236
2100	0.048209	0.11478421	5000	42.00%	0.4280	0.0040940	178	168	223.1	247
2200	0.050505	0.11478421	5000	44.00%	0.4460	0.0042661	186	175	233.8	257
2300	0.052801	0.11478421	5000	46.00%	0.4640	0.0044383	193	182	244.4	267
2400	0.055096	0.11478421	5000	48.00%	0.4820	0.0046105	201	189	255.0	278
2500	0.057392	0.11478421	5000	50.00%	0.5000	0.0047827	208	196	265.6	288
2600	0.059688	0.11478421	5000	52.00%	0.5180	0.0049549	216	203	276.3	298
2800	0.064279	0.11478421	5000	56.00%	0.5540	0.0052992	231	217	297.5	319
3000	0.068871	0.11478421	5000	60.00%	0.5900	0.0056436	246	231	318.8	340
3250	0.074610	0.11478421	5000	65.00%	0.6350	0.0060740	265	249	345.3	366
3500	0.080349	0.11478421	5000	70.00%	0.6800	0.0065044	283	267	371.9	392
3750	0.086088	0.11478421	5000	75.00%	0.7250	0.0069349	302	284	398.4	418
4000	0.091827	0.11478421	5000	80.00%	0.7700	0.0073653	321	302	425.0	444
4250	0.097567	0.11478421	5000	85.00%	0.8150	0.0077958	340	320	451.6	469
4500	0.103306	0.11478421	5000	90.00%	0.8600	0.0082262	358	337	478.1	495
4750	0.109045	0.11478421	5000	95.00%	0.9050	0.0086566	377	355	504.7	521
5000	0.114784	0.11478421	5000	100.00%	0.9500	0.0090871	396	373	531.3	547

Disturbed Area = 10,000 SF or Less

Determination of SWM Facility Sizing AG 3/3/7

Note: Disturbed area is all area that is to be stripped of natural vegetation and converted to lawn, roof, pavement, sidewalk or driveway.

Bioretention Assumptions
k = 0.5 ft/day for silt loam
df = filter bed depth = 4'
hf = half of ponding depth = 0.25'
tf = filter drain time = 2 days

Rock Sump Assumptions
Assume 4' Sump Depth

Pourous Pavement Assumptions
n = porosity of gravel = 0.32
d = gravel depth = 2'
k = percolation = 0.5 in/hour
T = fill time = 2 hours

1			2					3	4	5
Area Impervious (Square Feet)	Area Impervious (acre)	Disturbed Area (acre)	Disturbed Area (Square Feet)	Percent Impervious (%)	Volumetric Runoff Coeficient (Rv)	Water Quality Volume (acre - feet)	Water Quality Volume (cubic feet)	Bioretention Surface Area (Square Feet)	Rock Sump Surface Foot Print (Square Feet)	Pourous Pavement Surface Area (Square Feet)
250	0.005739	0.22956841	10,000	2.50%	0.0725	0.0013870	60	57	NA	84
300	0.006887	0.22956841	10,000	3.00%	0.0770	0.0014731	64	60	NA	89
400	0.009183	0.22956841	10,000	4.00%	0.0860	0.0016452	72	67	42.5	99
500	0.011478	0.22956841	10,000	5.00%	0.0950	0.0018174	79	75	53.1	109
600	0.013774	0.22956841	10,000	6.00%	0.1040	0.0019896	87	82	63.8	120
700	0.016070	0.22956841	10,000	7.00%	0.1130	0.0021618	94	89	74.4	130
800	0.018365	0.22956841	10,000	8.00%	0.1220	0.0023339	102	96	86.0	141
900	0.020661	0.22956841	10,000	9.00%	0.1310	0.0025061	109	103	95.6	151
1000	0.022957	0.22956841	10,000	10.00%	0.1400	0.0026783	117	110	106.3	161
1100	0.025253	0.22956841	10,000	11.00%	0.1490	0.0028505	124	117	116.9	172
1200	0.027548	0.22956841	10,000	12.00%	0.1580	0.0030227	132	124	127.5	182
1300	0.029844	0.22956841	10,000	13.00%	0.1670	0.0031948	139	131	138.1	192
1400	0.032140	0.22956841	10,000	14.00%	0.1760	0.0033670	147	138	148.8	203
1500	0.034435	0.22956841	10,000	15.00%	0.1850	0.0035392	154	145	159.4	213
1600	0.036731	0.22956841	10,000	16.00%	0.1940	0.0037114	162	152	170.0	224
1700	0.039027	0.22956841	10,000	17.00%	0.2030	0.0038835	169	159	180.6	234
1800	0.041322	0.22956841	10,000	18.00%	0.2120	0.0040557	177	166	191.3	244
1900	0.043618	0.22956841	10,000	19.00%	0.2210	0.0042279	184	173	201.9	255
2000	0.045914	0.22956841	10,000	20.00%	0.2300	0.0044001	192	180	212.5	265
2100	0.048209	0.22956841	10,000	21.00%	0.2390	0.0045722	199	187	223.1	275
2200	0.050505	0.22956841	10,000	22.00%	0.2480	0.0047444	207	195	233.8	286
2300	0.052801	0.22956841	10,000	23.00%	0.2570	0.0049166	214	202	244.4	296
2400	0.055096	0.22956841	10,000	24.00%	0.2660	0.0050888	222	209	255.0	306
2500	0.057392	0.22956841	10,000	25.00%	0.2750	0.0052609	229	216	265.6	317
2600	0.059688	0.22956841	10,000	26.00%	0.2840	0.0054331	237	223	276.3	327
2800	0.064279	0.22956841	10,000	28.00%	0.3020	0.0057775	252	237	297.5	348
3000	0.068871	0.22956841	10,000	30.00%	0.3200	0.0061218	267	251	318.8	369
3250	0.074610	0.22956841	10,000	32.50%	0.3425	0.0065523	285	269	345.3	395
3500	0.080349	0.22956841	10,000	35.00%	0.3650	0.0069827	304	286	371.9	421
3750	0.086088	0.22956841	10,000	37.50%	0.3875	0.0074131	323	304	398.4	446
4000	0.091827	0.22956841	10,000	40.00%	0.4100	0.0078436	342	322	425.0	472
4250	0.097567	0.22956841	10,000	42.50%	0.4325	0.0082740	360	339	451.6	498
4500	0.103306	0.22956841	10,000	45.00%	0.4550	0.0087045	379	357	478.1	524
4750	0.109045	0.22956841	10,000	47.50%	0.4775	0.0091349	398	375	504.7	550
5000	0.114784	0.22956841	10,000	50.00%	0.5000	0.0095654	417	392	531.3	576

Guidance Sheet - Bioretention Areas

Description: Shallow stormwater basin or landscaped area that utilizes engineered soils and vegetation to capture and treat runoff.

KEY CONSIDERATIONS

DESIGN CRITERIA:

- Maximum contributing drainage area of 5 acres
- Often located in "landscaping islands"
- Treatment area consists of grass filter, sand bed, ponding area, organic/mulch layer, planting soil, and vegetation
- Typically requires 5 feet of head

ADVANTAGES / BENEFITS:

- Applicable to small drainage areas
- Good for highly impervious areas, particularly parking lots
- Good retrofit capability
- Relatively low maintenance requirements
- Can be planned as an aesthetic feature

DISADVANTAGES / LIMITATIONS:

- Requires extensive landscaping
- Not recommended for areas with steep slopes

MAINTENANCE REQUIREMENTS:

- Inspect and repair/replace treatment area components

POLLUTANT REMOVAL

80%	**Total Suspended Solids**
60/50%	**Nutrients** - Total Phosphorus / Total Nitrogen removal
M	**Metals** - Cadmium, Copper, Lead, and Zinc removal
No data	**Pathogens** - Coliform, Streptococci, E.Coli removal

STORMWATER MANAGEMENT SUITABILITY

- [✓] **Water Quality**
- [9] **Channel Protection**
- [ ] **Extreme Flood Protection**

Accepts Hotspot Runoff: *Yes (requires impermeable liner)*

9 in certain situations

IMPLEMENTATION CONSIDERATIONS

M	**Land Requirement**
M	**Capital Cost**
L	**Maintenance Burden**

Residential Subdivision Use: *Yes*

High Density/Ultra-Urban: *Yes*

Drainage Area: *5 acres max.*

Soils: *Planting soils must meet specified criteria; No restrictions on surrounding soils*

Other Considerations:

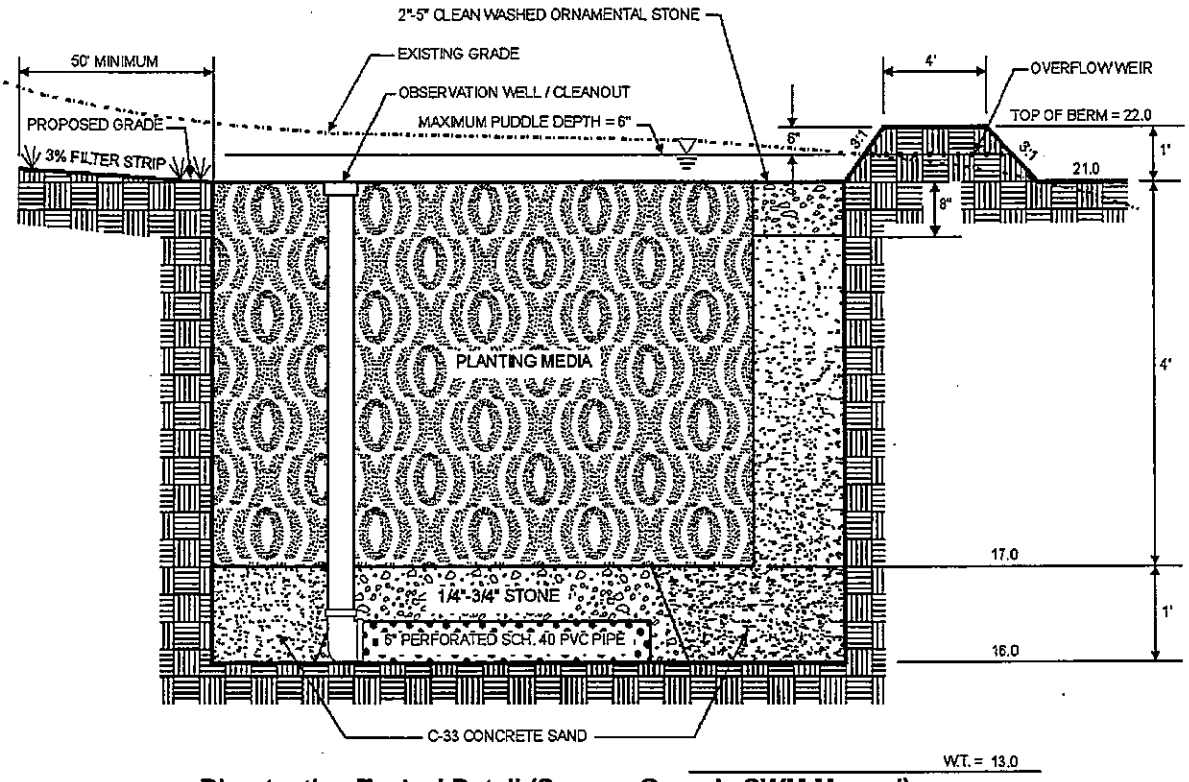
- *Use of native plants is recommended*

L=Low **M**=Moderate **H**=High

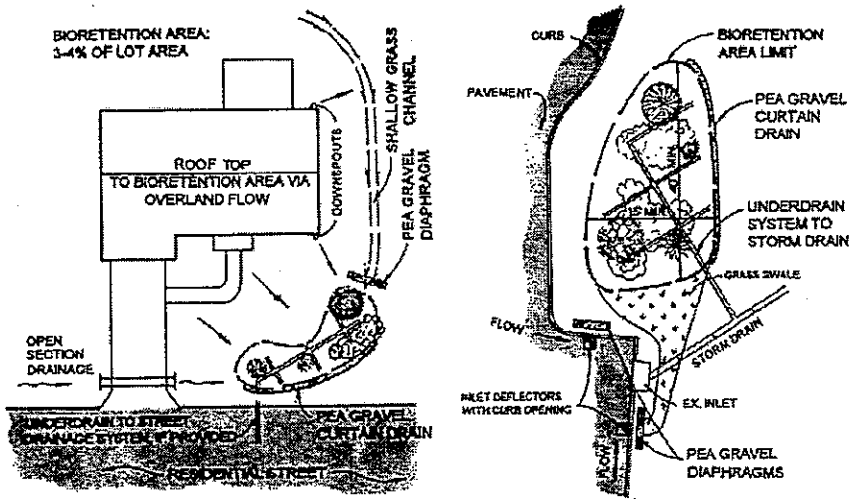
General Description

Bioretention areas (also referred to as *bioretention filters* or *rain gardens*) are structural stormwater controls that capture and temporarily store the water quality volume (WQ_v) using soils and vegetation in shallow basins or landscaped areas to remove pollutants from stormwater runoff.

Bioretention areas are engineered facilities in which runoff is conveyed as sheet flow to the "treatment area," which consists of a grass buffer strip, ponding area, organic or mulch layer, planting soil, and vegetation. An optional sand bed can also be included in the design to provide aeration and drainage of the planting soil. The filtered runoff is typically collected and returned to the conveyance system, though it can also be exfiltrated into the surrounding soil in areas where appropriate.



Bioretention Typical Detail (Source: Georgia SWM Manual)



Application and Site Feasibility Criteria

Bioretention areas are suitable for single-family residential lots of 1 acre or less. Because of its ability to be incorporated in landscaped areas, the use of bioretention is extremely flexible.

The following criteria should be evaluated to ensure the suitability of a bioretention area for meeting stormwater management objectives on a site or development.

Physical Feasibility - Physical Constraints at Project Site

- Site Slope – No more than 6% slope
- Minimum Head – Elevation difference needed at a site from the inflow to the outflow: 5 feet
- Minimum Depth to Water Table – A separation distance of 2 feet recommended between the bottom of the bioretention facility and the elevation of the seasonally high water table.
- Soils – No restrictions; engineered media required

Other Constraints / Considerations

- Aquifer Protection – Do not allow exfiltration of filtered hotspot runoff into groundwater

Planning and Design Criteria

*The following criteria are to be considered **minimum** standards for the design of a bioretention facility **for a single family residential lot.** Consult with the local review authority to determine if there are any variations to these criteria or additional standards that must be followed.*

A. LOCATION AND SITING

- Residential Bioretention areas should have a maximum contributing drainage area of 0.25 acres or less; multiple bioretention areas can be used.

- Bioretention systems are designed for intermittent flow and must be allowed to drain and reaerate between rainfall events. They should not be used on sites with a continuous flow from groundwater, sump pumps, or other sources.

- Bioretention area locations should be integrated into the site planning process, and aesthetic considerations should be taken into account in their siting and design. Elevations must be carefully worked out to ensure that the desired runoff flow enters the facility with no more than the maximum design depth.

B. GENERAL DESIGN

- The Standardized bioretention area for a single residential lot consists of:
  - **(1) Grass filter strip (lawn areas) between the contributing drainage area and the ponding area should where possible be a minimum of 15' in length.**
  - **(2) Ponding area containing vegetation with a planting soil bed,**
  - **(3) Organic/mulch layer must be four (4') in depth.**
  - **(4) Gravel and perforated pipe underdrain system to collect runoff that has filtered through the soil layers (bioretention areas can optionally be designed to infiltrate into the soil).**

- A bioretention area design will also include some of the following:
  - Optional **sand filter layer** to spread flow, filter runoff, and aid in aeration and drainage of the planting soil.
  - **Stone diaphragm** at the beginning of the grass filter strip to reduce runoff velocities and spread flow into the grass filter.

C. PHYSICAL SPECIFICATIONS / GEOMETRY

- The planting soil filter bed is sized using a Darcy's Law equation with a filter bed drain time of 48 hours and a coefficient of permeability (k) of 0.5 ft/day.
- The ponding depth of the bioretention areas is 6 inches.
- The planting soil bed must be at least 4 feet in depth. Planting soils should be sandy loam, loamy sand, or loam texture with a clay content ranging from 10 to 25%. The soil must have an infiltration rate of at least 0.5 inches per hour and a pH between 5.5 and 6.5. In addition, the planting soil should have a 1.5 to 3% organic content and a maximum 500 ppm concentration of soluble salts.
- Water should be directed as sheet flow over lawn area to the bioretention area.
- The mulch layer should consist of 2 to 4 inches of commercially available fine shredded hardwood mulch or shredded hardwood chips.
- The sand bed should be 12 to 18 inches thick. Sand should be clean and have less than 15% silt or clay content.
- Pea gravel for the diaphragm and curtain, where used, should be ASTM D 448 size No. 6 ($^1/_8$" to ¼").
- The underdrain collection system is equipped with a 6-inch perforated PVC pipe (AASHTO M 252) in an 8-inch gravel layer. The pipe should have 3/8-inch perforations, spaced at 6-inch centers, with a minimum of 4 holes per row. The pipe is spaced at a maximum of 10 feet on center and a minimum grade of 0.5% must be maintained. A permeable filter fabric is placed between the gravel layer and the planting soil bed.

D. PRETREATMENT

- Adequate pretreatment is provided when all of the following are provided: (a) water flows over grass filter strip (lawn area) prior to entering the bioretention area.

E. OUTLET STRUCTURES

- Outlet pipe is to be provided from the underdrain system to the facility discharge. Due to the slow rate of filtration, outlet protection is generally unnecessary.

F. EMERGENCY SPILLWAY

- An overflow structure and nonerosive overflow channel must be provided to safely pass flows from the bioretention area that exceed the storage capacity to a stabilized downstream area or watercourse. If the system is located off-line, the overflow should be set above the shallow ponding limit.

G. MAINTENANCE ACCESS

- Adequate access must be provided for all bioretention facilities for inspection, maintenance, and landscaping upkeep, including appropriate equipment and vehicles.

H. SAFETY FEATURES

- Bioretention areas generally do not require any special safety features. Fencing of bioretention facilities is not generally desirable.

I. LANDSCAPING

- Landscaping is critical to the performance and function of bioretention areas.
- A dense and vigorous vegetative cover should be established over the contributing pervious drainage areas before runoff can be accepted into the facility.

- The bioretention area should be vegetated to resemble a terrestrial forest ecosystem, with a mature tree canopy, subcanopy of understory trees, scrub layer, and herbaceous ground cover. Three species each of both trees and scrubs are recommended to be planted.
- The tree-to-shrub ratio should be 2:1 to 3:1. On average, the trees should be spaced 8 feet apart. Plants should be placed at regular intervals to replicate a natural forest. Woody vegetation should not be specified at inflow locations.
- After the trees and shrubs are established, the ground cover and mulch should be established.
- Choose plants based on factors such as whether native or not, resistance to drought and inundation, cost aesthetics, maintenance, etc. Planting recommendations for bioretention facilities are as follows:
  - Native plant species should be specified over non-native species.
  - Vegetation should be selected based on a specified zone of hydric tolerance.
  - A selection of trees with an understory of shrubs and herbaceous materials should be provided.

The following are some native plants suitable for rain gardens for the Northeast Region. They are also attractive to butterflies, birds, and other wildlife. Be sure to choose species appropriate for the degree of sun or shade on the site.

