

THE BOROUGH OF HATFIELD,
MONTGOMERY COUNTY

ORDINANCE NO. 509

STORMWATER MANAGEMENT

AN ORDINANCE OF THE HATFIELD BOROUGH, REPEALING CHAPTER 26 "STORMWATER MANAGEMENT" OF THE CODE OF ORDINANCES OF HATFIELD BOROUGH AND REPLACING IT WITH A NEW STORMWATER MANAGEMENT ORDINANCE IMPLEMENTING THE REQUIREMENTS OF THE NESHAMINY CREEK WATERSHED ACT 167 STORMWATER MANAGEMENT PLAN (INCLUDES LITTLE NESHAMINY CREEK WATERSHED)

WHEREAS, Hatfield Borough has enacted a Stormwater Management Ordinance; Ordinance 440 of March 3, 2004, and

WHEREAS, Hatfield Borough now desires to repeal that Ordinance and replace it with an Ordinance which implements the most current Neshaminy Creek Watershed Stormwater Management Plan,

NOW THEREFORE, the Borough Council of Hatfield hereby enacts the following as its Stormwater Management Ordinance, replacing Chapter 26, "Stormwater Management" of the Code of Ordinances of Hatfield Borough with the following:

TABLE OF CONTENTS

PAGE

A. GENERAL PROVISIONS 5

 §26-101. Short Title 5

 §26-102. Statement of Findings 5

 §26-103. Purpose 6

 §26-104. Statutory Authority 7

 §26-105. Applicability/Regulated Activities 7

 §26-106. Exemptions 7

 §26-107. Repealer 9

 §26-108. Severability 9

 §26-109. Compatibility with Other Ordinance or Legal Requirements 9

B. DEFINITIONS 10

 §26-111. Interpretation 10

 §26-112. Definitions 10

C. STORMWATER MANAGEMENT 23

 §26-121. General Requirements 23

 §26-122. Permit Requirements by Other Governmental Entities 25

 §26-123. Volume Control 27

 §26-124. Stormwater Peak Rate Control and Management Districts 30

 §26-125. Calculation Methodology 32

 §26-126. Other Requirements 34

D. STORMWATER MANAGEMENT (SWM) SITE PLAN REQUIREMENTS 35

 §26-131. General Requirements 35

 §26-132. SWM Site Plan Requirements 35

 §26-133. Plan Submission 38

 §26-134. Stormwater Management (SWM) Site Plan Review 39

 §26-135. Modification of Plans 39

 §26-136. Resubmission of Disapproved SWM Site Plans 39

 §26-137. Authorization to Construct and Term of Validity 40

E. INSPECTIONS 41

 §26-141. Inspections 41

F. FEES AND EXPENSES 42

§26-151. Municipal Stormwater Management (SWM) Site Plan Review and Inspection Fee	42
§26-152. Expenses Covered by Fees	42
G. MAINTENANCE RESPONSIBILITIES	43
§26-161. Performance Guarantee	43
§26-162. Responsibilities for Operations and Maintenance (O&M) of Stormwater Facilities and BMPs	43
§26-163. Municipal Review of Stormwater Facilities and BMP Operations and Maintenance (O&M) Plan.....	45
§26-164. Operations and Maintenance (O&M) Agreement for Privately Owned Stormwater Facilities and BMPs.....	45
§26-165. Stormwater Management Easements.....	46
H. PROHIBITIONS	47
§26-171. Prohibited Discharges.....	47
§26-172. Roof Drains.....	48
§26-173. Alteration of SWM BMPs.....	48
I. ENFORCEMENT AND PENALTIES	49
§26-181. Right-of-Entry	49
§26-182. Inspection.....	49
§26-183. Enforcement.....	50
§26-184. Suspension and Revocation of Permits and Approvals	50
§26-185. Penalties.....	51
§26-186. Appeals	51
J. NESHAMINY CREEK WATERSHED STORMWATER MANAGEMENT PLAN ORDINANCE ENACTMENT	53
APPENDIX A: STORMWATER CONTROLS AND BEST MANAGEMENT PRACTICES OPERATIONS AND MAINTENANCE AGREEMENT	54
APPENDIX B: STORMWATER MANAGEMENT DESIGN CRITERIA	58
APPENDIX C-1: SAMPLE SWM SITE PLAN APPLICATION	68
APPENDIX C-2: SWM SITE PLAN CHECKLIST	73
APPENDIX D. MAPS OF MANAGEMENT DISTRICTS.....	77
APPENDIX E: LOW IMPACT DEVELOPMENT (LID) PRACTICES.....	78
APPENDIX F: DISCONNECTED IMPERVIOUS AREA (DIA).....	81
APPENDIX G: HOT SPOTS.....	82
APPENDIX H: WEST NILE VIRUS GUIDANCE.....	86

APPENDIX I: SMALL PROJECT STORMWATER MANAGEMENT (SWM) SITE PLAN....	88
APPENDIX J: FEE-IN-LIEU-OF OPTION.....	103
APPENDIX K: REFERENCES.....	107

TABLES

TABLE 26-106.1 Impervious Surface Exemption Thresholds for the Neshaminy Creek Watershed.....	8
TABLE 26-124.1 Peak Rate Runoff Control Standards by Stormwater Management Districts in the Neshaminy Creek Watershed.....	31
TABLE 26-125.1 Acceptable Computation Methodologies for Stormwater Management Plans...	33

CHAPTER 26. STORMWATER MANAGEMENT

Part 1 Stormwater Management

A. General Provisions

§26-101. Short Title

This Ordinance shall be known and may be cited as the Hatfield Borough Stormwater Ordinance enacting the "Neshaminy Creek Watershed Stormwater Management Ordinance" (a.k.a. Neshaminy/Little Neshaminy Stormwater Management Ordinance).

§26-102. Statement of Findings

The Council of the Borough of Hatfield finds that:

- A. Inadequate management of accelerated stormwater runoff resulting from development and redevelopment throughout a watershed increases flood flows and velocities, contributes to erosion and sedimentation, overtaxes the carrying capacity of streams and storm sewers, greatly increases the cost of public facilities to convey and manage stormwater, undermines floodplain management and flood reduction efforts in upstream and downstream communities, reduces groundwater recharge, and threatens public health and safety.
- B. Inadequate planning and management of stormwater runoff resulting from land development and redevelopment throughout a watershed can also harm surface water resources by changing the natural hydrologic patterns, accelerating stream flows (which increase scour and erosion of streambeds and streambanks, thereby elevating sedimentation), destroying aquatic habitat, and elevating aquatic pollutant concentrations and loadings such as sediments, nutrients, heavy metals, and pathogens.
- C. A comprehensive program of stormwater management (SWM), including reasonable regulation of development and activities causing accelerated runoff, is fundamental to the public health, safety, welfare, and the protection of the people of the Borough and all the people of the Commonwealth, their resources, and the environment.
- D. Stormwater is an important water resource by providing groundwater recharge for water supplies and base flow of streams, which also protects and maintains surface water quality.
- E. Public education on the control of pollution from stormwater is an essential component in successfully addressing stormwater.
- F. Federal and state regulations require certain municipalities to implement a program of stormwater controls. These municipalities are required to obtain a permit for stormwater discharges from their separate storm sewer systems under the National Pollutant Discharge Elimination System (NPDES).
- G. Nonstormwater discharges to municipal separate storm sewer systems can contribute to pollution of waters of the Commonwealth by the Borough.

§26-103. Purpose

The purpose of this Ordinance is to promote the public health, safety, and welfare within the Neshaminy Creek watershed by maintaining the natural hydrologic regime and by minimizing the harms and maximizing the benefits described in Section 102 of this Ordinance, through provisions designed to:

- A. 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.
- B. Minimize increases in stormwater volume and control peak flows.
- C. Minimize impervious surfaces.
- D. Provide review procedures and performance standards for stormwater planning and management.
- E. Preserve the natural drainage systems as much as possible.
- F. Manage stormwater impacts close to the runoff source, requiring a minimum of structures and relying on natural processes.
- G. Focus on infiltration of stormwater to maintain groundwater recharge, to prevent degradation of surface and groundwater quality, and to otherwise protect water resources.
- H. Preserve and restore the flood-carrying capacity of streams.
- I. Prevent scour and erosion of streambanks and stream beds.
- J. Provide standards to meet National Pollution Discharge Elimination System (NPDES) permit requirements.
- K. Address certain requirements of the Municipal Separate Stormwater Sewer System (MS4) NPDES Phase II Stormwater Regulations.
- L. Provide for proper operation and maintenance of all stormwater management facilities and Best Management Practices (BMPs) that are implemented in the Borough.

§26-104. Statutory Authority

The Borough of Hatfield is empowered to regulate land use activities that affect stormwater impacts by the authority of the Borough Code, 53 P.S. §45101 *et seq.*, and/or the Municipalities Planning Code, 53 P.S. §10101 *et seq.*, and hereby supplements its existing Floodplain Ordinance, Ord. 395, 12/18/1996, as amended [Chapter 8], by adding to it the Hatfield Borough MS4 Water Quality Stormwater Management Ordinance as stated herein.

- A. Pennsylvania Municipalities Planning Code, Act 247, as amended.
- B. Cite applicable municipal code, [e.g. Second Class Township Code (Act 69 of 1933, P.L. 103; 53 P.S. § 65101, as amended) and Borough Code (Act 581 of 1965, P.L. 1656; 53 P.S. § 45101, as amended)].

§26-105. Applicability/Regulated Activities

All Regulated Activities and all activities that may effect stormwater runoff, including Land Development and Earth Disturbance Activity are subject to Regulation by this Ordinance.

Regulated activities include, but are not limited to:

1. Land development,
2. Subdivisions,
3. Prohibited or polluted discharges,
4. Alteration of the natural hydrologic regime,
5. Construction or reconstruction of, or addition of new impervious or semi-pervious surfaces (i.e., driveways, parking lots, roads, etc.), except for reconstruction of roads where there is no increase in impervious surface,
6. Construction of new buildings or additions to existing buildings,
7. Redevelopment,
8. Diversion piping or encroachments in any natural or man-made channel, and
9. Nonstructural and structural stormwater management Best Management Practices (BMPs) or appurtenances thereto.

§26-106. Exemptions

- A. Regulated Activities that create impervious surfaces smaller than or equal to 1,000 square feet do not have to apply the volume control requirements of this Ordinance. Regulated Activities of this size are exempt from the peak rate control requirements and

the SWM Site Plan preparation located in Part D of this Ordinance. If the activity is found to be a significant contributor of pollution to the waters of this Commonwealth, the Hatfield Borough may enforce any of the above requirements.

- B. Regulated Activities that create impervious surfaces greater than 1,000 square feet up to and including 5,000 square feet are exempt only from the peak rate control requirements of this Ordinance.

Table 26-106.1 Impervious Surface Exemption Thresholds for the Neshaminy Creek Watershed

Ordinance Article or Section	Type of Project	Proposed Impervious Surface		
		0 to 1,000 sq. ft.	>1,000 to 5000 sq. ft.	>5,000 sq. ft.
Article IV SWM Site Plan Requirements	Development	Exempt	Not Exempt	Not Exempt
Section 303 Volume Control Requirements	Development	Not Applicable	Not Exempt	Not Exempt
Section 304 Peak Rate Control Requirements	Development	Exempt	Exempt	Not Exempt
Erosion and Sediment Pollution Control Requirements	Must comply with Title 25, Chapter 102 of the PA Code and any other applicable state, county, and municipal codes.			

- C. Agricultural activity is exempt from the peak rate control requirements and SWM Site Plan preparation requirements of this Ordinance provided the activities are performed according to the requirements of 25 Pa. Code 102.
- D. Forest management and timber operations are exempt from the peak rate control requirements and SWM Site Plan preparation requirements of this Ordinance provided the activities are performed according to the requirements of 25 Pa. Code 102.
- E. Any aspect of BMP maintenance to an existing SWM system made in accordance with plans and specifications approved by the Borough is exempt.
- F. The use of land for gardening and/or landscaping for home consumption is exempt from the requirements of this ordinance.
- G. Exemptions from any provisions of this Ordinance shall not relieve the applicant from the requirements in Section 26-131 D through L.

H. Additional Exemption Criteria:

1. Exemption Responsibilities – An exemption shall not relieve the Applicant from implementing such measures as are necessary to protect public health, safety, and property.
2. Drainage Problems – Where drainage problems are documented or known to exist downstream of or is expected from the proposed activity, the Borough of Hatfield may deny exemptions.
3. Exemptions are limited to specific portions of this Ordinance.
4. HQ and EV Streams – The Borough of Hatfield may deny exemptions in high quality (HQ) or exceptional value (EV) waters and Source Water Protection Areas (SWPA).

§26-107. Repealer

The existing Chapter 26, “Stormwater Management” Ordinance 440 (2004) is hereby repealed and this Chapter 26 is substituted in its place.

Any other Ordinance or Ordinance provision of the Borough of Hatfield inconsistent with any of the provisions of this Ordinance is hereby repealed to the extent of the inconsistency only.

§26-108. Severability

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

§26-109. Compatibility with Other Ordinance or Legal Requirements

1. Approvals issued and actions taken under this Chapter 26 do not relieve the applicant of the responsibility to secure required permits or approvals for activities regulated by any other code, law, regulation or ordinance. To the extent that this Part imposes more rigorous or stringent requirements for stormwater management, the specific requirements contained in this Part shall be followed.
2. Nothing in this Chapter 26 shall be constructed to affect any of the Borough of Hatfield’s requirements regarding stormwater matters which do not conflict with the provisions in this Part, such as local stormwater management design criteria (e.g., inlet spacing, inlet type, collection system design and details, outlet structure design, etc.). Conflicting provisions in other municipal ordinances or regulations shall be construed to retain the requirements of the Part addressing State water requirements.

B. DEFINITIONS

§26-111. Interpretation

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

- A. Words used in the present tense include the future tense; the singular number includes the plural, and the plural number includes the singular; words of masculine gender include feminine gender; and words of feminine gender include masculine gender.
- B. The word "includes" or "including" shall not limit the term to the specific example, but is intended to extend its meaning to all other instances of like kind and character.
- C. The word "person" includes an individual, firm, association, organization, partnership, trust, company, corporation, unit of government, or any other similar entity.
- D. The words "shall" and "must" are mandatory; the words "may" and "should" are permissive.
- E. The words "used" or "occupied" include the words "intended, designed, maintained, or arranged to be used, occupied or maintained."

§26-112. Definitions

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

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

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

Applicant – A person who has filed an application for approval to engage in any Regulated Activity defined in Section 105 of this Ordinance.

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

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

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

Best Management Practices (BMP) – Activities, facilities, designs, measures, or procedures used to manage stormwater impacts from regulated activities, to meet state water quality requirements, to promote groundwater recharge, and to otherwise meet the purposes of this Ordinance. Stormwater BMPs are commonly grouped into one of two broad categories or measures: “structural” or “nonstructural.” In this Ordinance, nonstructural BMPs or measures refer to operational and/or behavior-related practices that attempt to minimize the contact of pollutants with stormwater runoff whereas structural BMPs or measures are those that consist of a physical device or practice that is installed to capture and treat stormwater runoff. Structural BMPs include, but are not limited to, a wide variety of practices and devices, from large-scale retention ponds and constructed wetlands, to small-scale underground treatment systems, infiltration facilities, filter strips, low impact design, bioretention, wet ponds, permeable paving, grassed swales, riparian or forested buffers, sand filters, detention basins, and manufactured devices. Structural stormwater BMPs are permanent appurtenances to the project site.

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

Borough Council - elected municipal officials of the Borough of Hatfield.

Buffer – The area of land immediately adjacent to any stream, measured perpendicular to and horizontally from the top-of-bank on both sides of a stream (see Top-of-bank).

Channel – An open drainage feature through which stormwater flows. Channels include, but shall not be limited to, natural and man-made watercourses, swales, streams, ditches, canals, and pipes that convey continuously or periodically flowing water.

Cistern – An underground reservoir or tank for storing rainwater.

Conservation District – The Montgomery County Conservation District.

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

Curve Number – Value used in the Soil Cover Complex Method. It is a measure of the percentage of precipitation which is expected to run off from the watershed and is a function of the soil, vegetative cover, and tillage method.

Dam – A man-made barrier, together with its appurtenant works, constructed for the purpose of impounding or storing water or another fluid or semifluid. A dam may include a refuse bank, fill or structure for highway, railroad or other purposes which impounds or may impound water or another fluid or semifluid.

Department – The Pennsylvania Department of Environmental Protection (PADEP).

Designee – The agent of the Montgomery County Conservation District, and/or agent of the Council involved with the administration, review, or enforcement of any provisions of this Ordinance by contract or memorandum of understanding.

Design Professional (Qualified) – A Pennsylvania Registered Professional Engineer, Registered Landscape Architect or Registered Professional Land Surveyor trained to develop stormwater management plans.

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

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

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

Developer – A person that seeks to undertake a land development or subdivision. See also “applicant.”

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

Development Site – The specific tract or parcel of land where any regulated activity set forth in Section 26-105 is planned, conducted or maintained.

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

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

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

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

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

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

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

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

Drainage Permit – A permit issued by the Borough of Hatfield after the SWM Site Plan has been approved.

Earth Disturbance Activity – A construction or other human activity that disturbs the surface of land, including, but not limited to, clearing and grubbing, grading, excavations, embankments, land development, agricultural plowing or tilling, timber harvesting activities, road maintenance activities, mineral extraction, and the moving, depositing, stockpiling, or storing of soil, rock or earth materials.

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

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

Existing Resources and Site Analysis Map – A base map which identifies fundamental environmental site information including floodplains, wetlands, topography, vegetative site features, natural areas, prime agricultural land and areas supportive of endangered species.

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

Erosion and Sediment Control Plan – A site-specific plan identifying BMPs to minimize accelerated erosion and sedimentation. For agricultural plowing or tilling activities, the Erosion and Sediment Control Plan is that portion of a conservation plan identifying BMPs to minimize accelerated erosion and sedimentation.

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

Existing Conditions – The initial condition of a project site prior to the proposed alteration.

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

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

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

Floodway – The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

Forest Management/Timber Operations – Planning and associated 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, and reforestation.

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

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

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

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

HEC-HMS – The U.S. Army Corps of Engineers, Hydrologic Engineering Center (HEC) - Hydrologic Modeling System (HMS). This model was used to model the Neshaminy Creek watershed during the Act 167 Plan development and was the basis for the Standards and Criteria of this Ordinance.

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

Hot spot – An area where land use or activity generates highly contaminated runoff, with concentrations of pollutants in excess of those typically found in stormwater. Typical pollutant loadings in stormwater may be found in Chapter 8 Section 6 of the *Pennsylvania Stormwater Best Management Practices Manual, Pennsylvania Department of Environmental Protection (PADEP) no. 363-0300-002 (2006)*. More information concerning hot spots may be found in Section 306.A of this Ordinance.

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

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

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

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

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

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

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

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

Initial Abstraction (I_a): The value used to calculate the volume or peak rate of runoff in the soil cover complex method. It represents the depth of rain retained on vegetation plus the depth of rain stored on the soil surface plus the depth of rain infiltrated prior to the start of runoff.

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

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

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

Land Development – Any of the following activities:

- (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 residential or nonresidential buildings, whether proposed initially or cumulatively, or a single nonresidential building on a lot or lots regardless of the number of occupants or tenure, or
 - b. The division or allocation of land or space, whether initially or cumulatively, between or among two or more existing or prospective occupants by means of, or for the purpose of streets, common areas, leaseholds, condominiums, building groups, or other features;
 - c. Land development as defined herein shall not include the addition of an accessory building subordinate to an existing principal building on a lot or lots.
- (ii) A subdivision of land;
- (iii) Development in accordance with Section 503(1.1) of the PA Municipalities Planning Code.

Lot – a contiguous tract, parcel, or unit of land held by a landowner and/or intended for use, development, lease, or transfer of ownership, and for which a deed description is recorded or is intended to be recorded at the Office of Recorder of Deeds for Montgomery County.

Low Impact Development (LID) Practices – Practices that will minimize proposed conditions runoff rates and volumes, which will minimize needs for artificial conveyance and storage facilities.

Main Stem (Main Channel) – Any stream segment or other runoff conveyance used as a reach in the Neshaminy Creek hydrologic model.

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

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

Borough of Hatfield – Hatfield Borough, Montgomery County, Pennsylvania.

Natural Hydrologic Regime (see Hydrologic Regime)

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

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

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

NRCS – Natural Resource Conservation Service (previously Soil Conservation Service).

Outfall – “Point source” as described in 40 CFR § 122.2 at the point where the Borough of Hatfield’s storm sewer system discharges to surface Waters of the Commonwealth.

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

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

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

Penn State Runoff Model (PSRM) – The computer-based hydrologic model developed at the Pennsylvania State University.

Perennial Stream – A stream which contains water at all times except during extreme drought.

Person – an individual, partnership, public or private association or corporation, or a governmental unit, public utility or any other legal entity whatsoever which is recognized by law as the subject of rights and duties.

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

Planning Commission, Borough -- the planning agency created by the Hatfield Borough Council in accordance with Article II, “Planning Agencies,” of the Pennsylvania Municipalities Planning Code, 53 P.S. §10201 *et seq.*

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

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

Predevelopment – (see Existing Condition)

Pretreatment – Techniques employed in stormwater BMPs to provide storage or filtering to trap coarse materials and other pollutants before they enter the system, but not necessarily designed to meet the volume requirements of Section 303.

Pervious Surface – A surface that allows the infiltration of water into the ground.

Project Site – The specific area of land where any Regulated Activities in the Borough of Hatfield 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.

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

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

Record Drawings – Original documents revised to suit the as-built conditions and subsequently provided by the Engineer to the Client. The Engineer reviews the Contractor's as-built drawings against his/her own records for completeness, then either turns these over to the Client or transfers the information to a set of reproducible, in both cases for the Client's permanent records. Record drawings are not the same as record plans submitted for recording with the County in accordance with the PA Municipalities Planning Code (Act 247).

Redevelopment – Any development that requires demolition or removal of existing structures or impervious surfaces at a site and replacement with new impervious surfaces. Maintenance activities such as top-layer grinding and re-paving are not considered to be redevelopment. Interior remodeling projects and tenant improvements are also not considered to be redevelopment. Utility trenches in streets are not considered redevelopment unless more than 50 percent of the street width including shoulders is removed and re-paved.

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

Regulated Earth Disturbance Activity - Activity involving earth disturbance subject to regulation under 25 Pa. Code 92, 25 Pa. Code 102, or the Clean Streams Law.

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

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

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

Retention Basin – A structure in which stormwater is stored and not released during the storm event. Retention basins are designed for infiltration purposes, and do not have an outlet. The retention basin must infiltrate stored water in 4 days or less.

Retention Volume/Removed Runoff – The volume of runoff that is captured and not released directly into the surface Waters of the Commonwealth during or after a storm event.

Return Period – The probability an event will occur in any given year. Typically displayed as a whole number, e.g. 25-year event, and represents the inverse of the frequency of that event. For example, the 25-year return period rainfall gives the probability, 1/25 or 4 %, which that size storm will occur in any given year.

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

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

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

SALDO – Subdivision and land development ordinance.

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

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

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

Seepage Pit/Seepage Trench – An area of excavated earth filled with loose stone or similar coarse material, into which surface water is directed for infiltration into the underground water. More information on Seepage Pits may be found in the PA BMP Manual, December 2006, Chapter 6, Section 4.

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

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

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

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

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

Special Protection Subwatersheds – Watersheds that have been designated in Pennsylvania Code Title 25 Environmental Protection, Chapter 93 Water Quality Standards as exceptional value (EV) or high quality (HQ) waters.

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

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

Storm Frequency – The number of times that a given storm “event” occurs or is exceeded on the average in a stated period of years. See “Return Period”.

Storm Sewer – A system of pipes or other conduits which carries intercepted surface runoff, street waters, or drainage, but excludes domestic sewage and industrial wastes.

Stormwater – The surface runoff generated by precipitation reaching the ground surface.

Stormwater Management Best Management Practices – Is abbreviated as **BMPs** or **SWM BMPs** throughout this Ordinance.

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

Stormwater Management Plan – The watershed plan, known as the “Neshaminy Creek Watershed Act 167 Stormwater Management Plan,” for managing those land use activities that will influence stormwater runoff quality and quantity and that would impact the Neshaminy Creekwatershed adopted by Bucks and Montgomery Counties as required by the Act of October 4, 1978, P.L. 864 (Act 167).

Stormwater SWM Site Plan – The plan prepared by the Applicant or his representative indicating how stormwater runoff will be managed at the particular site of interest according to this ordinance.

Stream – A flow of water in a natural channel or bed, as a brook, rivulet, or a small river

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

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

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

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

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

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

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

SWM Site Plan – The documentation of the stormwater management system to be used for a given development site, the contents of which are established in Section 26-132.

Timber Operations – See Forest Management.

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

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

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

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

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

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

Watershed – Region or area drained by a river, watercourse, or other body of water, whether natural or artificial.

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

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

C. STORMWATER MANAGEMENT

§26-121. General Requirements

- A. Applicants proposing Regulated Activities in the Neshaminy Creek watershed that do not fall under the exemption criteria shown in Section 26-106 shall submit a Stormwater Management (SWM) Site Plan consistent with the Neshaminy Creek Watershed SWM Plan to the Borough of Hatfield for review. The SWM criteria of this Ordinance shall apply to the total proposed development even if development is to take place in stages. Preparation and implementation of an approved SWM Site Plan is required. No Regulated Activities shall commence until the Borough of Hatfield issues written approval of a SWM Site Plan, which demonstrates compliance with the requirements of this Ordinance.
- B. SWM Site Plans approved by the Borough of Hatfield, in accordance with Section D, shall be on-site throughout the duration of the Regulated Activity.
- C. The Borough of Hatfield may, after consultation with the Department of Environmental Protection (PADEP), approve measures for meeting the state water quality requirements other than those in this Ordinance, provided that they meet the minimum requirements of, and do not conflict with, state law including but not limited to the Clean Streams Law.
- D. For all regulated earth disturbance activities, Erosion and Sediment (E&S) Control Best Management Practices (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 Title 25 of the Pennsylvania Code and the Clean Streams Law. Various BMPs and their design standards are listed in the *Erosion and Sediment Pollution Control Program Manual*, No. 363-2134-008 (April 15, 2000), as amended and updated.
- E. For all Regulated Activities, implementation of the volume controls in Section 26-123 of this Ordinance is required.
- F. Impervious areas:
 - 1. The measurement of impervious areas shall include all of the impervious areas in the total proposed development even if development is to take place in stages.
 - 2. For development taking place in stages, the entire development plan must be used in determining conformance with this Ordinance.
 - 3. For projects that add impervious area to a parcel, the total impervious area on the parcel is subject to the requirements of this Ordinance

- G. Stormwater flows onto adjacent property shall not be created, increased, decreased, relocated, or otherwise altered without written notification of the adjacent property owner(s) from the developer. Such stormwater flows shall be subject to the requirements of this Ordinance.
- H. All Regulated Activities shall include such measures as necessary to:
1. Protect health, safety, and property;
 2. Meet the water quality goals of this Ordinance by implementing measures to:
 - a. Minimize disturbance to floodplains, wetlands, and wooded areas.
 - b. Create, maintain, repair or extend riparian buffers.
 - c. Avoid erosive flow conditions in natural flow pathways.
 - d. Minimize thermal impacts to waters of this Commonwealth.
 - e. Disconnect impervious surfaces (i.e. Disconnected Impervious Areas, DIAs) by directing runoff to pervious areas, wherever possible. See Appendix F for detail on DIAs.
 3. To the maximum extent practicable, incorporate the techniques for Low Impact Development Practices (e.g. protecting existing trees, reducing area of impervious surface, cluster development, and protecting open space) described in the *Pennsylvania Stormwater Best Management Practices Manual*, Pennsylvania Department of Environmental Protection (PADEP) no. 363-0300-002 (2006). See Ordinance Appendix E for a summary description.
- I. Infiltration BMPs should be spread out, made as shallow as practicable, and located to maximize the use of natural on-site infiltration features while still meeting the other requirements of this Ordinance.
- J. The design of all facilities over karst shall include an evaluation of measures to minimize the risk of adverse effects.
- K. Storage facilities should completely drain both the volume control and rate control capacities over a period of time not less than 24 and not more than 72 hours from the end of the design storm.
- L. The design storm volumes to be used in the analysis of peak rates of discharge should be obtained from the Precipitation-Frequency Atlas of the United States, Atlas 14, Volume 2, Version 3.0, U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Weather Service, Hydrometeorological Design Studies Center, Silver Spring, Maryland. NOAA's Atlas 14 can be accessed at <http://hdsc.nws.noaa.gov/hdsc/pfds/>

- M. For all regulated activities, SWM BMPs shall be designed, implemented, operated, and maintained to meet the purposes and requirements of this Ordinance and to meet all requirements under Title 25 of the Pennsylvania Code, the Clean Streams Law, and the Storm Water Management Act.
- N. Various BMPs and their design standards are listed in the *Pennsylvania Stormwater Best Management Practices Manual* (PA BMP Manual).

§26-122. Permit Requirements by Other Governmental Entities

Approvals issued and actions taken under this Ordinance do not relieve the Applicant of the responsibility to secure other required permits or approvals for activities regulated by any other code, law, regulation or ordinance.

A. General

The following permit requirements may apply to certain regulated earth disturbance activities, and must be met prior to commencement of regulated earth disturbance activities, as applicable:

1. All regulated earth disturbance activities subject to permit requirements by DEP under regulations at 25 Pa.Code, Chapter 102.
2. Work within natural drainage ways subject to permit by DEP under 25 Pa.Code, Chapter 105.
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.
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).
5. Culverts, bridges, storm sewers or any other facilities which must pass 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.

B.- Erosion and Sediment Control During Regulated Earth Disturbance-Activities.

1. No regulated earth disturbance activities within the Borough of Hatfield shall commence until approval by the Borough of Hatfield of an erosion and sediment control plan for construction activities.
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).
3. In addition, under 25 Pa.Code, Chapter 92, a DEP "NPDES: construction activities" permit is required for regulated earth disturbance activities.

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 Borough of Hatfield. The issuance of an NPDES construction permit (or permit coverage under the Statewide General Permit (PAG-2) may satisfy the requirements of subsection.1.
5. A copy of the erosion and sediment control plan and any required permit, as required by DEP regulations, shall be available at the project site at all times.

C. Water Quality Requirements after Regulated Earth Disturbance Activities are Complete.

1. No regulated earth disturbance activities within the Borough of Hatfield shall commence until approval by the Borough of Hatfield of a plan which demonstrates compliance with State water quality requirements after construction is complete.
2. The BMPs must be designed, implemented and maintained to meet State Water Quality Requirements, and any other more stringent requirements as determined by the Borough of Hatfield.
3. To control post-construction stormwater impacts from regulated earth disturbance activities, State water quality requirements can be met by BMPs, including site design, which provide for replication of pre-construction stormwater infiltration and runoff conditions, so that post-construction stormwater discharges do not degrade the physical, chemical or biological characteristics of the receiving waters. As described in the DEP Comprehensive Stormwater Management Policy (#392-0300-002, September 28, 2002), this may be achieved by the following:
 - A. Infiltration-replication of pre-construction stormwater infiltration conditions.
 - B. Treatment-use of water quality treatment BMPs to ensure filtering out of the chemical and physical pollutants from the storm-water runoff.
 - C. Streambank and streambed protection-management of volume and rate of post-construction stormwater discharges to prevent physical degradation of receiving waters (e.g., from scouring).
4. DEP has regulations that require municipalities to ensure design, implementation and maintenance of best management practices (“BMPs”) that control runoff from new development and redevelopment after regulated earth disturbance activities are complete. These requirements include the need to implement post-construction stormwater BMPs with assurance of long-term operations and maintenance of those BMPs.
5. Evidence of any necessary permit(s) for regulated earth disturbance activities from the appropriate DEP regional office must be provided to the Borough of Hatfield. The issuance of an NPDES construction permit (or permit cover under the Statewide General Permit (PAG-2) may satisfy the requirements of subsection.1.
6. BMP operations and maintenance requirements are described in Article VII of this part.

§26-123. Volume Controls

Volume controls will mitigate increased runoff impacts, protect stream channel morphology, maintain groundwater recharge, and contribute to water quality improvements. Stormwater runoff volume control methods are based on the net change in runoff volume for the two-year storm event.

Volume controls shall be implemented using the Design Storm Method in subsection A or the Simplified Method in subsection B below. For Regulated Activities equal to or less than one (1) acre, this Ordinance establishes no preference for either methodology; therefore, the applicant may select either methodology on the basis of economic considerations, the intrinsic limitations of the procedures associated with each methodology, and other factors. All regulated activities greater than one (1) acre must use the Design Storm Method.

A. **Design-Storm Method (Any Regulated Activity):** This method requires detailed modeling based on site conditions. For modeling assumptions refer to Section 26-125.

1. Post-development total runoff should not be increased from pre-development total runoff for all storms equal to or less than the 2-year 24-hour duration precipitation.
2. The following applies in order to estimate the increased volume of runoff for the 2-year 24-hour duration precipitation event:

To calculate the runoff volume (cubic feet) for existing site conditions (pre-development) and for the proposed developed site conditions (post-development), it is recommended to use the soil cover complex method as shown on the following page. Table B-3 in Ordinance Appendix B is available to guide a qualified professional and/or an applicant to calculate the stormwater runoff volume. The calculated volume shall be either reused, evapotranspired, or infiltrated through structural or nonstructural means.

Soil Cover Complex Method:

Step 1: Runoff (in) = $Q = (P - 0.2S)^2 / (P + 0.8S)$ where

P = 2-year Rainfall (in)

S = $(1000 / CN) - 10$, the potential maximum retention
(including initial abstraction, Ia)

Step 2: Runoff Volume (Cubic Feet) = $Q \times \text{Area} \times 1/12$

Q = Runoff (in)

Area = SWM Area (sq ft)

B. Simplified Method (Regulated activities less than or equal to 1 acre):

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

Volume (cubic feet) = (2" runoff / 12 inches) * impervious surface (sq ft)

2. At least the first inch (1") of runoff volume from the new impervious surfaces shall be permanently removed from the runoff flow—i.e., it shall not be released into the surface waters of the Commonwealth. The calculated volume shall be either reused, evapotranspired or infiltrated through structural or nonstructural means.