Wildflowers, Ferns, Grasses, and Sedges:

- *Asclepias incarnata,* Swamp milkweed
- *Chelone glabra,* White turtlehead
- *Eupatorium maculatum,* Joe-pye weed
- *Lobelia cardinalis,* Cardinal flower
- *Lobelia syphilitica,* Blue lobelia
- *Monarda didyma,* Oswego tea
- *Vernonia noveboracensis,* Common ironweed
- *Athyrium filix-femina,* Lady fern
- *Osmunda regalis,* Royal fern
- *Osmunda cinnamomea,* Cinnamon fern
- *Carex pendula,* Drooping sedge
- *Carex stipata,* Tussock sedge

Trees and Shrubs:

- *Amelanchier laevis,* Shadbush
- *Asimina triloba,* Pawpaw
- *Betula nigra,* River birch
- *Cephalanthus occidentalis,* Buttonbush
- *Clethra alnifolia,* Sweet pepperbush
- *Cornus amomum,* Silky dogwood
- *Fothergilla gardenii,* Dwarf fothergilla
- *Ilex verticillata,* Winterberry holly
- *Lindera benzoin,* Spicebush
- *Liquidambar styraciflua,* Sweet gum
- *Sambucus canadensis,* American elderberry
- *Viburnum dentatum,* Arrowwood

Design Basis

The required planting soil filter bed area is computed using the following equation (based on Darcy's Law):

$$A_f = (WQv)\,(d_f) / [\,(k)\,(h_f + d_f)\,(t_f)]$$

where:

A_f = surface area of ponding area (ft^2)
WQ_v = water quality volume (or total volume to be captured in CF)
d_f = filter bed depth
(4 feet minimum)
k = coefficient of permeability of filter media (ft/day)
(use 0.5 ft/day for silt-loam)
h_f = average height of water above filter bed (ft)
(typically 3 inches, which is half of the 6-inch ponding depth)
t_f = design filter bed drain time (days)
(2.0 days or 48 hours is recommended maximum)

An overflow must be provided to bypass and/or convey larger flows to the downstream drainage system or stabilized watercourse. Nonerosive velocities need to be ensured at the outlet point.

A landscaping plan for the bioretention area should be prepared to indicate how it will be established with vegetation.

Inspection and Maintenance Requirements

Typical Maintenance Activities for Bioretention Areas
(Source: EPA, 1999)

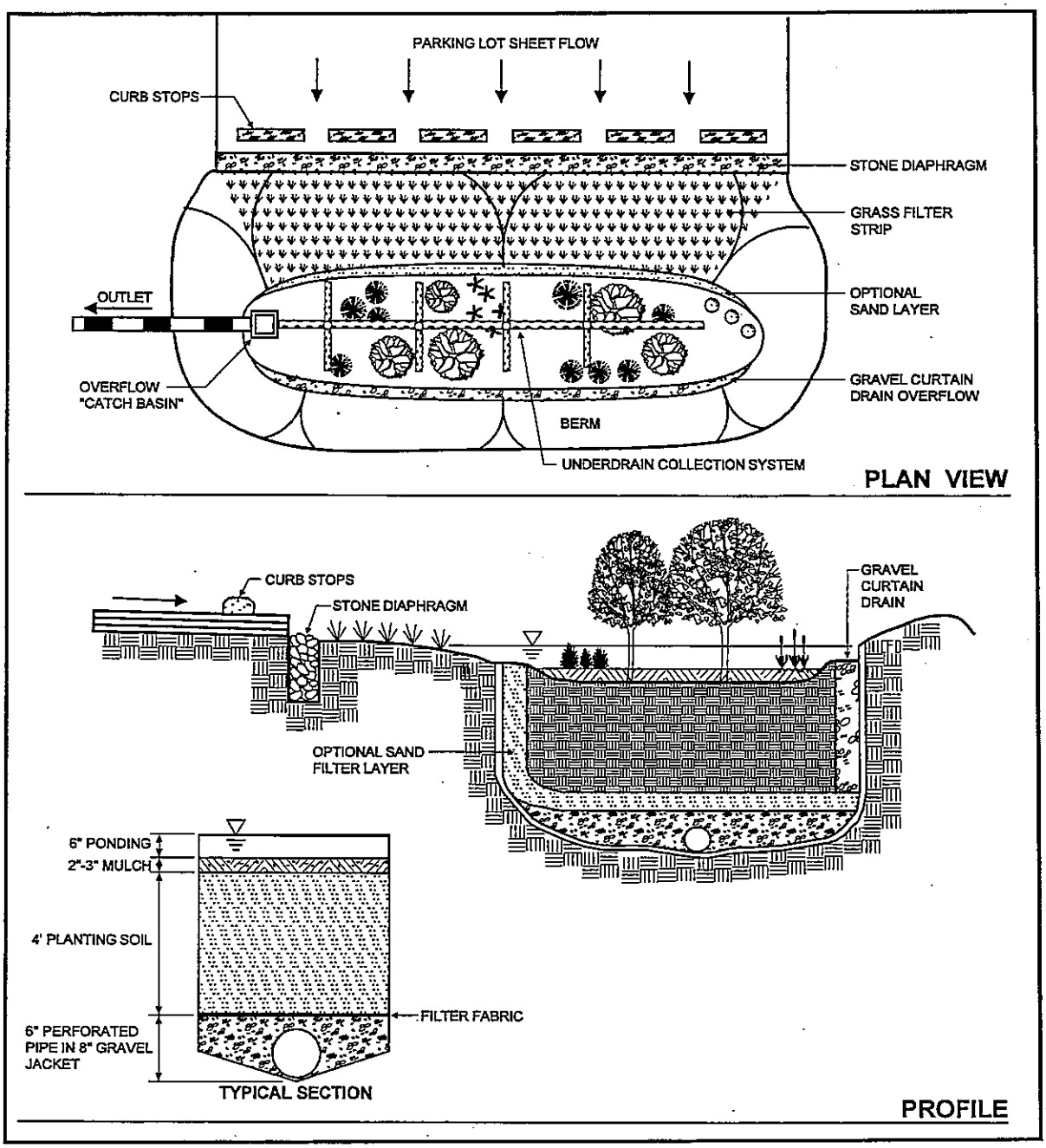
Activity	Schedule
• Pruning and weeding to maintain appearance. • Mulch replacement when erosion is evident. • Remove trash and debris.	As needed
• Inspect inflow points for clogging (off-line systems). Remove any sediment. • Inspect filter strip/grass channel for erosion or gullying. Re-seed or sod as necessary. • Trees and shrubs should be inspected to evaluate their health and remove any dead or severely diseased vegetation.	Semi-annually
• The planting soils should be tested for pH to establish acidic levels. If the pH is below 5.2, limestone should be applied. If the pH is above 7.0 to 8.0, then iron sulfate plus sulfur can be added to reduce the pH.	Annually
• Replace mulch over the entire area. • Replace pea gravel diaphragm if warranted.	2 to 3 years

Additional Maintenance Considerations and Requirements

- The surface of the ponding area may become clogged with fine sediment over time. Core aeration or cultivating of unvegetated areas may be required to ensure adequate filtration.

Regular inspection and maintenance is critical to the effective operation of bioretention facilities as designed. Maintenance responsibility for a bioretention area should be vested with a responsible authority by means of a legally binding and enforceable maintenance agreement that is executed as a condition of plan approval.

Example Schematic

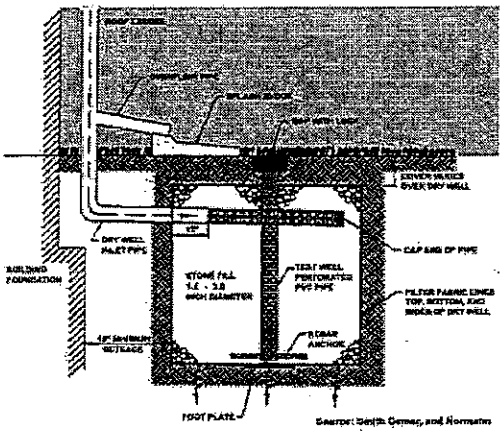


Schematic of a Typical On-line Bioretention Area

(Source: Claytor and Schueler, 1996)

This Guidance document is based upon information adapted from the Georgia Stormwater Manual and the Brooklyn Botanic Garden web site.

Guidance Sheet - Rock Sumps



Description: A Dry Well, or Seepage Pit, is a variation on an Infiltration system that is designed to temporarily store and infiltrate rooftop runoff.

(Source: PA BMP Manual)

KEY CONSIDERATIONS

- Maintain a minimum 2-foot separation to bedrock and seasonally high water table, provide distributed infiltration area (5:1 impervious area to infiltration area - maximum), site on natural, uncompacted soils with acceptable infiltration capacity, and follow other guidelines described in Protocol 2: Infiltration Systems Guidelines
- Maintain minimum distance from building foundation (typically 10 feet)
- Provide adequate overflow outlet for large storms
- Depth of Dry Well aggregate should be between 48 inches
- At least one observation well; clean out is recommended
- Wrap aggregate with nonwoven geotextile
- Maximum drain-down time is 72 hours

STORMWATER MANAGEMENT SUITABILITY

- [x] Water Quality
- [ ] Channel/Flood Protection

SPECIAL APPLICATIONS

- [ ] Pretreatment
- [x] High Density/Ultra-Urban
- [x] Other: Overflow Parking, Driveways & related uses

Residential Subdivision Use: *Yes*
(in common areas that are maintained)

9 in certain situations

General Description

A Dry Well, sometimes called a Seepage Pit, is a subsurface storage facility that temporarily stores and infiltrates stormwater runoff from the roofs of structures. Roof leaders connect directly into the Dry Well, which may be either an excavated pit filled with uniformly graded aggregate wrapped in geotextile or a prefabricated storage chamber or pipe segment. Dry Wells discharge the stored runoff via infiltration into the surrounding soils. In the event that the Dry Well is overwhelmed in an intense storm event, an overflow mechanism (surcharge pipe, connection to larger infiltration area, etc.) will ensure that additional runoff is safely conveyed downstream.