Volume (cubic feet) = (1" runoff / 12 inches) * impervious surface (sq ft)

3. Infiltration facilities should be designed to accommodate the first half inch (0.5") of the permanently removed runoff.
4. No more than one inch (1") of runoff volume from impervious surfaces shall be released from the site. The release time must be over 24 to 72 hours.

C. Stormwater Control Measures:

The applicant must demonstrate how the required volume is controlled through Stormwater Best Management Practices (BMPs) which shall provide the means necessary to capture, reuse, evaporate, transpire or infiltrate the total runoff volume.

1. If natural resources exist on the site and a SWM Site Plan submission is required for the regulated activity, the applicant shall determine and display the total acreage of protected area where no disturbance is proposed on the plan. The acreage of the protected area should be subtracted from the total site area and not included in the stormwater management site area acreage used in determining the volume controls.

**Stormwater Management Site Area =
{Total Site Area (for both pre and post development conditions) – Protected Area}**

Natural Resource Areas should be calculated based upon the Borough of Hatfield's own natural resource protection ordinance. If no ordinance exists, see Table B-2 in Ordinance Appendix B for guidance to assess the total protected area. For additional reference see Chapter 5 Section 5.4.1 of the PA BMP manual.

2. Calculate the volume controls provided through nonstructural BMPs. Table B-5 in Ordinance Appendix B is recommended as guidance.
3. Volume controls provided through nonstructural BMPs should be subtracted from the required volume to determine the necessary structural BMPs.

$$\text{Required Volume Control (ft}^3\text{)} - \text{Nonstructural Volume Control (ft}^3\text{)} = \text{Structural Volume Requirement (ft}^3\text{)}$$

4. Calculate the volume controls provided through structural BMPs. Table B-6 in Ordinance Appendix B is recommended as guidance. See PA BMP manual Chapter 6 for description of the BMPs.
5. Infiltration BMPs intended to receive runoff from developed areas shall be selected based on the suitability of soils and site conditions (see Table B-6 in Ordinance Appendix B for a list of Infiltration BMPs). Infiltration BMPs shall be constructed on soils that have the following characteristics:
 - a. A minimum soil depth of twenty-four inches (24") between the bottom of the infiltration BMPs and the top of bedrock or seasonally high water table.
 - b. An infiltration rate sufficient to accept the additional stormwater load and dewater completely as determined by field tests. A minimum of 0.2 inches/hour (in/hr) should be utilized and for acceptable rates a safety factor of 50% should be applied for design purposes (e.g., for soil which measured 0.4 in/hr, the BMP design should use 0.2 in/hr to insure safe infiltration rates after construction).
 - c. All open-air infiltration facilities shall be designed to completely infiltrate runoff volume within three (3) days (72 hours) from the start of the design storm.
6. Soils – A soils evaluation of the project site shall be required to determine the suitability of infiltration facilities. All regulated activities are required to perform a detailed soils evaluation by a qualified design professional which at minimum address' soil permeability, depth to bedrock, and subgrade stability. The general process for designing the infiltration BMP shall be:

- a. Analyze hydrologic soil groups as well as natural and man-made features within the site to determine general areas of suitability for infiltration practices. In areas where development on fill material is under consideration, conduct geotechnical investigations of sub-grade stability; infiltration may not be ruled out without conducting these tests.
- b. Provide field tests such as double ring infiltrometer or hydraulic conductivity tests (at the level of the proposed infiltration surface) to determine the appropriate hydraulic conductivity rate. Percolation tests are not recommended for design purposes.
- c. Design the infiltration structure based on field determined capacity at the level of the proposed infiltration surface and based on the safety factor of 50%.
- d. If on-lot infiltration structures are proposed, it must be demonstrated to the Borough of Hatfield that the soils are conducive to infiltrate on the lots identified.
- e. An impermeable liner will be required in detention basins where the possibility of groundwater contamination exists. A detailed hydrogeologic investigation may be required by the Borough of Hatfield.

§26-124. Stormwater Peak Rate Control and Management Districts

Peak rate controls for large storms, up to the 100-year event, is essential in order to protect against immediate downstream erosion and flooding. The following peak rate controls have been determined through hydrologic modeling of the Neshaminy Creek watershed.

- A. Standards for managing runoff from each subarea in the Neshaminy Creek Watershed for the 2-, 5-, 10-, 25-, 50-, and 100-year design storms are shown in Table 26-124.1. Development sites located in each of the management districts must control proposed development conditions runoff rates to existing conditions runoff rates for the design storms in accordance with Table 26-124.1 on the following page.

Table 26-124.1
Peak Rate Runoff Control Standards by Stormwater Management Districts
In The Neshaminy Creek Watershed
(includes Little Neshaminy Creek)

District	Design Storm Postdevelopment (Proposed Conditions)	Design Storm Predevelopment (Existing Conditions)
A	2-year	1-year
	5-year	5-year
	10-year	10-year
	25-year	25-year
	50-year	50-year
	100-year	100-year
B	2-year	1-year
	5-year	2-year
	10-year	5-year
	25-year	10-year
	50-year	25-year
	100-year	50-year
C	2-year	2-year
	5-year	5-year
	10-year	10-year
	25-year	25-year
	50-year	50-year
	100-year	100-year

- B. General – Proposed conditions rates of runoff from any Regulated Activity shall not exceed the peak release rates of runoff from existing conditions for the design storms specified on the Stormwater Management District Watershed Map (Ordinance Appendix D) and in this section of the Ordinance.
- C. District Boundaries – The boundaries of the Stormwater Management Districts are shown on official maps and are available for inspection at the municipal office and county planning offices. A copy of the map at a reduced scale, and four other maps with zoomed-in extents are included in Ordinance Appendix D. The exact location of the Stormwater Management District boundaries as they apply to a given development site shall be determined by mapping the boundaries using the two-foot topographic contours (or most accurate data required) provided as part of the SWM Site Plan.
- D. Sites Located in More Than One District – For a proposed development site located within two or more stormwater management district category subareas, the peak discharge rate from any subarea shall meet the Management District Criteria for the district in which the discharge is located.
- E. Off-Site Areas – When calculating the allowable peak runoff rates, developers do not have to account for runoff draining into the subject development site from an off-site area. On-site drainage facilities shall be designed to safely convey off-site flows through the development site.

- F. Site Areas – The stormwater management site area is the only area subject to the management district criteria. Non-impacted areas or non-regulated activities bypassing the stormwater management facilities would not be subject to the management district criteria.
- G. Alternate Criteria for Redevelopment Sites – For redevelopment sites, one of the following minimum design parameters shall be accomplished, whichever is most appropriate for the given site conditions as determined by the Borough of Hatfield:
 - 1. Meet the full requirements specified by Table 26-124.1 and Sections 26-124.A through 26-124.F

or

 - 2. Reduce the total impervious surface on the site by at least twenty (20) percent based upon a comparison of existing impervious surface to proposed impervious surface.
- H. Areas covered by a release rate map from an alternative approved Act 167 Stormwater Management Plan

For the 1-, 2-, 5-, 10-, 25-, 50 , and 100-year storms, the postdevelopment peak discharge rates will follow the applicable approved release rate maps. For any areas not shown on the release rate maps, the postdevelopment discharge rates shall not exceed the predevelopment discharge rates.

§26-125. Calculation Methodology

- A. The following criteria shall be used for runoff calculations:
 - 1. For development sites not considered redevelopment, the ground cover used to determine the existing conditions runoff volume and flow rate shall be as follows:
 - a. Wooded sites shall use a ground cover of “woods in good condition.” A site is classified as wooded if a continuous canopy of trees exists over a ¼ acre.
 - b. The undeveloped portion of the site including agriculture, bare earth, and fallow ground shall be considered as “meadow in good condition,” unless the natural ground cover generates a lower curve number (CN) or Rational “c” value (i.e., woods) as listed in Tables B-4 or B-7 in Appendix B of this Ordinance.
 - 2. For development and redevelopment sites, the ground cover used to determine the existing conditions runoff volume and flow rate for the developed portion of the site shall be based upon actual land cover conditions. If the developed site contains impervious surfaces, 20 percent of the impervious surface area shall be considered meadow in the model for existing conditions.

- B. Stormwater runoff peak discharges from all development sites with a drainage area equal to or greater than 200 acres shall be calculated using a generally accepted calculation technique that is based on the NRCS Soil Cover Complex Method. Table 26-125.1 summarizes acceptable computation methods. The method selected by the design professional shall be based on the individual limitations and suitability of each method for a particular site. The Borough of Hatfield may allow the use of the Rational Method ($Q=CIA$) to estimate peak discharges from drainage areas that contain less than 200 acres.

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.

- C. All calculations consistent with this ordinance using the Soil Cover Complex Method shall use the appropriate design rainfall depths for the various return period storms according to the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 rain data corresponding to the Doylestown rain gage, seen in Table B-1 in Ordinance Appendix B. The SCS Type II rainfall curve from NOAA is found on Figure B-1 in Ordinance Appendix B. This data may also be directly retrieved from the NOAA Atlas 14 website: hdsc.nws.noaa.gov/hdsc/pfds/orb/pa_pfds.html. If a hydrologic computer model such as PSRM or HEC-1 / HEC-HMS is used for stormwater runoff calculations, then the duration of rainfall shall be 24 hours.

TABLE 26-125.1
Acceptable Computation Methodologies For
Stormwater Management Plans

METHOD	METHOD DEVELOPED BY	APPLICABILITY
TR-20 (or commercial computer package based on TR-20)	USDA NRCS	Applicable where use of full hydrology computer model is desirable or necessary.
TR-55 (or commercial computer package based on TR-55)	USDA NRCS	Applicable for land development plans within limitations described in TR-55.
HEC-1 / HEC-HMS	U.S. Army Corps of Engineers	Applicable where use of full hydrologic computer model is desirable or necessary.
PSRM	Penn State University	Applicable where use of a hydrologic computer model is desirable or necessary; simpler than TR-20 or HEC-1.
Rational Method (or commercial computer package based on Rational Method)	Emil Kuichling (1889)	For sites less than 200 acres, or as approved by the Borough of Hatfield and/or Municipal Engineer.
Other Methods	Varies	Other computation methodologies approved by the Borough of Hatfield and/or Municipal Engineer.

- D. All calculations using the Rational Method shall use rainfall intensities consistent with appropriate times-of-concentration for overland flow and return periods from NOAA Atlas 14, Volume 2 Version 2.1. Times-of-concentration for overland flow shall be calculated using the methodology presented in Chapter 3 of *Urban Hydrology for Small Watersheds*, NRCS, TR-55 (as amended or replaced from time to time by NRCS). Times-of-concentration for channel and pipe flow shall be computed using Manning's equation.
- E. Runoff Curve Numbers (CN) for both existing and proposed conditions to be used in the soil cover complex method shall be based on Table B-4 in Ordinance Appendix B.
- F. Runoff coefficients (C) for both existing and proposed conditions for use in the Rational Method shall be consistent with Table B-7 in Ordinance Appendix B.
- G. Runoff from proposed sites graded to the subsoil will not have the same runoff conditions as the site under existing conditions because of soil compaction, even after top-soiling or seeding. The proposed condition "CN" or "C" shall increase by 5% to better reflect proposed soil conditions.
- H. The Manning equation is preferred for one-dimensional, gradually-varied, open channel flow. In other cases, appropriate, applicable methods should be applied, however, early coordination with the Borough of Hatfield is necessary.
- I. Outlet structures for stormwater management facilities shall be designed to meet the performance standards of this Ordinance using the generally accepted hydraulic analysis technique or method of the Borough of Hatfield.
- J. The design of any stormwater detention facilities intended to meet the performance standards of this Ordinance shall be verified by routing the design storm hydrograph through these facilities using the Storage-Indication Method. For drainage areas greater than 200 acres in size, the design storm hydrograph shall be computed using a calculation method that produces a full hydrograph. The Borough of Hatfield may approve the use of any generally accepted full hydrograph approximation technique that shall use a total runoff volume that is consistent with the volume from a method that produces a full hydrograph.

§26-126. Other Requirements

A. Hot Spots

- 1. The use of infiltration BMPs is prohibited on hot spot land use areas. Examples of hot spots are listed in Ordinance Appendix G.
- 2. Stormwater runoff from hot spot land uses shall be pretreated. In no case may the same BMP be employed consecutively to meet this requirement. Guidance regarding acceptable methods of pre-treatment is located in Appendix G.

B. West Nile Guidance Requirements

All wet basin designs shall incorporate biologic controls consistent with the West Nile Guidance found in Appendix H.

D. STORMWATER MANAGEMENT (SWM) SITE PLAN REQUIREMENTS

§26-131. General Requirements

For any of the activities regulated by this Ordinance, the preliminary or final approval of subdivision and/or land development plans, the issuance of any building or occupancy permit, the commencement of any earth disturbance, or activity may not proceed until the Property Owner or Applicant or his/her agent has received written approval of a SWM Site Plan from the Borough of Hatfield and an approval of an adequate Erosion and Sediment (E&S) Control Plan review from the Borough of Hatfield or County Conservation District.

§26-132. SWM Site Plan Requirements

The SWM Site Plan shall consist of a general description of the project, including calculations, maps, and plans. A note on the maps shall refer to the associated computations and E&S Control Plan by title and date. The cover sheet of the computations and E&S Control Plan shall refer to the associated maps by title and date. All SWM Site Plan materials shall be submitted to the Borough of Hatfield in a format that is clear, concise, legible, neat, and well organized; otherwise, the SWM Site Plan shall not be accepted for review and shall be returned to the Applicant.

The following items shall be included in the SWM Site Plan:

A. General

1. General description of the project including plan contents described in Section 26-132.B.
2. General description of proposed SWM techniques to be used for SWM facilities.
3. Complete hydrologic and hydraulic computations for all SWM facilities.
4. All reviews and letters of adequacy from the Conservation District for the Erosion & Sedimentation Plan as required by [Borough of Hatfield], county or state regulations.
5. A general description of proposed nonpoint source pollution controls.
6. The SWM Site Plan Application and completed fee schedule form and associated fee *for all regulated activities not already paying pay fees by under the SALDO regulations.* (Ordinance Appendix C-1).
7. The SWM Site Plan Checklist (Ordinance Appendix C-2).
8. Appropriate sections from the municipalities' Subdivision and Land Development Ordinance, and other applicable local ordinances, shall be followed in preparing the SWM Site Plan.

- B. Plans: SWM Site Plan shall provide the following information;
1. The overall stormwater management concept for the project.
 2. A determination of natural site conditions and stormwater management needs. This shall include, but not be limited to:
 - a. Site Features:
 - 1) The location of the project relative to highways, municipal boundaries or other identifiable landmarks.
 - 2) The locations of all existing and proposed utilities, sanitary sewers, and water lines on site and to within fifty (50) feet of property lines.
 - 3) Proposed structures, roads, paved areas, and buildings.
 - 4) The total tract boundary and size with distances marked to the nearest foot and bearings to the nearest degree.
 - 5) Plan and profile drawings of all SWM BMP's, including drainage structures, pipes, open channels, and swales. At a minimum this should include pre- and post-drainage area maps, an overall post construction stormwater management plan, stormwater details sheets, and landscape plans (if proposing bio-retention facilities, low impact development, bioretention, or vegetative basins).
 - 6) The locations and minimum setback distances of existing and proposed on-lot wastewater facilities and water supply wells.
 - 7) The location of all erosion and sediment control facilities.
 - 8) The location of proposed septic tank infiltration areas and wells in cases where groundwater recharge measures such as seepage pits, beds or trenches are proposed.
 - b. Natural Site Conditions:
 - 1) An Existing Resource and Site Analysis Map (ERSAM) showing environmentally sensitive areas including, but not limited to;
 - steep slopes,
 - ponds,
 - lakes,
 - streams,
 - wetlands,
 - hydric soils,
 - hydrologic soil groups A and B,
 - vernal pools,
 - stream buffers,
 - open channels,
 - existing recharge areas, and
 - floodplains.

The area of each of these sensitive areas shall be calculated and should be consistent with the runoff volume calculation Section 26-123.C.1.

- 2) A detailed site evaluation for projects proposed in areas of frequent flooding, karst topography, and other environmentally sensitive areas, such as brownfields and source water protection areas.
 - 3) Existing and proposed contour lines (2 ft).
 - 4) The total extent of the drainage area upstream from the site and all down gradient receiving channels, swales and waters to which stormwater runoff or drainage will be discharged.
- c. Stormwater runoff design computations and documentation as specified in this Ordinance, or as otherwise necessary to demonstrate that the maximum practicable measures have been taken to meet the requirements of this Ordinance, including the recommendations and general requirements in Section 26-121.
 - d. The effect of the project (in terms of runoff volumes, water quality, and peak flows) on surrounding properties and aquatic features and on any existing stormwater conveyance system that may be affected by the project.
3. The format of the Plan shall include the following:
- a. The expected project time schedule.
 - b. The name of the development, the name and address of the owner of the property, and the name of the individual or firm preparing the plan.
 - c. The date of submission.
 - d. A graphic and written scale of one (1) inch equals no more than fifty (50) feet; for tracts of twenty (20) acres or more, the scale shall be one (1) inch equals no more than one hundred (100) feet.
 - e. A north arrow.
 - f. An access easement around all stormwater management facilities is required that would provide ingress to and egress from a public right-of-way. The size of the easement shall commensurate with the maintenance and access requirements determined in the design of the BMP.
 - g. A key map showing all existing man-made features beyond the property boundary that would be affected by the project.

- h. A note on the plan indicating the location and responsibility for maintenance of stormwater management facilities. All facilities shall meet the performance standards and design criteria specified in this ordinance.
 - i. The following signature block for the Design Engineer: "I, (Design Engineer), on this date (date of signature), hereby certify that the SWM Site Plan meets all design standards and criteria of The Neshaminy Creek Watershed Act 167 Stormwater Management Ordinance or Plan."
 - j. A statement, signed by the Applicant, acknowledging that any revision to the approved SWM Site Plan must be approved by the Borough of Hatfield and that a revised E&S Plan must be submitted to the Conservation District.
- 4. A soil erosion and sediment control plan, where applicable, as prepared for and submitted to the approval authority.
 - 5. The SWM Site Plan shall include an Operations & Maintenance (O&M) Plan for all existing and proposed physical stormwater management facilities, as well as schedules and costs for O&M activities. This plan shall address long-term ownership and responsibilities for O&M.

§26-133. Plan Submission

The Borough of Hatfield requires submission of a complete SWM Site Plan, as specified in this Ordinance.

- A. Proof of application or documentation of required permit(s) or approvals for the programs listed below shall be part of the plan:
 - 1. NPDES Permit for Stormwater Discharges from Construction Activities.
 - 2. Any other permit under applicable state or federal regulations.
- B. Six (6) copies of the SWM Site Plan shall be submitted to the following agencies:
 - 1. Two (2) copies to the Borough of Hatfield accompanied by the requisite municipal review fee, as specified in this Ordinance.
 - 2. Two (2) copies to the County Conservation District.
 - 3. One (1) copy to the municipal engineer (where applicable).
 - 4. One (1) copy to the County Planning Commission/Department if the regulated activity is also required to submit a subdivision and/or land development plan to the county planning commission in accordance with the Pennsylvania Municipal Planning Code.

- C. Any submissions to the agencies listed above that are found to be incomplete shall not be accepted for review and shall be returned to the Applicant with a notification in writing of the specific manner in which the submission is incomplete.
- D. Additional copies shall be submitted as requested by the Borough of Hatfield or PADEP.

§26-134. Stormwater Management (SWM) Site Plan Review

- A. The SWM Site Plan shall be reviewed by a Qualified Professional on behalf of the Borough of Hatfield for consistency with the provisions of this Ordinance. After review, the Qualified Professional shall provide a written recommendation for the Borough of Hatfield to approve or disapprove the SWM Site Plan. If it is recommended to disapprove the SWM Site Plan, the Qualified Professional shall state the reasons for the disapproval in writing. The Qualified Professional also may recommend approval of the SWM Site Plan with conditions and, if so, shall provide the acceptable conditions for approval in writing. The SWM Site Plan review and recommendations shall be completed within the time allowed by the Municipalities Planning Code for reviewing subdivision plans.
- B. The Borough of Hatfield will notify the applicant in writing within 45 days whether the SWM Site Plan is approved or disapproved. If the SWM Site Plan involves a Subdivision and Land Development Plan, the notification period is 90 days. If a longer notification period is provided by other statute, regulation, or ordinance, the applicant will be so notified by the Borough of Hatfield. If the Borough of Hatfield disapproves the SWM Site Plan, the Borough of Hatfield shall cite the reasons for disapproval in writing.

§26-135. Modification of Plans

A modification to a submitted SWM Site Plan that involves a change in SWM BMPs or techniques, or that involves the relocation or redesign of SWM BMPs, or that is necessary because soil or other conditions are not as stated on the SWM Site Plan as determined by the Borough of Hatfield shall require a resubmission of the modified SWM Site Plan in accordance with this Article.

§26-136. Resubmission of Disapproved SWM Site Plans

A disapproved SWM Site Plan may be resubmitted, with the revisions addressing the Borough of Hatfield's concerns, to the Borough of Hatfield in accordance with this Article. The applicable review fee must accompany a resubmission of a disapproved SWM Site Plan.

§26-137. Authorization to Construct and Term of Validity

The Borough of Hatfield's approval of an SWM Site Plan authorizes the regulated activities contained in the SWM Site Plan for a maximum term of validity of 5 years following the date of approval. The Borough of Hatfield may specify a term of validity shorter than 5 years in the approval for any specific SWM Site Plan. Terms of validity shall commence on the date the Borough of Hatfield signs the approval for an SWM Site Plan. If an approved SWM Site Plan is not completed according to Section 26-132 within the term of validity, the Borough of Hatfield may consider the SWM Site Plan disapproved and may revoke any and all permits. SWM Site Plans that are considered disapproved by the Borough of Hatfield shall be resubmitted in accordance with Section 26-136 of this Ordinance.

E. INSPECTIONS

§26-141. Inspections

- A. The Borough of Hatfield shall inspect all phases of the installation of the Best Management Practices (BMPs) and/or stormwater management (SWM) facilities as deemed appropriate by the Borough of Hatfield.
- B. During any stage of the work, if the Borough of Hatfield determines that the BMPs and/or stormwater management facilities are not being installed in accordance with the approved SWM Site Plan, the Borough of Hatfield shall revoke any existing permits or other approvals and issue a cease and desist order until a revised SWM Site Plan is submitted and approved, as specified in this Ordinance and until the deficiencies are corrected.
- C. A final inspection of all BMPs and/or stormwater management facilities may be conducted by the Borough of Hatfield to confirm compliance with the approved SWM Site Plan prior to the issuance of any Occupancy Permit.
- D. The applicant and/or developer shall be responsible for providing as-built plans of all SWM BMPs included in the approved SWM Site Plan. The as-built plans and an explanation of any discrepancies, which were reviewed and received approval by the Borough of Hatfield, shall be submitted to the Borough of Hatfield.
- E. The as-built submission shall include a certification of completion signed by a Qualified Professional verifying that all SWM BMPs have been constructed according to the approved plans and specifications. If any Qualified Professionals contributed to the construction plans, they must sign and seal the completion certificate.
- F. When appropriate, the Borough may require the Applicant, Developer or Landowner to enter into an Agreement with the Borough providing for the maintenance of any BMP or stormwater facility, and an easement for the Borough to inspect any such facilities or BMP's and to require the landowner to maintain or repair any such BMP's or stormwater facilities, and in default thereof, to allow the Borough to maintain or repair such BMP's or stormwater facilities at the landowner's expense.

F. FEES AND EXPENSES

§26-151. Municipal Stormwater Management (SWM) Site Plan Review and Inspection Fee

Fees shall be established by the Borough of Hatfield to cover plan review and construction inspection costs incurred by the Borough of Hatfield. All fees shall be paid by the Applicant at the time of SWM Site Plan submission. A review and inspection fee schedule shall be established by Resolution of the Borough of Hatfield based on the size of the Regulated Activity and based on the Borough of Hatfield's costs for reviewing SWM Site Plans and conducting inspections pursuant to Section 26-141. The Borough of Hatfield shall periodically update the review and inspection fee schedule to ensure that review costs are adequately reimbursed.

§26-152. Expenses Covered by Fees

The fees required by this Ordinance (unless otherwise waived by the Borough of Hatfield) shall, at a minimum, cover:

- A. Administrative costs.
- B. The review of the Stormwater (SWM) Site Plan by the Borough of Hatfield.
- C. The review of As-built Drawings.
- D. The site inspections.
- E. The inspection of SWM facilities and drainage improvements during construction.
- F. The final inspection at the completion of the construction of the SWM facilities and drainage improvements presented in the SWM Site Plan.
- G. Any additional work required to enforce any permit provisions regulated by this Ordinance, correct violations, and assure proper completion of stipulated remedial actions.
- H. The cost of preparing, approving and recording any stormwater operation and maintenance agreements or easements necessary for the operation and maintenance of any BMP or stormwater facility.

G. MAINTENANCE RESPONSIBILITIES

§26-161. Construction and Performance Guarantees

- A. For subdivisions and land developments, the Applicant shall provide financial security acceptable to the Borough of Hatfield for the timely installation and proper construction of all stormwater management (SWM) facilities as:
 - 1. Required by the approved SWM Site Plan equal to or greater than the full construction cost of the required controls; or
 - 2. The amount and method of payment provided for in the subdivision and land development ordinance.
- B. For other regulated activities, the Borough of Hatfield may require financial security from the Applicant.

§26-162. Responsibilities for Operations and Maintenance (O&M) of Stormwater Facilities and BMPs

- A. The owner of any land upon which stormwater facilities and BMPs will be placed, constructed, or implemented, as described in the stormwater facility and BMP O&M plan, shall record the following documents in a form acceptable to the Borough Solicitor, in the Office of the Recorder of Deeds for Montgomery County, prior to the construction of the stormwater facility and BMP O&M plan by the Borough of Hatfield:
 - 1. The O&M plan, or a summary thereof,
 - 2. O&M agreements under Section 26-164, and
 - 3. Easements under Section 26-165.
- B. The Borough of Hatfield may suspend or revoke any approvals granted for the project site upon discovery of failure on the part of the owner to comply with this section.
- C. No regulated earth disturbance activities within the Borough of Hatfield shall commence until approval by the Borough of Hatfield of BMP operations and maintenance plan which describes how the permanent (e.g., post construction) stormwater BMPs will be properly operated and maintained.

The following items shall be included in the Stormwater Facility and BMP O&M Plan:

- 1. Plans or map(s) of the project area, in a form that meets the requirements for recording at the offices of the Recorder of Deeds of Montgomery County, and shall be submitted on 24-inch x 36 inch or 30 inch x 42-inch sheets. The contents of the maps(s) shall include, but not be limited to:

- a. Clear identification of the location and nature of stormwater facilities and BMPs.
 - b. The location of the project site relative to highways, municipal boundaries or other identifiable landmarks.
 - c. Existing and final contours at intervals of two (2) feet, or others as appropriate.
 - d. Existing streams, lakes, ponds, or other bodies of water within the project site area.
 - e. Other physical features including flood hazard boundaries, sinkholes, streams, existing drainage courses, and areas of natural vegetation to be preserved.
 - f. The locations of all existing and proposed utilities, sanitary sewers, and water lines on site and within 50 feet of property lines of the project site.
 - g. Proposed final changes to the land surface and vegetative cover, including the type and amount of impervious area that would be added.
 - h. Proposed final structures, roads, paved areas, and buildings, and
 - i. A twenty (20)-foot-wide access easement around all stormwater facilities and BMPs that would provide ingress to and egress from a public right-of-way.
2. A description of how each stormwater facility and BMP will be operated and maintained, and the identity and contact information associated with the person(s) responsible for O&M.
 3. The name of the project site, the name and address of the owner of the property, and the name of the individual or firm preparing the plan, and
 4. A statement, signed by the property owner, acknowledging that the stormwater facilities and BMPs are fixtures that cannot be altered or removed without the prior written approval of the Borough of Hatfield.
- D. The Stormwater Facility and BMP O&M Plan for the project site shall establish responsibilities for the continuing O&M of all stormwater facilities and BMPs, as follows:
1. If a plan includes structures or lots which are to be separately owned and in which streets, sewers and other public improvements are to be dedicated to the Borough of Hatfield, stormwater facilities and BMPs may also be offered for dedication to and maintained by the Borough of Hatfield, which is not required to accept any such facilities or BMPs; or

2. If a plan includes O&M by a homeowner's association or single ownership, or if sewers and other public improvements are to be privately owned and maintained by lot owners, the O&M of stormwater facilities and BMPs shall be the responsibility of the owner or private management entity on whose property the stormwater facility or BMP exists.
- E. The Borough of Hatfield shall make the final determination on the continuing O&M responsibilities. The Borough of Hatfield reserves the right to accept or reject the O&M responsibility for any or all of the stormwater facilities and BMPs.
 - F. Facilities, areas, or structures used as BMPs shall be enumerated as permanent real estate appurtenances and recorded as deed restrictions or conservation easements that run with the land.
 - G. The O&M Plan shall be recorded as a restrictive deed covenant that runs with the land.
 - H. The Borough may deny approval of subdivision, land development or construction plans or take enforcement actions against an owner for any failure to satisfy the provisions of this Chapter and this Ordinance.

§26-163. Municipal Review of Stormwater Facilities and BMP Operations and Maintenance (O&M) Plan

- A. The Borough of Hatfield shall review the Stormwater Facilities and BMP O&M Plan for consistency with the purposes and requirements of this ordinance, and any permits issued by PADEP.
- B. The Borough of Hatfield shall notify the Applicant in writing whether the Stormwater Facility and BMP O&M Plan is approved.
- C. The Borough of Hatfield shall require a "Record Drawing" of all stormwater facilities and BMPs.

§26-164. Operations and Maintenance (O&M) Agreement for Privately Owned Stormwater Facilities and BMPs

- A. The owner shall sign an O&M agreement approved by the Borough Solicitor with the Borough covering all stormwater facilities and BMPs that are to be privately owned. The O&M agreement shall be transferred with transfer of ownership. A sample agreement appears in Ordinance Appendix A.
- B. Other items may be included in the O&M agreement where determined necessary to guarantee the satisfactory O&M of all stormwater controls and BMPs. The O&M agreement shall be subject to the review and approval of the Borough.
- C. Unless accepted for dedication by the Borough, or as otherwise agreed, the owner of the land of which the stormwater facility or BMP is responsible for the O&M of the SWM BMPs. If the owner fails to adhere to the O&M Agreement, the Borough of Hatfield may

perform the services required and charge the owner appropriate fees. Nonpayment of fees may result in a lien against the property. It shall be unlawful to alter or remove any permanent stormwater BMP required by an approved BMP operations and maintenance plan, or to allow the property to remain in a condition which does not conform to an approved BMP operations and maintenance plan, unless an exception is granted in writing by the Borough.

§26-165. Stormwater Management Easements

1. Stormwater management easements are required for all areas used for off-site stormwater control, unless a waiver is granted by the Municipal Engineer.

2. Stormwater management easements shall be provided by the property owner if necessary for (A) access for inspections and maintenance, or (B) preservation of stormwater runoff conveyance, infiltration, and detention areas on other BMPs, by persons other than the property owner. The purpose of the easement shall be specified in any agreement under Section 704.

§26-166. Stormwater Management Easements

- A. If stormwater facilities, detention basins, or BMPs are accepted by the Borough for dedication, the Borough shall require applicants, developers or persons installing stormwater facilities or BMPs to pay a specified amount to the Municipal Stormwater BMP Operation and Maintenance Fund, to help defray costs of operations and maintenance activities. The amount shall be determined by the Borough Engineer.

H. PROHIBITED ACTIVITIES

§26-171. Prohibited Discharges

- A. Any drain or conveyance, whether on the surface or subsurface, that allows any non-stormwater discharge, including sewage, process wastewater, and wash water to enter the waters of the Commonwealth is prohibited.
- B. No person shall allow, or cause to allow, discharges into surface waters of this Commonwealth which are not composed entirely of stormwater, except (1) as provided in Subsection C below, and (2) discharges allowed under a state or federal permit.
- C. The following discharges are authorized unless they are determined to be significant contributors to pollution to the waters of the Commonwealth:
 - 1. Discharges from firefighting activities,
 - 2. Potable water sources including water line flushing,
 - 3. Irrigation drainage,
 - 4. Air conditioning condensate,
 - 5. Springs,
 - 6. Water from crawl space pumps,
 - 7. Flows from riparian habitats and wetlands,
 - 8. Uncontaminated water from foundations or from footing drains,
 - 9. Lawn watering,
 - 10. De-chlorinated swimming pool discharges (per Department of Environmental Protection (PADEP) requirements),
 - 11. Uncontaminated groundwater,
 - 12. Water from individual residential car washing, and/or
 - 13. Routine external building wash down and 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.
- D. In the event that the Borough or PADEP determines that any of the discharges identified in Subsection C significantly contribute to pollution of the waters of this Commonwealth, the Borough of Hatfield or PADEP will notify the responsible person(s) to cease the discharge.
- E. Upon notice provided by the Borough under subsection D, the discharger will have a reasonable time, as determined by the Borough, to cease the discharge consistent with the degree of pollution caused by the discharge.
- F. Nothing in this Section shall affect a discharger's responsibilities under State law.

§26-172. Roof Drains

1. Roof drains and sump pumps shall discharge to infiltration or vegetative BMPs and to the maximum extent practicable satisfy the criteria for disconnected impervious areas (DIAs).
2. Roof drains shall not be connected to streets, sanitary or storm sewers or roadside ditches, except as provided in subsection.2.
3. When the Borough Engineer determines that it is more advantageous to connect directly to streets or storm sewers, connections of roof drains or streets or roadside ditches may be permitted by the Borough of Hatfield.