By capturing runoff at the source, Dry Wells can dramatically reduce the increased volume of stormwater generated by the roofs of structures. Though roofs are generally not a significant source of runoff pollution, they are still one of the most important sources of new or increased runoff volume from developed areas. By decreasing the volume of stormwater runoff, Dry Wells can also reduce runoff rate and improve water quality. As with other infiltration practices, Dry Wells may not be appropriate for "hot spots" or other areas where high pollutant or sediment loading is expected without additional design considerations. Dry Wells are not recommended within a specified distance to structures or subsurface sewage disposal systems.

Design Criteria and Specifications

The use of a single stage rock sump is one of several alternatives that may be appropriate for small project area developments. Site parameters which must be considered when determining the suitability of a sump for stormwater control include the following:

- Soil type
- Slope
- Slope Stability
- Discharge location
- Basement elevation
- Offsite stormwater conveyance systems
- Offsite detention systems

Where it is determined that a single stage rock sump is appropriate, the following procedure is designed to provide a fast, simple method to determine the rock volume and orifice size required to provide adequate stormwater control for small projects. In order to develop a practical solution for this type of design problem, several qualifying assumptions are necessary to set the limits for which the procedure is applicable. Those limits were designed to incorporate the type of situation most often encountered. In general, the following conditions must be satisfied in order for the use of single stage rock sumps to be appropriate:

- The project area tributary to the proposed sump is less than 5000 square feet, and consists entirely of impervious (paved or roofed areas) surfaces, i.e., RCN = 98;

- To minimize the sump size, runoff from impervious surfaces may be divided and conveyed to the separate sumps. If runoff from impervious surfaces is not divided, the sump must be designed for the entire area that will be tributary to the facility;

- The pre-development area to be altered must have an existing time of concentration (Tc) of six (6) minutes or less; and

- The single stage rock sump must be designed according to the parameters shown in the attached drawing.

Prior to using the following procedure, the designer must verify that all of the above criteria apply to the subject project. Should any of the conditions not apply, the use of the procedure outlined herein is inappropriate and may result in either the over-design or under-design of the rock sump facility.

DESIGN SIZING

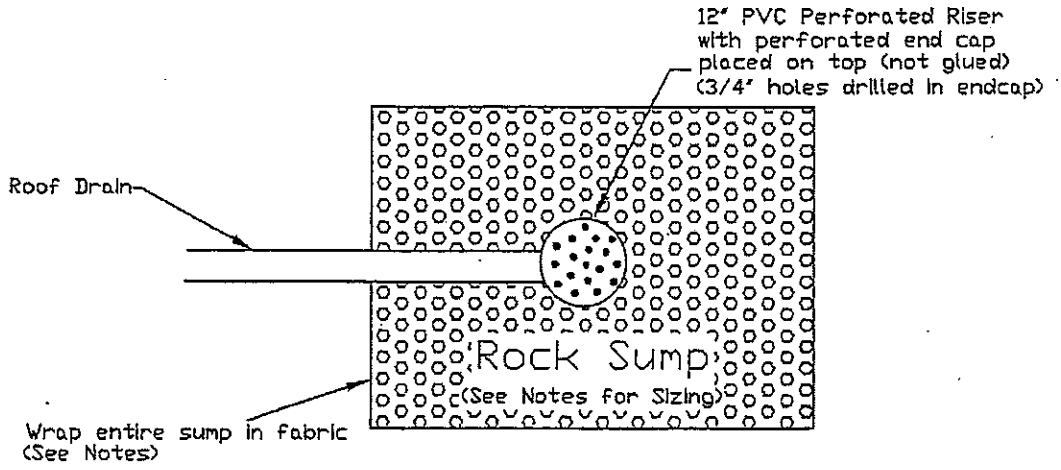
1. Determine the area of the impervious surfaces that will be collected and conveyed to the sump.

2. Enter the sizing table and determine the size of the release orifice and volume of the sump.

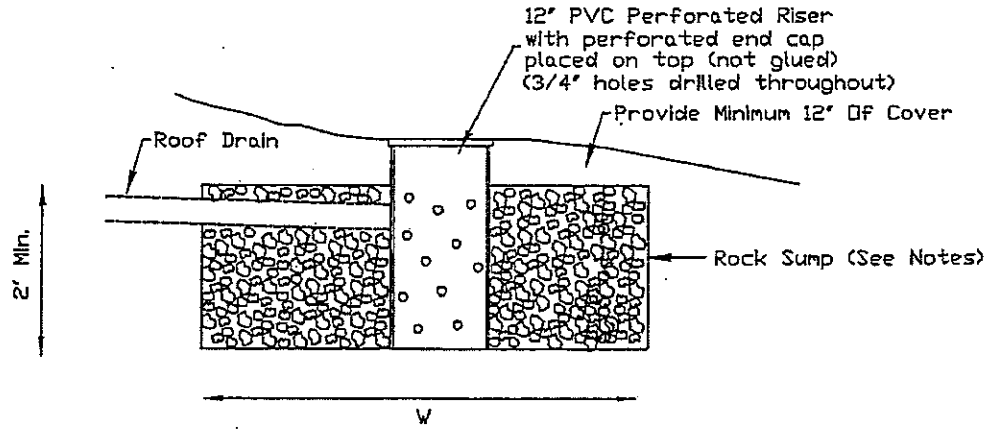
3. Determine the sump dimensions based on the site topography and surface features.

4. Design the sump in accordance with the parameters shown in the attached drawing.

NOTE: If the development will result in an increase in impervious surface of less than 400 square feet, the infiltration sump design (below) should be used. The sump volume should be based on 40 cubic feet of stone for each 100 square feet of impervious surface.



PLAN VIEW



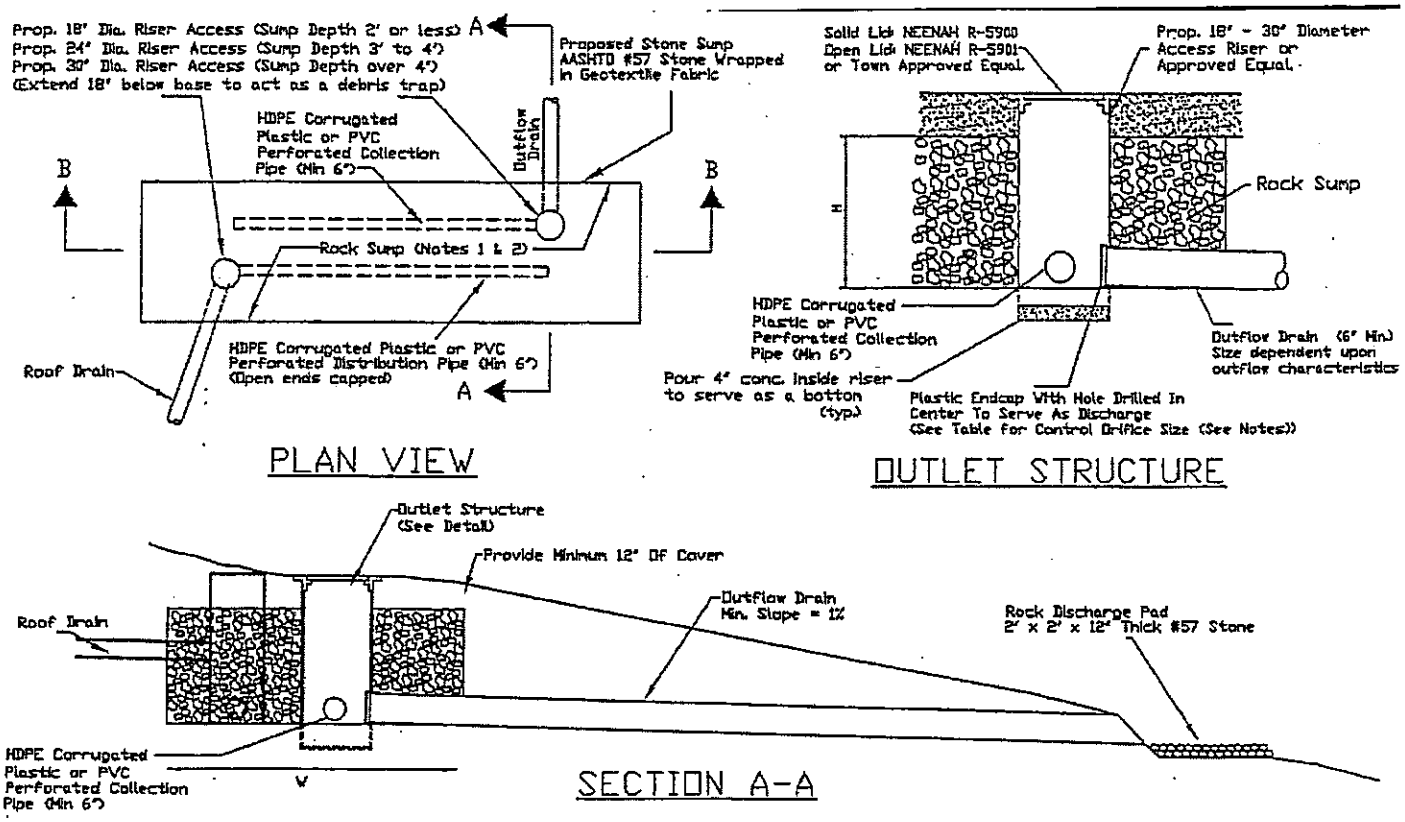
SECTION

Notes:

1. The Rock Sump shall be designed as follows:
   40 c.f. of Rock per 100 s.f. of Impervious area
2. Rock Sump shall be constructed of AASHTO #57 Limestone or 2B Gravel.
3. Wrap sump on all sides with PennDOT Class 2, Type B Non-woven Geotextile Material.
4. Dimensions and ratios shall vary as per design volume required.
5. Dry sumps in fill areas not permitted.
6. Cleanouts shall be located just before any horizontal bends.
7. When feasible, the Rock Sump should be located such that the top elevation of the riser pipe is below the basement floor elevation.