§26-173. Alteration of SWM BMPs

- A. No person shall modify, remove, fill, landscape, or alter any Stormwater Management (SWM) Best Management Practices (BMPs), facilities, areas, or structures unless it is part of a maintenance program approved by the Borough Engineer and written approval of the Borough has been obtained in advance.
- B. No person shall place any structure, fill, landscaping, or vegetation into a stormwater facility or BMP or within a drainage easement which would limit or alter the functioning of the stormwater facility or BMP without the prior written approval of the Borough.

§26-174. Prohibited Connections

1. The following connections are prohibited, except as provided in Section 26-171.C above:
 - A. Any drain or conveyance, whether on the surface or subsurface, which allows any nonstormwater discharge including sewage, process wastewater, and wash water, to enter the separate storm sewer system, and any connections to the storm drain system from indoor drains and sinks.
 - B. Any drain or conveyance connected from a commercial or industrial land use to the separate storm sewer system which has not been documented in plans, maps, or equivalent records, and approved by the Borough of Hatfield.

I. ENFORCEMENT AND PENALTIES

§26-181. Right-of-Entry

- A. Duly authorized representatives of the Borough may enter at reasonable times upon any property within the inspect the implementation, condition, or operation and maintenance of the stormwater facilities or Best Management Practices (BMPs) in regard to any aspect governed by this Ordinance.
- B. Landowners with stormwater facilities and BMPs on their property shall allow persons working on behalf of the Borough ready access to all parts of the premises for the purposes of determining compliance with this Ordinance.
- C. Persons working on behalf of the Borough shall have the right to temporarily locate on any stormwater facility or BMP in the Borough such devices as are necessary to conduct monitoring and/or sampling of the discharges from such stormwater facilities or BMP.
- D. Unreasonable delays in allowing the Borough of Hatfield access to a BMP is a violation of this Section.

§26-182. Inspection

- A. Stormwater Management (SWM) Best Management Practices (BMPs) should be inspected for proper operation by the landowner, or the owner's designee (including the Borough of Hatfield for dedicated and owned facilities), according to the following list of minimum frequencies:
 - 1. Annually for the first 5 years,
 - 2. Once every 3 years thereafter,
 - 3. During or immediately after the cessation of a 10-year or greater storm, and/or
 - 4. As specified in the Operations and Maintenance (O&M) agreement.
- B. DEP or its designees (e.g., County Conservation Districts) normally ensure compliance with any permits issued, including those for stormwater management. In addition to DEP compliance programs, the Borough of Hatfield or its designee may inspect all phases of the construction, operations, maintenance and any other implementation of stormwater BMPs.
- C. During any stage of the regulated earth disturbance activities, if the Borough of Hatfield or its designee determines that any BMPs are not being implemented in accordance with this Part, the Borough of Hatfield may suspend or revoke any existing permits or other approvals until the deficiencies are corrected.

§26-183. Enforcement

All inspections regarding compliance with the Stormwater Management (SWM) Site Plan and this Ordinance shall be the responsibility of the Borough of Hatfield.

- A. Whenever the Borough of Hatfield finds that a person has violated a prohibition or failed to meet a requirement of this Ordinance, the Borough of Hatfield may order compliance by written notice to the responsible person. Such notice may, without limitation, require the following remedies:
 - 1. Performance of monitoring, analyses, and reporting;
 - 2. Elimination of prohibited connections or discharges;
 - 3. Cessation of any violating discharges, practices, or operations;
 - 4. Abatement or remediation of stormwater pollution or contamination hazards and the restoration of any affected property;
 - 5. Payment of a fine to cover administrative and remediation costs;
 - 6. Implementation of stormwater facilities and Best Management Practices (BMPs); and
 - 7. Operation and Maintenance (O&M) of stormwater facilities and BMPs.
- B. Such notification shall set forth the nature of the violation(s) and establish a time limit for correction of these violations(s). Said notice may further advise that, if applicable, should the violator fail to take the required action within the established deadline, the work will be done by the Borough of Hatfield and the expense may be charged to the violator.
- C. Failure to comply within the time specified may subject a violator to the penalty provisions of this Ordinance. All such penalties shall be deemed cumulative and shall not prevent the Borough of Hatfield from pursuing any and all other remedies available in law or equity.

§26-184. Suspension and Revocation of Permits and Approvals

- A. Any building, land development, or other permit or approval issued by the Borough of Hatfield may be suspended or revoked, in whole or in part, by the Borough of Hatfield for:
 - 1. Noncompliance with or failure to implement any provision of the permit;
 - 2. A violation of any provision of this ordinance; or
 - 3. The creation of any condition or the commission of any act during construction or development which constitutes or creates a hazard or nuisance, pollution or which endangers the life, health, or property of others.

- B. A suspended permit may be reinstated by the Borough of Hatfield when:
1. The Borough of Hatfield has inspected and approved the corrections to the stormwater facilities and BMPs or the elimination of the hazard or nuisance, and;
 2. The Borough of Hatfield is satisfied that all applicable violations in this Ordinance have been corrected.
- C. Any permit or approval that has been revoked by the Borough of Hatfield cannot be reinstated. The Applicant may apply for a new permit under the procedures outlined of this Ordinance.

§26-185. Penalties and Remedies

- A. Any violation of this Ordinance constitutes a public nuisance. Violations may be subject to a civil penalty of \$500. Each day that the violation continues shall constitute a separate offense and the applicable fines and remedies are cumulative.
- B. The Borough 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.
- C. Any person, firm or corporation who shall violate any provision of this Part, upon conviction thereof in an action brought before a magisterial district judge in the manner provided for the enforcement of summary offenses under the Pennsylvania Rules of Criminal Procedure, shall be sentenced to pay a fine or not more than \$1,000 plus costs and, in default of payment of said fine and costs, to a term of imprisonment not exceed 90 days. Each day that a violation of this Part continues or each Section of the Part which shall be found to have been violated shall constitute a separate offense.

§26-186. Appeals

- A. Any person aggrieved by an action of Hatfield Borough or its designees may appeal to the relevant judicial or administrative body according to law, within the time allowed.

J. RELATIONSHIP TO SUBDIVISION AND LAND DEVELOPMENT ORDINANCE

This Chapter 26 shall be read in conjunction with Chapter 22 "Subdivision and Land Development" and Chapter 27 "Zoning" so as to give full effect to each. In the case of a conflict, the stricter standard shall apply

This Stormwater Management Ordinance and its appendices A through J which are incorporated herein are ENACTED and ORDAINED at the regular meeting of the Borough Council of Hatfield on the 21ST day of MAY, 2014.


ATTEST:

HATFIELD BOROUGH


MICHAEL J. DEFINIS, SECRETARY


JOHN H. WEIERMAN, PRESIDENT

APPROVED this 21ST day of MAY, 2014.


Mayor Robert L. Kaler, III

Stormwater Management Ordinance
APPENDIX A: STORMWATER CONTROLS AND BEST
MANAGEMENT PRACTICES OPERATIONS AND
MAINTENANCE AGREEMENT

THIS AGREEMENT, made and entered into this _____ day of _____, 20____, by and between _____, (hereinafter the "Landowner" or "Grantor"), _____ and
(address)

the Borough of Hatfield, 401 Main Street, P.O. Box 190, Hatfield, Montgomery County, Pennsylvania 19440, (hereinafter "Borough of Hatfield");

WITNESSETH

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

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

WHEREAS, the Stormwater Controls and BMP Operations and Maintenance Plan approved by the Borough of Hatfield (hereinafter referred to as the "Plan") for the property identified herein, which is attached hereto as Appendix A and made part hereof, as approved by the Borough of Hatfield, provides for management of stormwater within the confines of the Property through the use of Best Management Practices (BMPs); and

WHEREAS, the Borough of Hatfield, and the Landowner, his successors and assigns, agree that the health, safety, and welfare of the residents of the Borough of Hatfield and the protection and maintenance of water quality require that on-site stormwater facilities and Best Management Practices be constructed and maintained on the Property; and

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

Stormwater Facilities and BMP Best Management Practice means those 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 pipes, culverts, basins, inlets, outlets, infiltration trenches, seepage pits, filter strips, bioretention, wet ponds, permeable paving, rain gardens, grassed swales, forested buffers, sand filters and detention basins.

WHEREAS, the Borough of Hatfield requires, through the implementation of the Plan, that stormwater management facilities and 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, and

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

1. The Stormwater Facilities and BMPs consist of _____ and shall be constructed by the Landowner in accordance with the plans and specifications identified in the Plan and the Borough Engineer.
2. The Landowner shall operate and maintain the Stormwater Facilities and BMP(s) as shown on the Plan in good working order acceptable to the Borough of Hatfield and in accordance with the specific maintenance requirements noted on the Plan.
3. The Landowner hereby grants permission to the Borough of Hatfield, its authorized agents and employees, to enter upon the property, at reasonable times and upon presentation of proper identification, to inspect the Stormwater Facilities and BMP(s) whenever it deems necessary. Whenever possible, the Borough of Hatfield shall notify the Landowner prior to entering the property.
4. In the event the Landowner fails to operate and maintain the Stormwater Facilities and BMP(s) as shown on the Plan in good working order acceptable to the Borough of Hatfield, the Borough of Hatfield or its representatives may enter upon the Property and take whatever action is deemed necessary to maintain said BMP(s). It is expressly understood and agreed that the Borough of Hatfield 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 Borough of Hatfield.

5. In the event the Borough of Hatfield, 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 Borough of Hatfield for all expenses (direct and indirect) incurred within 10 days of receipt of invoice from the Borough of Hatfield. The Borough may lien the Property for any such expenses.
6. The intent and purpose of this Agreement is to ensure the proper maintenance of the Stormwater Facilities and BMP(s) by the Landowner; provided, however, that this Agreement shall not be deemed to create or effect any additional liability of any party for damage alleged to result from or be caused by stormwater runoff.
7. The Landowner, its executors, administrators, assigns, and other successors in interests, shall release the Borough of Hatfield's employees and designated representatives from all damages, accidents, casualties, occurrences or claims which might arise or be asserted against said employees and representatives from the construction, presence, existence, or maintenance of the BMP(s) by the Landowner or Borough of Hatfield. In the event that a claim is asserted against the Borough of Hatfield, its designated representatives or employees, the Borough of Hatfield shall promptly notify the Landowner and the Landowner shall defend, at his own expense, the Borough and its agents, representative and employees any suit based on the claim. If any judgment or claims against the Borough of Hatfield's employees or designated representatives shall be allowed, the Landowner shall pay all costs and expenses regarding said judgment or claim.

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

ATTEST:

WITNESS the following signatures and seals:

(SEAL)

For the Borough of Hatfield:

(SEAL)

For the Landowner:

ATTEST:

_____ (City, Borough, Township)

County of _____, Pennsylvania

I, _____, a Notary Public in and for the County and State aforesaid, whose commission expires on the _____ day of _____, 20__, do hereby certify that _____ whose name(s) is/are signed to the foregoing Agreement bearing date of the _____ day of _____, 20__, has acknowledged the same before me in my said County and State.

GIVEN UNDER MY HAND THIS _____ day of _____, 200_.

NOTARY PUBLIC

(SEAL)

Stormwater Management Ordinance

APPENDIX B: STORMWATER MANAGEMENT DESIGN CRITERIA

TABLE B-1

DESIGN STORM RAINFALL AMOUNT

Source: NOAA Atlas 14 website, Doylestown Gage (36-2221)
http://hdsc.nws.noaa.gov/hdsc/pfds/orb/pa_pfds.html.

FIGURE B-1

ATLAS 14 TYPE II S-CURVES FOR ALL FREQUENCY STORMS – DOYLESTOWN GAGE (36-2221)

Source: NOAA Atlas 14 website, Doylestown Gage (36-2221)
http://hdsc.nws.noaa.gov/hdsc/pfds/orb/pa_pfds.html.

TABLE B-2

NATURAL RESOURCE PROTECTION STORMWATER MANAGEMENT CONTROLS

Source: PA BMP Manual Chapter 8, pg 33

TABLE B-3

GUIDANCE TO CALCULATE THE 2-YEAR, 24-HOUR VOLUME INCREASE FROM PRE-DEVELOPMENT TO POST-DEVELOPMENT CONDITIONS

Source: PA BMP Manual Chapter 8, pg 37

TABLE B-4

RUNOFF CURVE NUMBERS

Source: NRCS (SCS) TR-55

TABLE B-5

VOLUME CONTROL CALCULATION GUIDANCE FOR NONSTRUCTURAL BMPS

Source: PA BMP Manual Chapter 8, pg 34

TABLE B-6

VOLUME CONTROL CALCULATION GUIDANCE FOR STRUCTURAL BMPS

Source: PA BMP Manual Chapter 8, pg 38

TABLE B-7

RATIONAL RUNOFF COEFFICIENTS

Source: New Jersey Department of Transportation, Technical Manual for Stream Encroachment, August, 1984

TABLE B-8

MANNING ROUGHNESS COEFFICIENTS

TABLE B-1
DESIGN STORM RAINFALL AMOUNT (INCHES)

The design storm rainfall amount chosen for design should be obtained from the National Oceanic and Atmospheric Administration Atlas 14 interactive website:

http://hdsc.nws.noaa.gov/hdsc/pfds/orb/pa_pfds.html

Source: NOAA Atlas 14 website, Doylestown Gage (36-2221)
http://hdsc.nws.noaa.gov/hdsc/pfds/orb/pa_pfds.html

Precipitation Frequency Estimates (inches)																		
ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.34	0.54	0.68	0.93	1.15	1.38	1.51	1.89	2.30	2.71	3.13	3.48	4.07	4.61	6.23	7.76	9.85	11.81
2	0.40	0.64	0.81	1.12	1.40	1.67	1.83	2.28	2.78	3.26	3.78	4.19	4.87	5.51	7.39	9.14	11.57	13.83
5	0.47	0.76	0.96	1.36	1.75	2.10	2.30	2.86	3.50	4.11	4.76	5.24	6.02	6.71	8.81	10.65	13.30	15.78
10	0.53	0.84	1.06	1.54	2.01	2.42	2.66	3.32	4.11	4.81	5.57	6.09	6.96	7.68	9.93	11.83	14.60	17.23
25	0.59	0.94	1.19	1.76	2.34	2.86	3.15	3.98	4.99	5.83	6.71	7.30	8.30	9.03	11.44	13.36	16.25	19.04
50	0.63	1.00	1.27	1.92	2.60	3.21	3.54	4.52	5.74	6.70	7.66	8.29	9.41	10.11	12.61	14.52	17.46	20.35
100	0.67	1.07	1.35	2.07	2.85	3.56	3.94	5.09	6.55	7.63	8.67	9.33	10.59	11.23	13.79	15.66	18.61	21.57
200	0.71	1.13	1.42	2.21	3.11	3.92	4.35	5.69	7.43	8.64	9.75	10.44	11.83	12.39	14.98	16.79	19.69	22.70
500	0.76	1.20	1.51	2.40	3.44	4.41	4.90	6.54	8.73	10.12	11.30	12.01	13.60	14.00	16.58	18.23	21.02	24.08
1000	0.79	1.24	1.56	2.53	3.69	4.78	5.34	7.23	9.82	11.35	12.57	13.29	15.04	15.28	17.80	19.31	21.96	25.04

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.