THIS DETAIL MAY BE UTILIZED FOR TOTAL IMPERVIOUS AREAS < 400 S.F.

Figure S1 - Rock Sump Detail (< 400 SF of impervious area)
(Detailed from Town of McCandless / Partridge Venture Engineering)



Notes:

1. Design Parameters (volume and outlet control works) shall be based upon the Table of values as shown on Detail SW-5, (400 S.F. < Impervious Area < 5000 s.f.)
2. Rock Sump shall be constructed of AASHTO #57 Limestone or 2B Gravel.
3. Wrap sump on all sides with PennDOT Type B Non-woven Geotextile Material.
4. Dimensions and ratios of L (Length), W (Width) and H (Height) shall vary as per design volume required.
5. Minimum ratio L to W is 3:1; (ie. L = 3W).
6. Dry sumps in fill areas not permitted.
7. Dimensions L (Length) shall be oriented to be parallel to the grade contour alignment.
8. No 90° elbows permitted on cleanout installations.
9. Cleanouts shall be located just before any horizontal bends.
10. All pipe and fittings shall be ASTM D2729.
11. When feasible, the Rock Sump should be located such that the outflow elevation is below the basement floor elevation.

THIS DETAIL MAY BE UTILIZED FOR TOTAL IMPERVIOUS AREAS > 400 S.F. & < 5,000 S.F.

Figure S2 - Rock Sump Detail (> 400 SF & < 5000 SF of impervious area)

(Detailed from Town of McCandless / Partridge Venture Engineering)

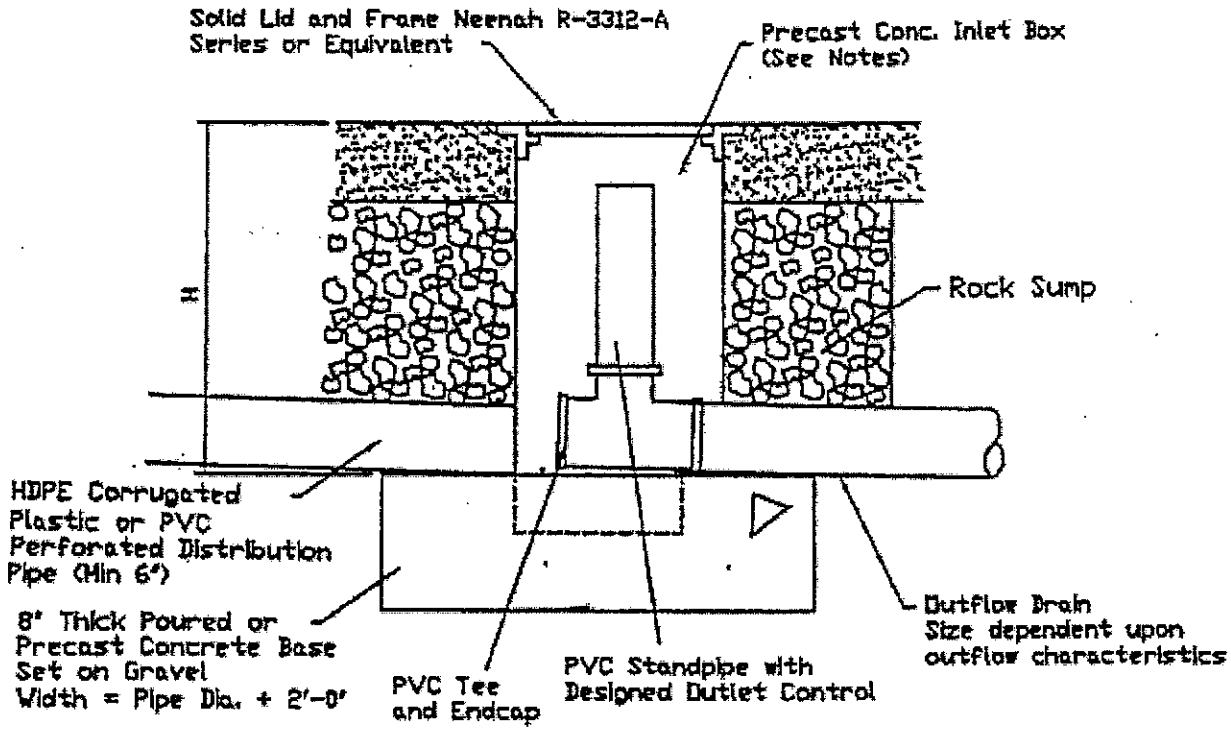


Figure S3 – Sump Outlet Structure
(Information from Town of McCandless / Partridge Venture Engineering)

DESIGN PARAMETERS
RESIDENTIAL ON-LOT SUMP
(TOTAL IMPERVIOUS AREA < 5,000 S.F.)

IMPERVIOUS AREA (SQ. FT.)	DEPTH OF SUMP (FT.)					SUMP VOLUME REQUIRED (CU. FT.)	
	1	2	3	4	5		
	DIAMETER OF OUTLET ORIFICE (IN)					NET	ROCK
400	11/16	9/16	1/2	1/2	1/2	68	170
600	13/16	11/16	5/8	9/16	9/16	102	255
800	15/16	13/16	11/16	5/8	5/8	136	340
1000	1-1/16	7/8	13/16	3/4	11/16	170	425
1200	1-3/16	1-0	7/8	13/16	3/4	204	510
1400	1-1/4	1-1/16	15/16	7/8	13/16	238	595
1600	1-3/8	1-1/8	1-0	15/16	7/8	272	680
1800	1-7/16	1-3/16	1-1/16	1-0	15/16	306	765
2000	1-1/2	1-1/4	1-1/8	1-1/16	1-0	340	850
2200	1-9/16	1-5/16	1-3/16	1-1/8	1-1/16	374	935
2400	1-5/8	1-3/8	1-1/4	1-3/16	1-1/8	408	1020
2600	1-11/16	1-7/16	1-5/16	1-1/4	1-1/8	442	1105
2800	1-3/4	1-1/2	1-3/8	1-1/4	1-3/16	476	1190
3000	1-13/16	1-9/16	1-3/8	1-5/16	1-1/4	510	1275
3200	1-7/8	1-5/8	1-7/16	1-3/8	1-1/4	544	1360
3400	1-15/16	1-5/8	1-1/2	1-3/8	1-5/16	578	1445
3600	2-0	1-11/16	1-9/16	1-7/16	1-3/8	612	1530
3800	2-1/16	1-3/4	1-9/16	1-7/16	1-3/8	646	1615
4000	2-1/8	1-13/16	1-5/8	1-1/2	1-7/16	680	1700
4200	2-3/16	1-13/16	1-11/16	1-9/16	1-7/16	714	1785
4400	2-1/4	1-7/8	1-11/16	1-9/16	1-1/2	748	1870
4600	2-5/16	1-15/16	1-3/4	1-5/8	1-9/16	782	1955
4800	2-5/16	1-15/16	1-3/4	1-5/8	1-9/16	816	2040
5000	2-3/8	2-0	1-13/16	1-11/16	1-5/8	850	2125

Table S1
(Information from Town of McCandless / Partridge Venture Engineering)

Design Basis

The sump designs are based upon documents and detail sheets provided by Partridge Venture Engineering.

Determine the square footage for the Standardized Rock Sump Foot Print from the "Determination of SWM Facility Sizing" table (Disturbed Area Table).

Note that the square footage of the "sump foot print" for the Standardized Design provided in the Disturbed Area Table is based upon an assumed sump rock depth of 4'.

Different sump rock depths may be used. These may be determined by multiplying the "sump foot print" by the assumed rock depth of four (4') feet, to determine the cubic feet of rock required for the sump. Then use Table S1 to select determine the "diameter of the outlet orifice" need for the actual depth proposed.

To determine the sump foot print needed for the actual depth proposed, multiply the cubic feet of rock required by the actual depth of the sump proposed.

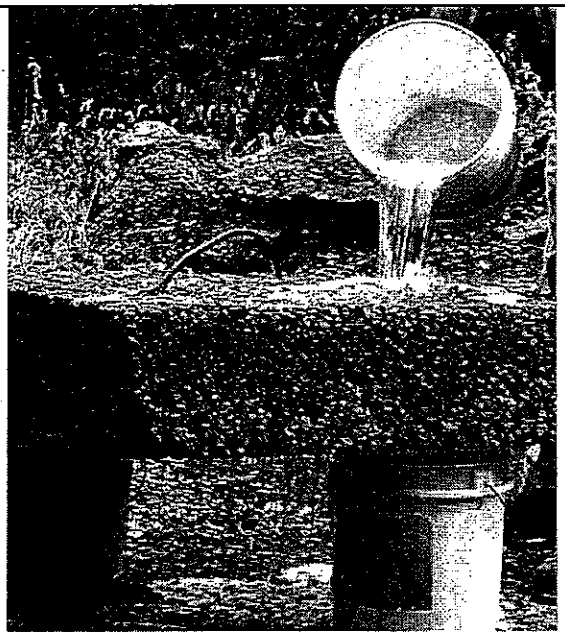
Inspection and Maintenance Requirements

As with all infiltration practices, Dry Wells require regular and effective maintenance to ensure prolonged functioning. The following represent minimum maintenance requirements for Dry Wells:

Activity	Schedule
• Initial inspection	By Building Inspector to Insure Proper Sizing
• Ensure that sediment is not directed to the sump	As needed
• Regularly clean out gutters and ensure proper connections to facilitate the effectiveness of the dry well.	As needed, based on inspection
• Evaluate the drain-down time of the Dry Well to ensure the maximum time of 72 hours is not being exceeded. If drain-down times are exceeding the maximum, drain the Dry Well via pumping and clean out perforated piping, if included. If slow drainage persists, the system may need replacing.	As needed, based on inspection
• Reconstruct sump if its no longer functioning as originally designed	As needed, based on inspection
• Replace filter screen that intercepts roof runoff as necessary. If an intermediate sump box exists, clean it out at least once per year.	Annually

This Guidance document is based upon information abstracted from the Georgia Stormwater Manual, the PA SW BMP Manual and the Town of McCandless. .