FIGURE B-1

Atlas 14 Type II S-Curves for All Frequency Storms – Doylestown Gage (36-2221)

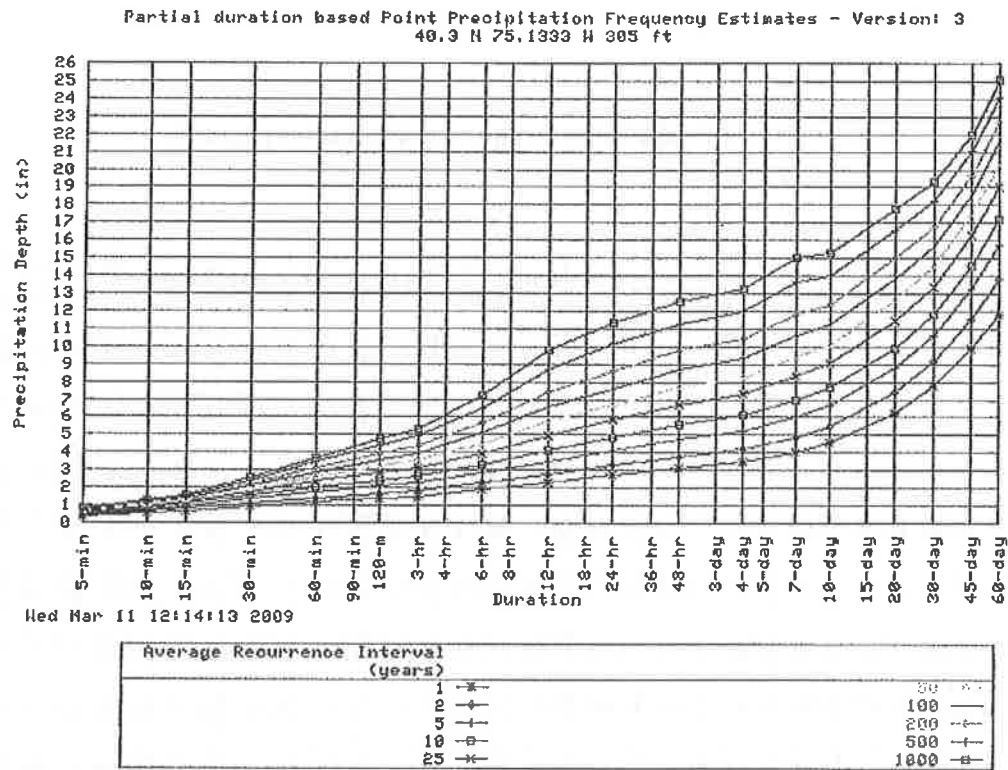


TABLE B-2: NATURAL RESOURCE PROTECTION

STORMWATER MANAGEMENT CONTROLS

Existing Natural Sensitive Resource	Mapped in the ERSAM? Yes/No/n/a	Total Area (Ac.)	Area to be Protected (Ac.)
Waterbodies			
Floodplains			
Riparian Areas / Buffers			
Wetlands			
Vernal Pools			
Woodlands			
Natural Drainage Ways			
Steep Slopes, 15%-25%			
Steep Slopes, over 25%			
Other:			
Other:			
Total Existing:			

TABLE B-3: GUIDANCE TO CALCULATE THE 2-YEAR, 24-HOUR VOLUME INCREASE FROM PRE-DEVELOPMENT TO POST-DEVELOPMENT CONDITIONS

Existing Conditions: Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff (in)	Runoff Volume (ft3)
Woodland								
Meadow								
Impervious								
Total:								

Developed Conditions: Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff (in)	Runoff Volume (ft3)
Total:								

2-year Volume Increase (ft3):

TABLE B-4. Runoff Curve Numbers (from NRCS (SCS) TR-55)

LAND USE DESCRIPTION	Hydrologic Condition	HYDROLOGIC SOIL GROUP			
		A	B	C	D
Open Space					
Grass cover < 50%	Poor	68	79	86	89
Grass cover 50% to 75%	Fair	49	69	79	84
Grass cover > 75%	Good	39	61	74	80
Meadow		30	58	71	78
Agricultural					
Pasture, grassland, or range – Continuous forage for grazing	Poor	68	79	86	89
Pasture, grassland, or range – Continuous forage for grazing.	Fair	49	69	79	84
Pasture, grassland, or range – Continuous forage for grazing	Good	39	61	74	80
Brush-weed-grass mixture with brush the major element.	Poor	48	67	77	83
Brush-weed-grass mixture with brush the major element.	Fair	35	56	70	77
Brush-weed-grass mixture with brush the major element.	Good	30	48	65	73
Fallow Bare soil	-----	77	86	91	94
Crop residue cover (CR)	Poor	76	85	90	93
	Good	74	83	88	90
Woods – grass combination (orchard or tree farm)	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30	55	70	77
Commercial (85% Impervious)		92	94	95	
Industrial (72% Impervious)		88	91	93	
Institutional (50% Impervious)		82	88	90	
Residential districts by average lot size:					
	% Impervious				
1/8 acre or less * (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Farmstead		59	74	82	86
Smooth Surfaces (Concrete, Asphalt, Gravel or Bare Compacted Soil)	98	98	98	98	
Water	98	98	98	98	
Mining/Newly Graded Areas (Pervious Areas Only)	77	86	91	94	

* Includes Multi-Family Housing unless justified lower density can be provided.

Note: Existing site conditions of bare earth or fallow ground shall be considered as meadow when choosing a CN value.

**TABLE B-5: VOLUME CONTROL CALCULATION GUIDANCE FOR
NONSTRUCTURAL BMPS**

Type of Nonstructural BMP

AREA (sq ft) * Runoff * 1/12 = Volume Reduction(ft³)
Volume (in)

Use of Natural Drainage Feature

Utilize natural flow pathways _____ sq ft * 1/4" * 1/12 = _____ cu ft

Minimum Soil Compaction

Lawn _____ sq ft * 1/3" * 1/12 = _____ cu ft

Meadow _____ sq ft * 1/3" * 1/12 = _____ cu ft

Protecting existing trees (not located in protected area)

For trees within 20 feet of impervious cover:

Tree Canopy _____ sq ft * 1" * 1/12 = _____ cu ft

For trees within 20-100 feet of impervious cover:

Tree Canopy _____ sq ft * 1/2" * 1/12 = _____ cu ft

Rooftop Disconnection

For runoff directed to pervious and/or vegetative areas where infiltration occurs

Roof Area _____ sq ft * 1/4" * 1/12 = _____ cu ft

Impervious Disconnection

For runoff from impervious surfaces such as streets and concrete directed to pervious and/or vegetative areas where infiltration occurs

Impervious Area _____ sq ft * 1/4" * 1/12 = _____ cu ft

Total Volume Reduction _____ cu ft

* represents multiply

TABLE B-6: VOLUME CONTROL CALCULATION GUIDANCE FOR STRUCTURAL BMPS

$$\text{Required Volume Control (ft}^3\text{)} - \text{Nonstructural Volume Control (ft}^3\text{)} = \text{Structural Volume Requirement (ft}^3\text{)}$$

Table B-3
Table B-5

Type	Proposed Structural BMP	Section in BMP Manual	Area (sq ft)	Storage Volume (cu ft)
Infiltration and / or Evapotranspiration	Porous Pavement	6.4.1		
	Infiltration Basin	6.4.2		
	Infiltration Bed	6.4.3		
	Infiltration Trench	6.4.4		
	Rain Garden/Bioretention	6.4.5		
	Dry Well/Seepage Pit	6.4.6		
	Constructed Filter	6.4.7		
	Vegetative Swale	6.4.8		
	Vegetative Filter Strip	6.4.9		
	Infiltration Berm	6.4.10		
Evaporation and / or Reuse	Vegetative Roof	6.5.1		
	Capture and Re-use	6.5.2		
Runoff Quality	Constructed Wetlands	6.6.1		
	Wet Pond / Retention Basin	6.6.2		
	Dry Extended Detention Basin	6.6.3		
	Water Quality Filters	6.6.4		
Restoration	Riparian Buffer Restoration	6.7.1		
	Landscape Restoration / Reforestation	6.7.2		
	Soil Amendment	6.7.3		
Other	Level Spreader	6.8.1		
	Special Storage Areas	6.8.2		
	other			

Total Volume Control from Structural BMPs: _____

TABLE E-7. RATIONAL RUNOFF COEFFICIENTS
By Hydrologic Soil Group and Overland Slope (%)

Land Use	A			B			C			D		
	0-5%	5-10%	10-15%	0-5%	5-10%	10-15%	0-5%	5-10%	10-15%	0-5%	5-10%	10-15%
Urban												
Commercial	0.80	0.75	0.70	0.70	0.65	0.60	0.60	0.55	0.50	0.50	0.45	0.40
Industrial	0.75	0.70	0.65	0.65	0.60	0.55	0.55	0.50	0.45	0.45	0.40	0.35
Residential	0.60	0.55	0.50	0.55	0.50	0.45	0.50	0.45	0.40	0.45	0.40	0.35
Low Density	0.50	0.45	0.40	0.45	0.40	0.35	0.40	0.35	0.30	0.35	0.30	0.25
Medium Density	0.40	0.35	0.30	0.35	0.30	0.25	0.30	0.25	0.20	0.25	0.20	0.15
High Density	0.30	0.25	0.20	0.25	0.20	0.15	0.20	0.15	0.10	0.15	0.10	0.05
Rural												
Forest	0.30	0.25	0.20	0.25	0.20	0.15	0.20	0.15	0.10	0.15	0.10	0.05
Open Space	0.20	0.15	0.10	0.15	0.10	0.05	0.15	0.10	0.05	0.10	0.05	0.00
Parking	0.85	0.80	0.75	0.75	0.70	0.65	0.70	0.65	0.60	0.65	0.60	0.55

* Runoff coefficients for areas not shown are interpolated from the 20-year values.
† Runoff coefficients for areas not shown are interpolated from the 25-year values.

Source: Frank Y. S. Wang and R.E. McCuen, 1981, "Computation of Urban Flood Frequency: Procedures", Preliminary Draft, U.S. Department of the Interior, Bureau of Reclamation, Denver, Colorado.

TABLE B-8. MANNING'S ROUGHNESS COEFFICIENTS

DESCRIPTION	Manning's n-value
Smooth-wall Plastic Pipe	0.011
Concrete Pipe	0.012
Smooth-lined Corrugated Metal Pipe	0.012
Corrugated Plastic Pipe	0.024
Annular Corrugated Steel And Aluminum Alloy Pipe (Plain or polymer coated)	
68 mm × 13 mm (2 2/3 in × 1/2 in) Corrugations	0.024
75 mm × 25 mm (3 in × 1 in) Corrugations	0.027
125 mm × 25 mm (5 in × 1 in) Corrugations	0.025
150 mm × 50 mm (6 in × 2 in) Corrugations	0.033
Helically Corrugated Steel And Aluminum Alloy Pipe (Plain or polymer coated)	
75 mm × 25 mm (3 in × 1 in), 125 mm × 25 mm (5 in × 1 in), or 150 mm × 50 mm (6 in × 2 in) Corrugations	0.024
Helically Corrugated Steel And Aluminum Alloy Pipe (Plain or polymer coated)	
68 mm × 13 mm (2 2/3 in × 1/2 in) Corrugations	
a. Lower Coefficients*	
450 mm (18 in) Diameter	0.014
600 mm (24 in) Diameter	0.016
900 mm (36 in) Diameter	0.019
1200 mm (48 in) Diameter	0.020
1500 mm (60 in) Diameter or larger	0.021
b. Higher Coefficients**	0.024
Annular or Helically Corrugated Steel or Aluminum Alloy Pipe Arches or Other Non-Circular Metal Conduit (Plain or Polymer coated)	0.024
Vitrified Clay Pipe	0.012
Ductile Iron Pipe	0.013
Asphalt Pavement	0.015
Concrete Pavement	0.014
Grass Medians	0.050
Grass – Residential	0.30
Earth	0.020
Gravel	0.030
Rock	0.035
Cultivated Areas	0.030 - 0.050
Dense Brush	0.070 - 0.140
Heavy Timber (Little undergrowth)	0.100 - 0.150
Heavy Timber (w/underbrush)	0.40
Streams:	
a. Some Grass And Weeds (Little or no brush)	0.030 - 0.035
b. Dense Growth of Weeds	0.035 - 0.050
c. Some Weeds (Heavy brush on banks)	0.050 - 0.070

Notes:

* Use the lower coefficient if any one of the following conditions apply:

- a. A storm pipe longer than 20 diameters, which directly or indirectly connects to an inlet or manhole, located in swales adjacent to shoulders in cut areas or depressed medians.
- b. A storm pipe which is specially designed to perform under pressure.

**Use the higher coefficient if any one of the following conditions apply:

- a. A storm pipe which directly or indirectly connects to an inlet or manhole located in highway pavement sections or adjacent to curb or concrete median barrier.
- b. A storm pipe which is shorter than 20 diameters long.
- c. A storm pipe which is partly lined helically corrugated metal pipe.

Stormwater Management Ordinance

APPENDIX C-1: SAMPLE SWM SITE PLAN APPLICATION

Application is hereby made for review under the HATFIELD BOROUGH STORMWATER MANAGEMENT ORDINANCE and related data as submitted herewith, Stormwater Management Ordinance.

Final Plan _____ Preliminary Plan _____ Sketch Plan _____

Date of Submission _____ Submission No. _____

1. Name of subdivision or development _____

2. Name of Applicant _____ Telephone No. _____

(if corporation, list the corporation's name and the names of two officers of the corporation)

_____ Officer 1

_____ Officer 2

Address _____

Zip _____

Applicants interest in subdivision or development

(if other than property owner give owners name and address)

3. Name of property owner _____ Telephone No. _____

Address _____

Zip _____

4. Name of engineer or surveyor _____ Telephone No. _____

Address _____

Zip _____

5. Type of subdivision or development proposed:

<input type="checkbox"/> Single-Family Lots	<input type="checkbox"/> Townhouses	<input type="checkbox"/> Commercial (Multi-Lot)
<input type="checkbox"/> Two Family Lots	<input type="checkbox"/> Garden Apartments	<input type="checkbox"/> Commercial (One-Lot)
<input type="checkbox"/> Multi-Family Lots	<input type="checkbox"/> Mobile-Home Park	<input type="checkbox"/> Industrial (Multi-Lot)
<input type="checkbox"/> Cluster Type Lots	<input type="checkbox"/> Campground	<input type="checkbox"/> Industrial (One-Lot)
<input type="checkbox"/> Planned Residential Development	<input type="checkbox"/> Other (_____)	

6. Linear feet of new road proposed _____ L.F.

7. Area of proposed and existing impervious area on the entire tract.

a. Existing (to remain) _____ S.F. _____ % of Property

b. Proposed _____ S.F. _____ % of Property

8. Stormwater

- a. Does the peak rate of runoff from proposed conditions exceed that flow which occurred for existing conditions for the designated design storm? _____
- b. Design storm utilized (on-site conveyance systems) (24 hr.) _____
No. of Subarea _____
Watershed Name _____

Explain: _____

- c. Does the submission and/or district meet the criteria for the applicable Management District? _____
- d. Number of subarea(s) from Ordinance Appendix D of the Neshaminy Creek Watershed Stormwater Management Plan. _____
- e. Type of proposed runoff control _____
- f. Does the proposed stormwater control criteria meet the requirements/guidelines of the Stormwater Ordinances? _____

If not, what waivers are requested? _____

Reasons _____
- g. Does the plan meet the requirements of Article III of the Stormwater Ordinances? _____

If not, what waivers are requested? _____

Reasons Why _____

- h. Was TR-55, June 1986 utilized in determining the time of concentration? _____
- i. What hydrologic method was used in the stormwater computations? _____

- j. Is a hydraulic routing through the stormwater control structure submitted? _____

- k. Is a construction schedule or staging attached? _____
- l. Is a recommended maintenance program attached? _____

9. Erosion and Sediment Pollution Control (E&S):

- a. Has the stormwater management and E&S plan, supporting documentation and narrative been submitted to the Montgomery County Conservation District? _____
- b. Total area of earth disturbance _____ S.F.

10. Wetlands

- a. Have wetlands been delineated by someone trained in wetland delineation? _____
- b. Have the wetland lines been verified by a state or federal permitting authority? _____
- c. Have the wetland lines been surveyed? _____
- d. Total acreage of wetland within the property _____
- e. Total acreage of wetland disturbed _____
- f. Supporting documentation _____

11. Filing

- a. Has the required fee been submitted? _____
Amount _____
- b. Has the proposed schedule of construction inspection to be performed by the Applicant's engineer been submitted? _____
- c. Name of individual who will be making the inspections _____
- d. General comments about stormwater management at the development _____

CERTIFICATE OF OWNERSHIP AND ACKNOWLEDGMENT OF APPLICATION:

COMMONWEALTH OF PENNSYLVANIA
COUNTY OF [County Name] .

On this the _____ day of _____, 20____, before me, the undersigned officer, personally appeared _____ who being duly sworn, according to law, deposes and says that _____ owners of the property described in this application and that the application was made with _____ knowledge and/or direction and does hereby agree with the said application and to the submission of the same.

_____ Property Owner

My Commission Expires _____ 20_____

Notary Public _____

THE UNDERSIGNED HEREBY CERTIFIES THAT TO THE BEST OF HIS KNOWLEDGE AND BELIEF THE INFORMATION AND STATEMENTS GIVEN ABOVE ARE TRUE AND CORRECT.

SIGNATURE OF APPLICANT _____



(Information Below This Line To Be Completed By The Borough of Hatfield)

_____ (Name of) Borough of Hatfield official submission receipt:

Date complete application received _____ Plan Number _____

Fees _____ date fees paid _____ received by _____

Official submission receipt date _____

Received by _____

Borough of Hatfield

PROPOSED SCHEDULE OF FEES

Subdivision name _____ Submittal No. _____

Owner _____ Date _____

Engineer _____

1. Filing fee		\$ _____
2. Land use		
2a. Subdivision, campgrounds, mobile home parks, and multi-family dwelling where the units are located in the same local watershed.		\$ _____
2b. Multi-family dwelling where the designated open space is located in a different local watershed from the proposed units.		\$ _____
2c. Commercial/industrial.		\$ _____
3. Relative amount of earth disturbance		
3a. Residential		
road <500 l.f.		\$ _____
road 500-2,640 l.f.		\$ _____
road >2,640 l.f.		\$ _____
3b. Commercial/industrial and other impervious area <3,500 s.f.		\$ _____
impervious area 3,500-43,460 s.f.		\$ _____
impervious area >43,560 s.f.		\$ _____
4. Relative size of project		
4a. Total tract area <1 ac		\$ _____
1-5 ac		\$ _____
5.1-25 ac		
25.1-100 ac		\$ _____
100.1-200 ac		\$ _____
>200 ac		\$ _____
5. Stormwater control measures		
5a. Detention basins & other controls which require a review of hydraulic routings (\$ per control).		\$ _____
5b. Other control facilities which require storage volume calculations but no hydraulic routings. (\$ per control)		\$ _____
6. Site inspection (\$ per inspection)		\$ _____
Total		\$ _____

All subsequent reviews shall be 25 percent the amount of the initial review fee unless a new application is required as per Section 406 of the stormwater ordinance. A new fee shall be submitted with each revision in accordance with this schedule.