Guidance Sheet - Porous Pavements



Description: Porous concrete is the term for a mixture of coarse aggregate, Portland cement and water that allow for rapid infiltration of water and overlays a stone aggregate reservoir. This reservoir provides temporary storage as runoff infiltrates into underlying permeable soils and/or out through an underdrain system.

(Photograph Source: Pittsburgh Mobile Concrete)

KEY CONSIDERATIONS

- Soil infiltration rate of 0.5 in/hr or greater required
- Pour the concrete using a volumetric (mobile) mixer
- Excavated area filled with stone media; gravel and sand filter layers with observation well
- Pre-treat runoff if sediment present
- Provides reduction in runoff volume
- Somewhat higher cost when compared to conventional pavements
- Potential for high failure rate if poorly designed, poorly constructed, not adequately maintained or used in unstabilized areas
- Potential for groundwater contamination

STORMWATER MANAGEMENT SUITABILITY

- [✓] Water Quality
- [ϑ] Channel/Flood Protection

SPECIAL APPLICATIONS

- [ ] Pretreatment
- [✓] High Density/Ultra-Urban
- [✓] Other: Overflow Parking, Driveways & related uses

Residential Subdivision Use: *Yes*
(in common areas that are maintained)

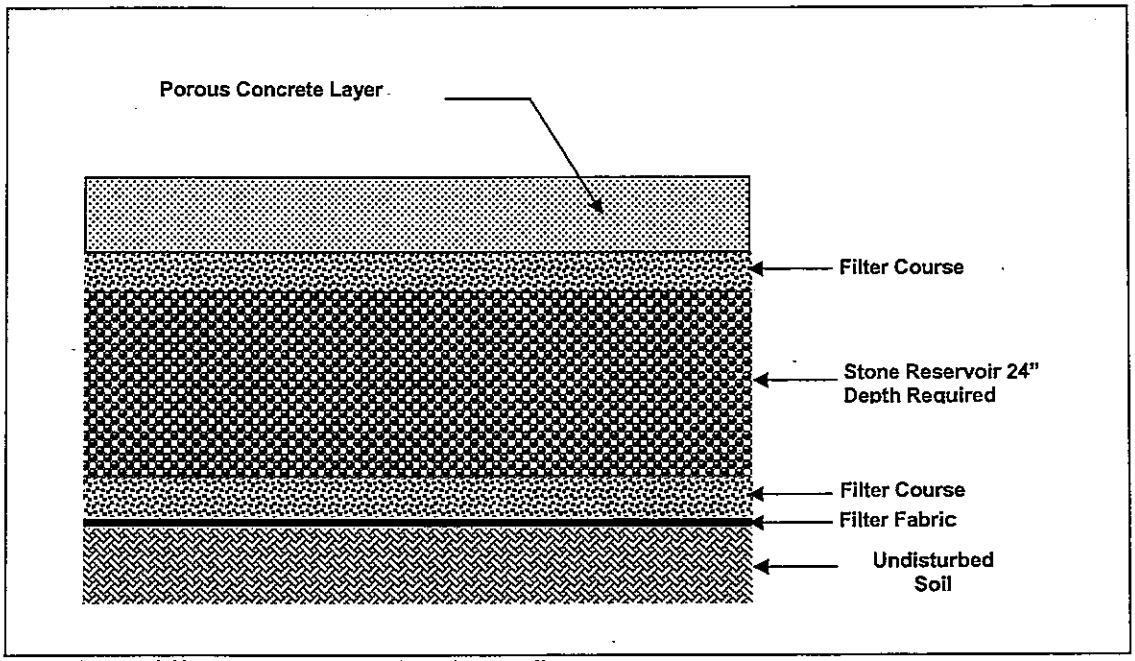
ϑ in certain situations

General Description – Porous Concrete

Porous concrete (also referred to as *enhanced porosity concrete*, *porous concrete*, *portland cement pervious pavement* and *pervious pavement*) is a subset of a broader family of pervious pavements including porous asphalt, and various kinds of grids and paver systems. Porous concrete is thought to have a greater ability than porous asphalt to maintain its porosity in hot weather and thus is provided as a limited application control. Although, porous concrete has seen growing use, there is still very limited practical experience with this measure.

Porous concrete consists of a specially formulated mixture of Portland cement, uniform, open graded course aggregate, and water. The concrete layer has a high permeability often many times that of the underlying permeable soil layer, and allows rapid percolation of rainwater through the surface and into the layers beneath. The void space in porous concrete is in the 15% to 22% range compared to three to five percent for conventional pavements. The permeable surface is placed over a layer of open-graded gravel and crushed stone. The void spaces in the stone act as a storage reservoir for runoff.

Porous concrete is designed primarily for stormwater quality, i.e. the removal of stormwater pollutants. However, they can provide limited runoff quantity control, particularly for smaller storm events. For some smaller sites, trenches can be designed to capture and infiltrate the channel protection volume (Cp_v) in addition to WQ_v. Porous concrete will need to be used in conjunction with another structural control to provide overbank and extreme flood protection, if required.



Typical Detail (Source: Georgia SWM Manual)

Modifications or additions to the standard design have been used to pass flows and volumes in excess of the water quality volume, or to increase storage capacity or treatment. These include:

- Placing a perforated pipe near the top of the crushed stone reservoir to pass excess flows after the reservoir is filled
- Providing surface detention storage in a parking lot, adjacent swale, or detention pond with suitable overflow conveyance
- Connecting the stone reservoir layer to a stone filled trench
- Adding a sand layer and perforated pipe beneath the stone layer for filtration of the water quality volume
- Placing an underground detention tank or vault system beneath the layers

The infiltration rate of the soils in the subgrade should be adequate to support drawdown of the entire runoff capture volume within 24 to 48 hours. Special care must be taken during construction to avoid undue compaction of the underlying soils which could affect the soils' infiltration capability.

Slopes should be flat or gentle to facilitate infiltration versus runoff and the seasonally high water table or bedrock should be a minimum of two feet below the bottom of the gravel layer if infiltration is to be relied on to remove the stored volume.

Porous concrete has the positive characteristics of volume reduction due to infiltration, groundwater recharge, and an ability to blend into the normal urban landscape relatively unnoticed. It also allows a

reduction in the cost of other stormwater infrastructure, a fact that may offset the greater placement cost somewhat.

A drawback is the cost and complexity of porous concrete systems compared to conventional pavements. Porous concrete systems require a very high level of construction workmanship to ensure that they function as designed. They experience a high failure rate if they are not designed, constructed and maintained properly.

Design Criteria and Specifications

- Porous concrete systems can be used where the underlying in-situ subsoils have an infiltration rate greater than 0.5 inches per hour. Therefore, porous concrete systems are not suitable on sites with hydrologic group D and many group C soils, or soils with a high (>30%) clay content. In areas where poor infiltration is expected the gravel bed should be properly graded and an overflow provided to drain the bed so that water will not be trapped in the pervious concrete. During construction and preparation of the subgrade, special care must be taken to avoid compaction of the soils.

- Pour the concrete using volumetric (mobile) mixer.

- Porous concrete systems should typically be used in applications where the pavement receives tributary runoff only from impervious areas. Actual pervious surface area sizing will depend on achieving a 24 hour minimum and 48 hour maximum draw down time for the design storm volume.

- If runoff is coming from adjacent pervious areas, it is important that those areas be fully stabilized to reduce sediment loads and prevent clogging of the porous paver surface. Pretreatment using filter strips or vegetated swales for removal of course sediments is recommended. (see sections 3.3.1 and 3.3.2)

- Porous concrete systems should not be used on slopes greater than 5% with slopes of no greater than 2% recommended. For slopes greater than 1% barriers perpendicular to the direction of drainage should be installed in sub-grade material to keep it from washing away, or filter fabric should be placed at the bottom and sides of the aggregate to keep soil from migrating into the aggregate and reducing porosity.

- A minimum of four feet of clearance is recommended (may be reduced to two feet in coastal areas) between the bottom of the gravel base course and underlying bedrock or the seasonally high groundwater table.

- Porous concrete systems should be sited at least 10 feet down-gradient from buildings and 100 feet away from drinking water wells.

- To protect groundwater from potential contamination, runoff from designated hotspot land uses or activities must not be infiltrated. Porous concrete should not be used for manufacturing and industrial sites, where there is a potential for high concentrations of soluble pollutants and heavy metals. In addition, porous concrete should not be considered for areas with a high pesticide concentration. Porous concrete is also not suitable in areas with karst geology without adequate geotechnical testing by qualified individuals and in accordance with local requirements.
- Porous concrete system designs must use some method to convey larger storm event flows to the conveyance system. One option is to use storm drain inlets set slightly above the elevation of the pavement. This would allow for some ponding above the surface, but would accept bypass flows that are too large to be infiltrated by the porous concrete system, or if the surface clogs.

- For the purpose of sizing downstream conveyance and structural control system, porous concrete surface areas can be assumed to 35% impervious. In addition, credit can be taken for the runoff volume infiltrated from other impervious areas using the methodology in Section 3.1.

- For treatment control, the design volume should be, at a minimum, equal to the water quality volume. The water quality storage volume is contained in the surface layer, the aggregate reservoir, and the sub-grade above the seasonal high water table – if the sub-grade is sandy. The

storm duration (fill time) is normally short compared to the infiltration rate of the sub-grade, a duration of two hours can be used for design purposes. The total storage volume in a layer is equal to the percent of voids times the volume of the layer. Alternately storage may be created on the surface through temporary ponding, though this would tend to accelerate clogging if course sediment or mud settles out on the surface.