Stormwater Management Ordinance

1. APPENDIX C-2: SWM SITE PLAN CHECKLIST

Project: _____
Borough of Hatfield: _____
Engineer: _____
Submittal No: _____
Date: _____
Project ID: _____ (for Municipal use ONLY)

SECTION I: REGULATED ACTIVITIES

Reference: Section 105

1. Is the Proposed Project within the Neshaminy Creek watershed? Yes No
2. Does the Proposed Project meet the definition of a "Regulated Activity"? Yes No

STOP – If you have checked NO for either of the above questions, you are not required to submit a Stormwater Management Plan under the Neshaminy Creek Stormwater management Ordinance.

SECTION II: EXEMPTION

Reference: Section 106

1. Does the regulated activity create an Impervious Surface less than or equal to 1,000 square feet?
 Yes No
2. Does the regulated activity create an Impervious Surface greater than 1,000 square feet but less than 5,000 square feet? Yes No
3. Does the regulated activity involve an Agricultural Activity? Yes No
4. Does the regulated activity involve Forest Management or Timber Operations? Yes No

Parcel IS Exempt from the SWM Site Plan and Peak Rate Control
Parcel IS Exempt from Peak Rate Control
Parcel IS NOT Exempt

SECTION III: VOLUME CONTROLS

Reference: Section 303

A. Site Disturbance Minimization

1. Has an Existing Resource and Site Analysis Map (ERSAM) been prepared?

Yes No, Explain _____

2. Are any of the following environmentally sensitive areas identified on site?

- | | | | |
|-------------------------------|------------------------------|-----------------------------|----------------------------------|
| Steep Slopes | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Unknown |
| Ponds / Lakes / Vernal Pools | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Unknown |
| Streams | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Unknown |
| Wetlands | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Unknown |
| Hydric Soils | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Unknown |
| Flood plains | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Unknown |
| Stream Buffer Zones | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Unknown |
| Hydrologic Soil Groups A or B | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Unknown |
| Recharge Areas | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Unknown |
| Others: _____ | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Unknown |

3. Does the site layout plan avoid environmentally sensitive areas identified on site?

- Yes No, Explain _____

B. Post-development Runoff Volume Control

1. What method is used to calculate the required volume control?

- Design-storm method Simplified method

2. What is the level of runoff volume (ft³) required to be controlled from the post-development site?
_____ (ft³)

C. Stormwater runoff control measures

1. What is the level of runoff volume (ft³) controlled through nonstructural BMPs? _____ (ft³)

2. What is the level of runoff volume (ft³) controlled through structural BMPs? _____ (ft³)

3. Have provisions been installed to promote infiltration on site?

- Yes No, Explain _____

4. Have provisions been installed to promote evapotranspiration, capture or reuse on site?

- Yes No, Explain _____

SECTION IV: PEAK RATES

Reference: Section 304

1. In which of the following Storm Water Management District(s) is the site located?

<input type="checkbox"/>	A
<input type="checkbox"/>	B
<input type="checkbox"/>	C

2. Does the Proposed Conditions Runoff meet the Criteria established in Table 304.1?

Yes No, if you answered Yes proceed to Section VI.

SECTION V: CALCULATION METHODOLOGY

Reference: Section 305 and Ordinance Appendix B

1. Which method(s) are utilized in the site stormwater management plan for computing stormwater runoff rates and volumes?

TR-20 PSRM
 TR-55 Rational Method
 HEC-1 / HEC-HMS Other: _____

2. Was Table B-1 or Figure B-1 utilized in rainfall determination?

Yes No, Explain _____

3. Was Table B-4 (Runoff Curve Numbers) or Table B-7 (Rational Runoff Coefficients) utilized in calculations for runoff?

Yes No, Explain _____

SECTION VI: OTHER REQUIREMENTS

Reference: Section 306

1. Is the proposed activity considered a "Stormwater hot spot" as defined in Ordinance Appendix G?
 Yes No, If yes, what pre-treatment BMPs are planned?

2. Have proposed wet detention basins incorporated biologic control consistent with the West Nile Virus Guidelines presented in Ordinance Appendix G?

Yes No Not Applicable

SECTION VII: FACILITY OPERATION AND MAINTENANCE PLAN

Reference: Section 702

1. Has a Stormwater Control and BMP Operations and Maintenance Plan been approved by the Borough of Hatfield?

Yes No, Explain _____

2. Who shall assume responsibility for implementing the Stormwater Control and BMP Operations and Maintenance Plan?

Borough of Hatfield Homeowner Association
 Private Owner Other

Stormwater Management Ordinance

APPENDIX D. MAPS OF MANAGEMENT DISTRICTS

Stormwater Management Ordinance

APPENDIX E: LOW IMPACT DEVELOPMENT (LID) PRACTICES

ALTERNATIVE APPROACH FOR MANAGING STORMWATER RUNOFF

Natural hydrologic conditions can be altered radically by poorly planned development practices, such as introducing unnecessary impervious surfaces, destroying existing drainage swales, constructing unnecessary storm sewers, and changing local topography. A traditional drainage approach of development has been to remove runoff from a site as quickly as possible and capture it in a detention basin. This approach leads ultimately to the degradation of water quality as well as expenditure of additional resources for detaining and managing concentrated runoff at some downstream location.

The recommended alternative approach is to promote practices that will minimize post-development runoff rates and volumes and will minimize needs for artificial conveyance and storage facilities. To simulate predevelopment hydrologic conditions, infiltration is often necessary to offset the loss of infiltration by the creation of impervious surfaces. 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.

Sometimes regulations create obstacles for an applicant interested in implementing low impact development techniques on their site. A Borough of Hatfield should consider examining their ordinances and amending the sections which limit LID techniques. For example, a Borough of Hatfield could remove parking space minimums and establish parking space maximums to reduce the area of impervious surface required. Other allowable regulations to promote LID includes permitting curb cuts or wheel stops instead of requiring curbs and allowing sumped landscaping where the runoff can drain instead of requiring raised beds. These small changes to ordinances can remove the barriers which prevent applicants from pursuing LID practices.

The following describes various LID techniques:

1. **Protect Sensitive and Special Value Resources:** See Section 5.4 of the *Pennsylvania Stormwater Best Management Practices Manual, Pennsylvania Department of Environmental Protection (PADEP) no. 363-0300-002 (2006)*.
 - a. **Preserving Natural Drainage Features.** Protecting natural drainage features, particularly vegetated drainage swales and channels, is desirable because of their ability to infiltrate and attenuate flows and to filter pollutants. However, this objective is often not accomplished in land development. In fact, commonly held drainage philosophy encourages just the opposite pattern—streets and adjacent storm sewers are typically located in the natural headwater valleys and swales, thereby replacing natural drainage functions with a completely impervious system. As a result, runoff and pollutants generated from impervious surfaces flow directly into storm sewers with no opportunity for attenuation, infiltration, or filtration. Developments designed to fit site topography also minimizes the amount of grading

on site.

- b. **Protecting Natural Depression Storage Areas.** Depressional storage areas either have no surface outlet or drain very slowly following a storm event. They can be commonly seen as ponded areas in farm fields during the wet season or after large runoff events. Traditional development practices eliminate these depressions by filling or draining, thereby obliterating their ability to reduce surface runoff volumes and trap pollutants. The volume and release rate characteristics of depressions should be protected in the design of the development site. The depressions can be protected by simply avoiding the depression or by incorporating its storage as additional capacity in required detention facilities.

2. **Reduce Impervious Coverage:** See Section 5.7 of the *Pennsylvania Stormwater Best Management Practices Manual, Pennsylvania Department of Environmental Protection (PADEP) no. 363-0300-002 (2006)*.

- a. **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 of runoff.
- b. **Disconnecting Impervious Surfaces (DIA's):** 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. (See Ordinance Appendix F for additional description)
- c. **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.
- d. **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.
- e. **Reducing Building Setbacks.** Reducing building setbacks reduces impervious cover associated with driveway and entry walks and is most readily accomplished along low-traffic streets where traffic noise is not a problem.

3. **Disconnect/Distribute/Decentralize:** See Section 5.8 of the *Pennsylvania Stormwater Best Management Practices Manual, Pennsylvania Department of Environmental Protection (PADEP) no. 363-0300-002 (2006)*.

- a. **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.
 - b. **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.
4. **Cluster and Concentrate:** See Section 5.5 of the *Pennsylvania Stormwater Best Management Practices Manual, Pennsylvania Department of Environmental Protection (PADEP) no. 363-0300-002 (2006)*. Cluster developments can also reduce the amount of impervious area for a given number of lots. The biggest savings occurs with street length, which also will reduce costs of the development. Cluster development “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. Benefits include reduced potential of downstream flooding, water quality improvement of receiving streams/water bodies and enhancement of aesthetics and reduction of development costs. Other benefits include more stable baseflows in receiving streams, improved groundwater recharge, reduced flood flows, reduced pollutant loads, and reduced costs for conveyance and storage.

Stormwater Management Ordinance

APPENDIX F: DISCONNECTED IMPERVIOUS AREA (DIA)

ROOFTOP DISCONNECTION

When rooftop downspouts are directed to a pervious area that allows for infiltration, filtration, and increased time of concentration, the rooftop may qualify as completely or partially DIA and a portion of the impervious rooftop area may be excluded from the calculation of total impervious area.

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

- The contributing area of a rooftop to each disconnected discharge is 500 square feet or less, and
- The soil, in proximity of the roof water discharge area, is not designated as hydrologic soil group "D" or equivalent, and
- The overland flow path from roof water discharge area has a positive slope of 5% or less.

For designs that meet these requirements, the portion of the roof that may be considered disconnected depends on the length of the overland path as designated in Table F.1.

Table F.1: Partial Rooftop Disconnection

Length of Pervious Flow Path *	Roof Area Treated as Disconnected
(ft)	(% of contributing area)
0 – 14	0
15 – 29	20
30 – 44	40
45 – 59	60
60 – 74	80
75 or more	100

* Flow path cannot include impervious surfaces and must be at least 15 feet from any impervious surfaces.

If the discharge is concentrated at one or more discrete points, no more than 1,000 square feet may discharge to any one point. In addition, a gravel strip or other spreading device is required for concentrated discharges. For non-concentrated discharges along the edge of the pavement, this requirement is waived; however, there must be a provision for the establishment of vegetation along the pavement edge and temporary stabilization of the area until vegetation becomes stabilized.

REFERENCE

Philadelphia Water Department. 2006. *Stormwater Management Guidance Manual*. Section 4.2.2: Integrated Site Design. Philadelphia, PA.

Stormwater Management Ordinance

APPENDIX G: HOT SPOTS

Hot spots are sites where the land use or activity produces a higher concentration of trace metals, hydrocarbons, or priority pollutants than normally found in urban runoff.

1. EXAMPLES OF STORMWATER HOT SPOTS

- vehicle salvage yards and recycling facilities
- vehicle fueling stations
- vehicle service and maintenance facilities
- vehicle and equipment cleaning facilities
- fleet storage areas (bus, truck, etc.)
- industrial sites (based on Standard Industrial Codes defined by the U.S. Department of Labor)
- marinas (service and maintenance)
- outdoor liquid container storage
- outdoor loading/unloading facilities
- public works storage areas
- facilities that generate or store hazardous materials
- commercial container nursery
- other land uses and activities as designated by an appropriate review authority

2. LAND USE AND ACTIVITIES NOT NORMALLY CONSIDERED HOT SPOTS

- residential streets and rural highways
- residential development
- institutional development
- office developments
- nonindustrial rooftops
- pervious areas, except golf courses and nurseries (which may need an Integrated Pest Management (IPM) Plan).

3. **LIST OF ACCEPTABLE BMPs for Hot Spot Treatment:** The following BMP's listed under the Best Management Practice column are BMPs appropriate for application on hot spot sites. BMPs which facilitate infiltration are prohibited by this ordinance. In many design manuals the BMPs with a * designation are designed with infiltration, however it is possible to design these without infiltration.

The numbers listed under the Design Reference Number column correlate with the Reference Table which lists materials that can be used for design guidance.

Best Management Practice	Design Reference Number
Bioretention*	4, 5, 11, 16

Capture/Reuse	4, 14
Constructed Wetlands	4, 5, 8, 10, 16
Dry Extended Detention Ponds	4, 5, 8, 12, 18
Minimum Disturbance/ Minimum Maintenance Practices	1, 9
Significant Reduction of Existing Impervious Cover	N/A
Stormwater Filters* (Sand, Peat, Compost, etc.)	4, 5, 10, 16
Vegetated Buffers/Filter Strips	2, 3, 5, 11, 16, 17
Vegetated Roofs	4, 13
Vegetated Swales*	2, 3, 5, 11, 16, 17
Water Quality Inlets (Oil/Water Separators, Sediment Traps/Catch Basin Sumps, and Trash/Debris Collectors in Catch Basins)	4, 7, 15, 16, 19
Wet Detention Ponds	4, 5, 6, 8

Reference Table

Number	Design Reference Title
1	"Conservation Design For Stormwater Management – A Design Approach to Reduce Stormwater Impacts From Land Development and Achieve Multiple Objectives Related to Land Use", Delaware Department of Natural Resources and Environmental Control, The Environmental Management Center of the Brandywine Conservancy, September 1997
2	"A Current Assessment of Urban Best Management Practices: Techniques for Reducing Nonpoint Source Pollution in the Coastal Zone", Schueler, T. R., Kumble, P. and Heraty, M., Metropolitan Washington Council of Governments, 1992.
3	"Design of Roadside Channels with Flexible Linings", Federal Highway Administration, Chen, Y. H. and Cotton, G. K., Hydraulic Engineering Circular 15, FHWA-IP-87-7, McLean, Virginia, 1988.
4	"Draft Stormwater Best Management Practices Manual", Pennsylvania Department of Environmental Protection, January 2005.
5	"Evaluation and Management of Highway Runoff Water Quality", Federal Highway Administration, FHWA-PD-96-032, Washington, D.C., 1996.
6	"Evaporation Maps of the United States", U.S. Weather Bureau (now NOAA/National Weather Service) Technical Paper 37, Published by Department of Commerce, Washington D.C., 1959.
7	"Georgia Stormwater Manual", AMEC Earth and Environmental, Center for Watershed Protection, Debo and Associates, Jordan Jones and Goulding, Atlanta Regional Commission, Atlanta, Georgia, 2001.
8	"Hydraulic Design of Highway Culverts", Federal Highway

	Administration, FHWA HDS 5, Washington, D.C., 1985 (revised May 2005).
9	"Low Impact Development Design Strategies <i>An Integrated Design Approach</i> , Prince Georges County, Maryland Department of Environmental Resources, June 1999.
10	"Maryland Stormwater Design Manual", Maryland Department of the Environment, Baltimore, Maryland, 2000.
11	"Pennsylvania Handbook of Best Management Practices for Developing Areas", Pennsylvania Department of Environmental Protection, 1998.
12	"Recommended Procedures for Act 167 Drainage Plan Design", LVPC, Revised 1997.
13	"Roof Gardens History, Design, and Construction", Osmundson, Theodore. New York: W.W. Norton & Company, 1999.
14	"The Texas Manual on Rainwater Harvesting", Texas Water Development Board, Austin, Texas, Third Edition, 2005.
15	"VDOT Manual of Practice for Stormwater Management", Virginia Transportation Research Council, Charlottesville, Virginia, 2004.
16	"Virginia Stormwater Management Handbook", Virginia Department of Conservation and Recreation, Richmond, Virginia, 1999.
17	"Water Resources Engineering", Mays, L. W., John Wiley & Sons, Inc., 2005.
18	"Urban Hydrology for Small Watersheds", Technical Report 55, US Department of Agriculture, Natural Resources Conservation Service, 1986.
19	US EPA, Region 1 New England web site (as of August 2005) http://www.epa.gov/NE/assistance/ceitts/stormwater/techs/html .

4. **RECOMMENDED PRE-TREATMENT METHODS FOR "HOT SPOT" LAND USES:** The following table recommends what is considered the best pre-treatment option for the listed land use. These methods are either a BMP or can be applied in conjunction with BMPs.