- The cross-section typically consists of four layers, as shown on the Typical Detail. The aggregate reservoir can sometimes be avoided or minimized if the sub-grade is sandy and there is adequate time to infiltrate the necessary runoff volume into the sandy soil without by-passing the water quality volume. Descriptions of each of the layers is presented below:

  Porous Concrete Layer – The porous concrete layer consists of an open-graded concrete mixture usually ranging from depths of 2 to 4 inches depending on required bearing strength and pavement design requirements. Porous concrete can be assumed to contain 18 percent voids (porosity = 0.18) for design purposes. The omission of the fine aggregate provides the porosity of the porous pavement. To provide a smooth riding surface and to enhance handling and placement a coarse aggregate of 3/8 inch maximum size is normally used. Use No. 89 coarse aggregate (3/8 to No. 50) per ASTM D 448.

  Top Filter Layer – Consists of a 0.5 inch diameter crushed stone to a depth of 1 to 2 inches. This layer serves to stabilize the porous asphalt layer. Can be combined with reservoir layer using suitable stone.

  Reservoir Layer – The reservoir gravel base course consists of washed, bank-run gravel, 1.5 to 2.5 inches in diameter with a void space of about 40% (Clean Washed No. 2B Stone). **The depth of this layer shall be two (2') feet.** A porosity value (void space/total volume) of 0.32 was assumed.

  Bottom Filter Layer – The surface of the subgrade should be an 6 inch layer of sand (ASTM C-33 concrete sand) or a 2 inch thick layer of 0.5 inch crushed stone, and be completely flat to promote infiltration across the entire surface. This layer serves to stabilize the reservoir layer, to protect the underlying soil from compaction, and act as the interface between the reservoir layer and the filter fabric covering the underlying soil.

  Filter Fabric – It is very important to line the entire trench area, including the sides, with filter fabric prior to placement of the aggregate. The filter fabric serves a very important function by inhibiting soil from migrating into the reservoir layer and reducing storage capacity. Fabric should be MIRFI # 14 N or equivalent.

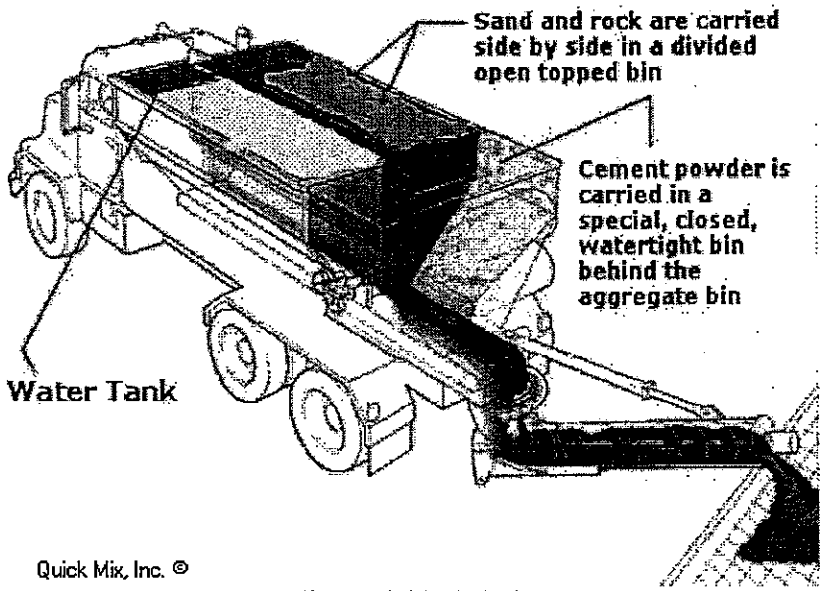
  Underlying Soil – The underlying soil should have an infiltration capacity of at least 0.5 in/hr, but preferably greater than 0.50 in/hr.

- The pit excavation should be limited to the width and depth specified in the design. Excavated material should be placed away from the open trench as not to jeopardize the stability of the trench sidewalls. The bottom of the excavated trench should not be loaded so as to cause compaction, and should be scarified prior to placement of sand. The sides of the trench shall be trimmed of all large roots. The sidewalls shall be uniform with no voids and scarified prior to backfilling. All infiltration trench facilities should be protected during site construction, and should be constructed after upstream areas have been stabilized.

- An observation well consisting of perforated PVC pipe 4 to 6 inches in diameter may be placed at the downstream end of the facility and protected. The well should be used to determine actual infiltration rates.

Volumetric (Mobile) Concrete Mixers

The Mobile Concrete Mixer is a combination materials transporter and mobile concrete mixing plant, mounted on a transport vehicle, usually a truck or trailer, which carries sufficient unmixed material, sand, cement, coarse aggregates, water (and any other chemicals that may be used for special mix designs) to the job to produce fresh concrete, mixed to design specifications.



(Source: Quick Mix, Inc.)

Sand and stone are accurately proportioned by adjusting gates to the correct height. The settings are based on actual calibration of the gate settings done with the specific aggregates being used.

(Source: Pittsburgh Mobile Concrete)

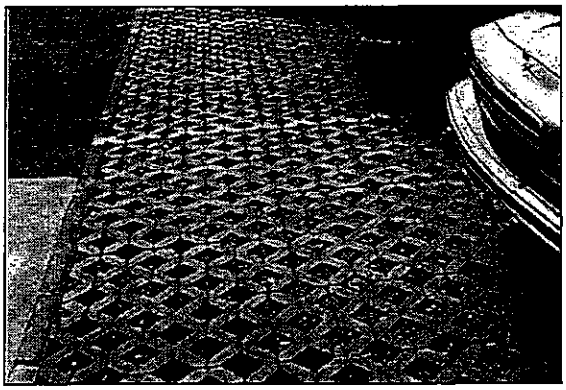
The three basic dry ingredients (sand, stone, and cement powder) simultaneously drop off the main conveyor into the charging end of the mixer at the rear of the unit. At this point, a predetermined metered flow of water also enters the mixer. Action of the combined auger and paddle mixer rapidly, thoroughly, and continuously mixes the ingredients and water to produce a continuous discharge of uniform quality concrete.

The materials blending action is continuous, and may proceed until the ingredient bins are empty. On the other hand, mixing and delivery may be stopped at any time and then started again at the will of the

operator. This permits production to be balanced to the demands of the placing and finishing crews and other job requirements

General Description Modular Paver Systems

Modular porous pavers are structural units, such as concrete blocks, bricks, or reinforced plastic mats, with regularly interdispersed void areas used to create a load-bearing pavement surface. The void areas are filled with pervious materials (gravel, sand, or grass turf) to create a system that allows for the infiltration of stormwater runoff. Porous paver systems provide water quality benefits in addition to groundwater recharge and a reduction in stormwater volume. The use of porous paver systems results in a reduction of the effective impervious area on a site.



There are many different types of modular porous pavers available from different manufacturers, including both pre-cast and mold in-place concrete blocks, concrete grids, interlocking bricks, and plastic mats with hollow rings or hexagonal cells

Modular porous pavers are typically placed on a gravel (stone aggregate) base course. Runoff infiltrates through the porous paver surface into the gravel base course, which acts as a storage reservoir as it exfiltrates to the underlying soil. The infiltration rate of the soils in the subgrade must be adequate to support drawdown of the entire runoff capture volume within 24 to 48 hours. Special care must be taken during construction to avoid undue compaction of the underlying soils, which could affect the soils' infiltration capability.

A drawback is the cost and complexity of modular porous paver systems compared to conventional pavements. Porous paver systems require a higher level of construction workmanship to ensure that they function as designed. In addition, there is the difficulty and cost of rehabilitating the surfaces should they become clogged.

The system must be installed based upon the manufactures recommendations. **The gravel layer required for the Standardized Single Lot Residential Facility is a minimum of two (2') feet in depth.**

Design Basis

For the Standardized BMP for a single residential lot, the minimum surface area of the porous pavement was determined from the following equation:

$$A = WQ_v/(n_g d_g + kT/12)$$

Where:

A = Surface Area Porous Pavement (SF)
WQv = Water Quality Volume in CF
n_g = 0.32 = porosity of the gravel
d_g = 2' = depth or gravel layer (feet)
k = percolation = 0.5 inches/hour assumed
T= Fill Time = 2 hours (time for the practice to fill with water), in hours

Inspection and Maintenance Requirements

Typical Maintenance Activities for Porous Concrete Systems

Activity	Schedule
• Initial inspection	Monthly for three months after installation
• Ensure that the porous paver surface is free of sediment	Monthly
• Ensure that the contributing and adjacent area is stabilized and mowed, with clippings removed	As needed, based on inspection
• Vacuum sweep porous concrete surface followed by high pressure hosing to keep pores free of sediment	Four times a year
• Inspect the surface for deterioration or spalling • Check to make sure that the system dewaters between storms	Annually
• Spot clogging can be handled by drilling half-inch holes through the pavement every few feet • Rehabilitation of the porous concrete system, including the top and base course as needed	Upon failure

To ensure proper maintenance of porous pavement, a carefully worded maintenance agreement is essential. It should include specific the specific requirements and establish the responsibilities of the property owner and provide for enforcement.

This Guidance document is based upon information abstracted from the Georgia Stormwater Manual and the Quick Mix, Inc. web site.

STANDARD PROCEDURES
EROSION AND SEDIMENTATION CONTROLS
FOR INDIVIDUAL RESIDENTIAL LOTS

General

Erosion and Sedimentation from individual residential lots can most often be controlled by silt fence along the lower perimeter of all disturbed areas and the installation of a rock construction entrance where construction traffic will enter and exit the site. Standard Construction Detail, Sheet ES-1, shows the typical erosion controls that should be placed on high and low side lots. If the scope of the work requires additional measures on the site, an individual plan must be submitted and approved by the Township of Ross. In all cases, the Contractor is responsible for complying with the provisions of PA DEP Chapter 102.

Temporary Erosion Controls

Silt fence must be installed along the lower perimeter of all disturbed areas and will function as the primary control for the site. A stone construction entrance must be installed at the driveway entrance to the site to help prevent mud from being tracked out onto the roadway. When at all possible, construction vehicles should be restricted to paved surfaces.

All uncompleted disturbed areas on which activity will cease for more than twenty (20) days should be seeded and stabilized. After construction is complete and all areas are stabilized, all temporary control measures may be removed and all monitoring will cease. Stabilization is defined as the establishment of a uniform 70% perennial vegetal cover.

Staging Schedule

In general, the following staging schedule should be followed for small projects"

1. Install the silt fence in accordance with the standard detail shown on Detail Sheet ES-2 along the lower perimeter of all disturbed areas.

2. Install the rock construction entrance in accordance with the standard detail shown on Detail Sheet ES-2 at the entrance to the site. The stone base for the driveway should also be installed as soon as it is graded in order to prevent erosion.

3. Grub the construction area and remove the topsoil, stockpiling it at the area designated on the plans.

4. Construct the site improvements.

5. Seed and mulch all disturbed areas.

6. Remove all E & S Controls once the site is stabilized. An area will not be considered stabilized until a uniform 70% perennial vegetal cover is established over the disturbed area.

Maintenance Schedule

It shall be the sole responsibility of the contractor to execute the control of inspection, maintenance, and repair of various sediment control facilities according to the guidelines prescribed below.

All control measures must be inspected on a weekly basis, and in all cases immediately following each runoff event. All necessary repairs should be carried out immediately after their identification. Materials cleaned from the BMP's shall be disposed of by spreading them in the topsoil stockpile area.

Silt Fence

Maintenance checks shall include inspecting silt fence for undercutting, tears, collapse offence, and depths of sediment accumulation. All repairs of damaged fence must be performed immediately to ensure that the fence meets design specifications. Sediment should be removed periodically, and in all cases

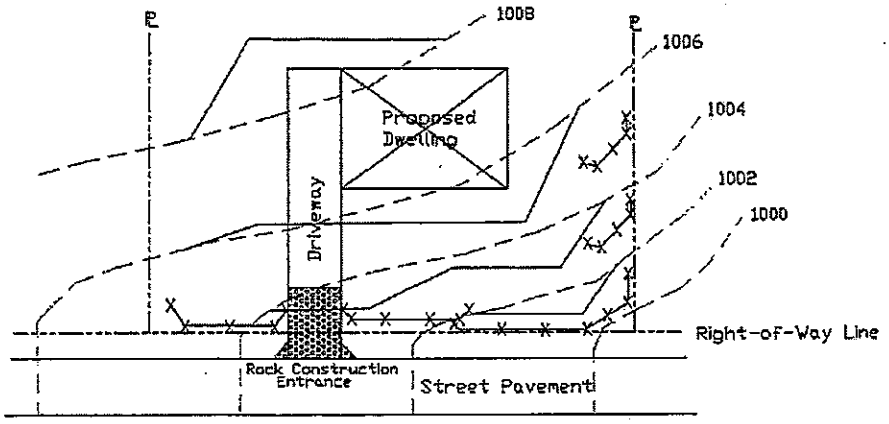
should accumulation attain depths equal to half the height of fence. Sediment deposits removed from the silt fence must be disposed of by spreading the material within the topsoil stockpile area. Undercutting of the toe shall be immediately repaired by installing a rock filter outlet.

Construction Entrance

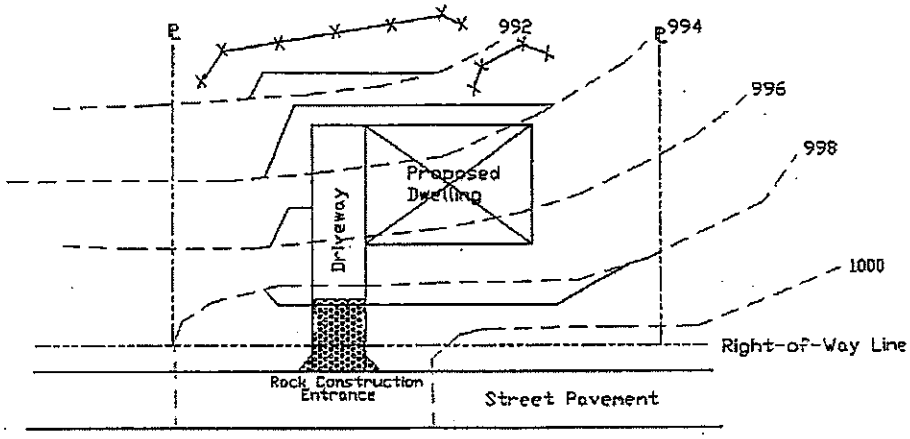
The stabilized construction entrance should be maintained so as to ensure a constant rock thickness. This will be achieved by the placement of additional rock to the specified dimension as required. A stockpile of rock must be maintained on-site for this purpose. At the completion of each work day, all sediment deposited on the public roadways must be removed and returned to the construction site. Washing of the roadway with water will be unacceptable.

Vegetation

All areas to be stabilized by vegetation should be inspected for rills and gullies, bare soil patches or accumulation of sediment at the toe of slopes. Eroded areas shall be regraded, and substandard vegetated areas shall be re-seeded and mulched as specified in the plans.



TYPICAL HIGH-SIDE ON-LOT CONTROL



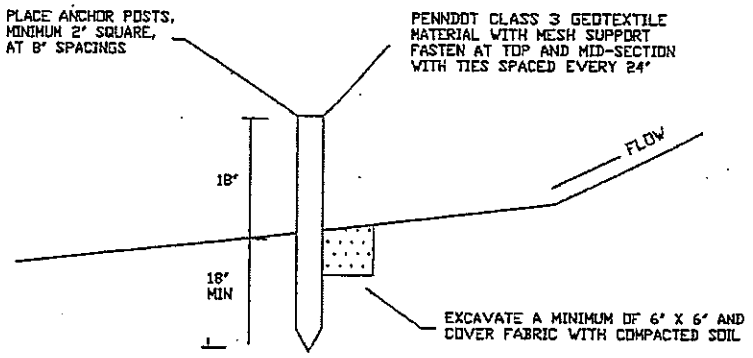
TYPICAL LOW-SIDE ON-LOT CONTROL

LEGEND

Finished Grade
Existing Grade
Silt Fence

Detail ES-1

(Detail from Town of McCandless / Partridge Venture Engineering)



INSTALLATION:

A TRENCH WILL BE PLOWED OR OTHERWISE EXCAVATED TO THE REQUIRED DEPTH WITH LITTLE, IF ANY, DISTURBANCE TO THE DOWNSLOPE SIDE OF THE TRENCH. THE BOTTOM OF THE TRENCH AND THE FENCE TOP WILL BE PLACED ON A LEVEL GRADE. WHEN IT IS NECESSARY TO CROSS SMALL DEPRESSIONS, THE TRENCH BOTTOM AND FENCE TOP EDGE MAY DEVIATE SLIGHTLY FROM LEVEL GRADE. GRADES IN SUCH SECTIONS WILL NOT EXCEED 1% NOR WILL THE DEVIATION EXTEND FOR MORE THAN 25 FEET.

SUPPORT STAKES WILL BE DRIVEN TO THE REQUIRED DEPTH BELOW THE EXISTING GROUND SURFACE AT SPECIFIED INTERVALS AS ILLUSTRATED.

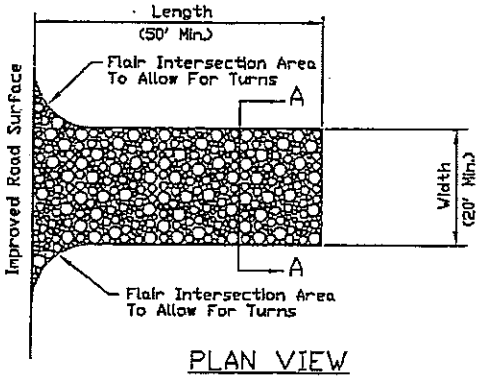
STRETCH AND FASTEN FABRIC TO THE UPSLOPE SIDE OF THE SUPPORT STAKES.

WHERE ENDS OF FABRIC COME TOGETHER, THEY WILL BE OVERLAPPED, FOLDED, AND STAPLED TO PREVENT SEDIMENT BYPASS. AT THE ENDS OF EACH LINE OF SILT FENCE, OR EVERY 100 FEET, WHICHEVER IS S SHORTER, EXTEND THE FENCE UPSLOPE AT A 90 DEGREE ANGLE FOR 4 FEET TO PREVENT ENDFLOW.

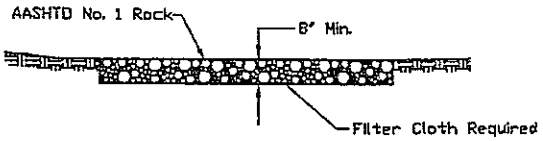
THE TOE ANCHOR WILL BE BACKFILLED AND COMPACTED TO A DENSITY EQUAL TO SURROUNDING SOILS.

SILT FENCE

NO SCALE



PLAN VIEW



SECTION A-A

MAINTENANCE: The structure's thickness will be constantly maintained to the specified dimensions by adding rock. A stockpile of rock material will be maintained on the site for this purpose. At the end of each construction day, all sediment deposited on public roadways will be removed and returned to the

ROCK CONSTRUCTION ENTRANCE DETAIL

NO SCALE

Detail ES-2

(Detail from Town of McCandless / Partridge Venture Engineering)