Hot Spot Land Use	Pre-treatment Method(s)
Vehicle Maintenance and Repair Facilities including Auto Parts Stores	-Water Quality Inlets -Use of Drip Pans and/or Dry Sweep Material Under Vehicles/Equipment -Use of Absorbent Devices to Reduce Liquid Releases -Spill Prevention and Response Program
Vehicle Fueling Stations	-Water Quality Inlets -Spill Prevention and Response Program
Storage Areas for Public Works	-Water Quality Inlets -Use of Drip Pans and/or Dry Sweep Material Under Vehicles/Equipment -Use of Absorbent Devices to Reduce Liquid

	Releases -Spill Prevention and Response Program -Diversion of Stormwater away from Potential Contamination Areas
Outdoor Storage of Liquids	-Spill Prevention and Response Program
Commercial Nursery Operations	-Vegetated Swales/Filter Strips -Constructed Wetlands -Stormwater Collection and Reuse
Salvage Yards and Recycling Facilities*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit
Fleet Storage Yards and Vehicle Cleaning Facilities*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit
Facilities that Store or Generate Regulated Substances*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit
Marinas*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit
Certain Industrial Uses (listed under NPDES)*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit

*Regulated under the NPDES Stormwater Program

Stormwater Management Ordinance

APPENDIX H: WEST NILE VIRUS GUIDANCE

(This source is from the Monroe County, PA Conservation District, who researched the potential of West Nile Virus problems from BMPs due to a number of calls they were receiving.)

Monroe County Conservation District Guidance: Stormwater Management and West Nile Virus

Source: Brodhead McMichaels Creeks Watershed Act 167 Stormwater Management Ordinance Final Draft 2/23/04

The Monroe County Conservation District recognizes the need to address the problem of nonpoint source pollution impacts caused by runoff from impervious surfaces. The new stormwater policy being integrated into Act 167 Stormwater Management regulations by the PA Department of Environmental Protection (PADEP) will make nonpoint pollution controls an important component of all future plans and updates to existing plans. In addition, to meet post-construction anti-degradation standards under the state National Pollution Discharge Elimination System (NPDES) permitting program, applicants will be required to employ Best Management Practices (BMPs) to address non-point pollution concerns.

Studies conducted throughout the United States have shown that wet basins and in particular constructed wetlands are effective in traditional stormwater management areas such as channel stability and flood control, and are one of the most effective ways to remove stormwater pollutants (United States Environmental Protection Agency 1991, Center for Watershed Protection 2000). From Maryland to Oregon, studies have shown that as urbanization and impervious surface increase in a watershed, the streams in those watersheds become degraded (CWP 2000). Although there is debate over the threshold of impervious cover when degradation becomes apparent (some studies show as little as 6% while others show closer to 20%), there is agreement that impervious surfaces cause non-point pollution in urban and urbanizing watersheds, and that degradation is ensured if stormwater BMPs are not implemented.

Although constructed wetlands and ponds are desirable from a water quality perspective there may be concerns about the possibility of these stormwater management structures becoming breeding grounds for mosquitoes. The Conservation District feels that although it may be a valid concern, **municipalities should not adopt ordinance provisions prohibiting wet basins for stormwater management.**

Mosquitoes

The questions surrounding mosquito production in wetlands and ponds have intensified in recent years by the outbreak of the mosquito-borne West Nile Virus. As is the case with all vector-borne maladies, the life cycle of West Nile Virus is complicated, traveling from mosquito to bird, back to mosquito and then to other animals including humans. *Culex pipiens* was identified as the vector species in the first documented cases from New York in 1999. This species is still considered the primary transmitter of the disease across its range. Today there are some 60 species of mosquitoes

that inhabit Pennsylvania. Along with *C. pipiens*, three other species have been identified as vectors of West Nile Virus while four more have been identified as potential vectors.

The four known vectors in NE Pennsylvania are *Culex pipiens*, *C. restuans*, *C. salinarius* and *Ochlerotatus japonicus*. All four of these species prefer, and almost exclusively use, artificial containers (old tires, rain gutters, birdbaths, etc.) as larval habitats. In the case of *C. pipiens*, the most notorious of the vector mosquitoes, the dirtier the water the better they like it. The important factor is that these species do not thrive in functioning wetlands where competition for resources and predation by larger aquatic and terrestrial organisms is high.

The remaining four species, *Aedes vexans*, *Ochlerotatus Canadensis*, *O. triseriatus* and *O. trivittatus* are currently considered potential vectors due to laboratory tests (except the *O. trivittatus*, which did have one confirmed vector pool for West Nile Virus in PA during 2002). All four of these species prefer vernal habitats and ponded woodland areas following heavy summer rains. These species may be the greatest threat of disease transmission around stormwater basins that pond water for more than four days. This can be mitigated however by establishing ecologically functioning wetlands.

Stormwater Facilities

If a stormwater wetland or pond is constructed properly and a diverse ecological community develops, mosquitoes should not become a problem. Wet basins and wetlands constructed as stormwater management facilities, should be designed to attract a diverse wildlife community. If a wetland is planned, proper hydrologic soil conditions and the establishment of hydrophytic vegetation will promote the population of the wetland by amphibians and other mosquito predators. In natural wetlands, predatory insects and amphibians are effective at keeping mosquito populations in check during the larval stage of development while birds and bats prey on adult mosquitoes.

The design of a stormwater wetland must include the selection of hydrophytic plant species for their pollutant uptake capabilities and for not contributing to the potential for vector mosquito breeding. In particular, species of emergent vegetation with little submerged growth are preferable. By limiting the vegetation growing below the water surface, larvae lose protective cover and there is less chance of anaerobic conditions occurring in the water.

Stormwater ponds can be designed for multiple purposes. When incorporated into an open space design a pond can serve as a stormwater management facility and a community amenity. Aeration fountains and stocked fish should be added to keep larval mosquito populations in check.

Publications from the PA Department of Health and the Penn State Cooperative Extension concerning West Nile Virus identify aggressive public education about the risks posed by standing water in artificial containers (tires, trash cans, rain gutters, bird baths) as the most effective method to control vector mosquitoes.

Conclusion

The Conservation District understands the pressure faced by municipalities when dealing with multifaceted issues such as stormwater management and encourages the incorporation of water quality management techniques into stormwater designs. As Bucks and Montgomery Counties

continue to grow, conservation design, groundwater recharge and constructed wetlands and ponds should be among the preferred design options to reduce the impacts of increases in impervious surfaces. When designed and constructed appropriately, the runoff mitigation benefits to the community from these design options will far out-weigh their potential to become breeding grounds for mosquitoes.

Stormwater Management Ordinance

APPENDIX I: SMALL PROJECT STORMWATER MANAGEMENT (SWM) SITE PLAN

This Small Project SWM Site Plan is included as an option for municipalities to adopt to give small regulated activities the opportunity to submit a non-engineered stormwater management plan. The requirements of this site plan alternative are consistent with the volume control requirements of the *Neshaminy Creek Watershed Stormwater Management Plan (SMP)*. The Bucks and Montgomery County Planning Commissions recommend that this site plan be applied only to residential development activities proposing less than or equal to 5,000 square feet of impervious surface and less than 1 acre of earth disturbance. These recommendations are the result of a multi-municipal roundtable discussion and guidance from PADEP and the Bucks and Montgomery County Conservation Districts. The following table is an example of how the exemption criteria of the Neshaminy Creek Watershed SMP Model Ordinance could change as the result of adopting this site plan alternative into the municipal stormwater management regulations.

Ordinance Article or Section	Type of Project	Proposed Impervious Surface		
		0 – 1,000 sq. ft.	1,001 – 5,000 sq. ft.	5,000 + sq. ft.
Article IV SWM Site Plan Requirements	All Development	Exempt	Not Exempt (except residential activity)	Not Exempt
Non-Engineered Small Project Site Plan	Only Residential Development Applicable	Exempt	Not Exempt	Not Applicable
Section 303 Volume Control Requirements	All Development	Not Applicable	Not Exempt	Not Exempt
Section 304 Peak Rate Control Requirements	All Development	Exempt	Exempt	Not Exempt
Erosion and Sediment Pollution Control Requirements	Must comply with Title 25, Chapter 102 of the PA Code and any other applicable state, county and municipal codes. PADEP requires an engineered post-construction SWM Plan with projects proposing earth disturbance greater than 1 acre.			

Small Project Stormwater Management Site Plan

This small project stormwater site plan has been developed to assist those proposing residential projects to meet the requirements of the *Neshaminy Creek Watershed Stormwater Management Plan* Model Ordinance without having to hire professional services to draft a formal stormwater management plan. This small project site plan is only permitted for residential projects proposing less than or equal to 5,000 square feet of impervious surface and less than 1 acre of earth disturbance.

A. What is an applicant required to submit?

A brief description of the proposed stormwater facilities, including types of materials to be used, total square footage of proposed impervious areas, volume calculations, and a simple sketch plan showing the following information:

- Location of proposed structures, driveways, or other paved areas with approximate surface area in square feet.
- Location of any existing or proposed onsite septic system and/or potable water wells showing proximity to infiltration facilities.
- Bucks or Montgomery County Conservation District erosion and sediment control "Adequacy" letter as required by Municipal, County or State regulations.

B. Determination of Required Volume Control and Sizing Stormwater Facilities

By following the simple steps outlined below in the provided example, an applicant can determine the runoff volume that is required to be controlled and how to choose the appropriate stormwater facility to permanently remove the runoff volume from the site. Impervious area calculations must include all areas on the lot proposed to be covered by roof area or pavement which would prevent rain from naturally percolating into the ground, including impervious surfaces such as sidewalks, driveways, parking areas, patios or swimming pools. Sidewalks, driveways or patios that are designed and constructed to allow for infiltration are not included in this calculation.

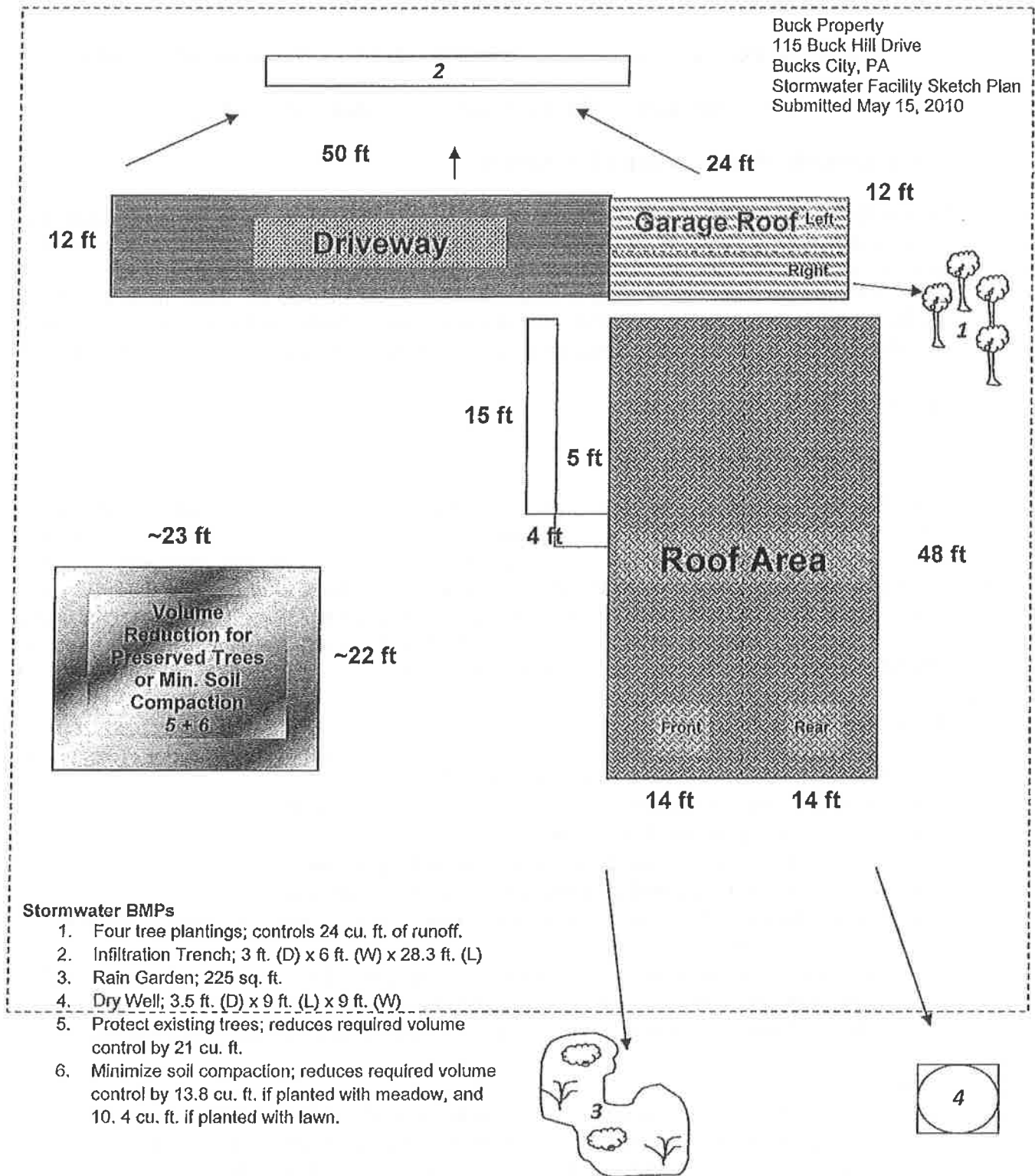
Site Plan Example: Controlling runoff volume from a proposed home site

Step 1: Determine Total Impervious Surfaces

Impervious Surface		Area (sq. ft.)
House Roof (Front)	14 ft. x 48 ft. =	672 sq. ft.
House Roof (Rear)	14 ft. x 48 ft. =	672 sq. ft.
Garage Roof (Left)	6ft. x 24 ft. =	144 sq. ft.
Garage Roof (Right)	6 ft. x 24 ft. =	144 sq. ft.
Driveway	12 ft. x 50 ft. =	1000 sq. ft.
Walkway	4 ft. x 20 ft. =	80 sq. ft.

	Total Impervious	3000 sq ft

Figure 1: Sample Site Sketch Plan



Stormwater BMPs

1. Four tree plantings; controls 24 cu. ft. of runoff.
2. Infiltration Trench; 3 ft. (D) x 6 ft. (W) x 28.3 ft. (L)
3. Rain Garden; 225 sq. ft.
4. Dry Well; 3.5 ft. (D) x 9 ft. (L) x 9 ft. (W)
5. Protect existing trees; reduces required volume control by 21 cu. ft.
6. Minimize soil compaction; reduces required volume control by 13.8 cu. ft. if planted with meadow, and 10.4 cu. ft. if planted with lawn.

Step 2: Determine Required Volume Control (cubic feet) using the following equation:

$$\text{Volume (cu. ft.)} = (\text{Total impervious area in square feet} \times 2 \text{ inches of runoff}) / 12 \text{ inches}$$
$$(3,000 \text{ sq. ft.} \times 2 \text{ inches of runoff}) / 12 \text{ inches} = 500 \text{ cu. ft.}$$

Step 3: Sizing the Selected Volume Control BMP

Several Best Management Practices (BMPs), as described below, are suitable for small stormwater management projects. However, their application depends on the volume required to be controlled, how much land is available, and the site constraints. Proposed residential development activities can apply both non-structural and structural BMPs to control the volume of runoff from the site. A number of different volume control BMPs are described below. Note that Figure 1 is an example of how these BMPs can be utilized in conjunction to control the total required volume on one site.

Structural BMPs

1. Infiltration Trench

An Infiltration Trench is a linear stormwater BMP consisting of a continuously perforated pipe at a minimum slope in a stone-filled trench. During small storm events, infiltration trenches can significantly reduce volume and serve in the removal of fine sediments and pollutants. Runoff is stored between the stones and infiltrates through the bottom of the facility and into the soil matrix. Runoff should be pretreated using vegetative buffer strips or swales to limit the amount of coarse sediment entering the trench which can clog and render the trench ineffective. In all cases, an infiltration trench should be designed with a positive overflow.

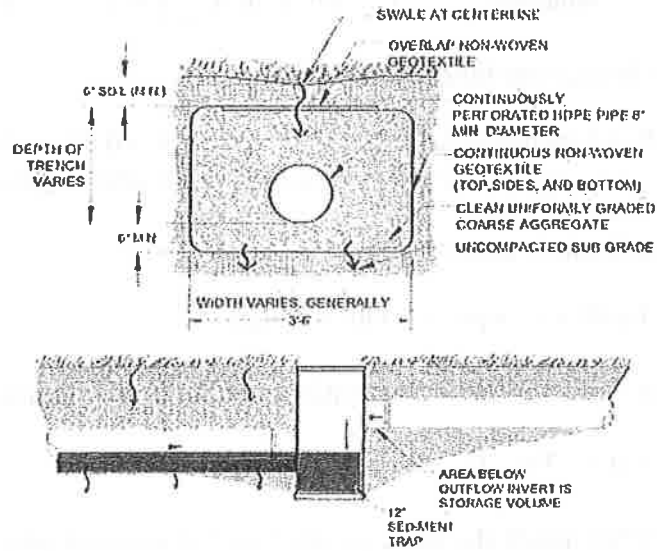
Design Considerations:

- Although the width and depth can vary, it is recommended that Infiltration Trenches be limited in depth to not more than six (6) feet of stone.
- Trench is wrapped in nonwoven geotextile (top, sides, and bottom).
- Trench needs to be placed on uncompacted soils.
- Slope of the Trench bottom should be level or with a slope no greater than 1%.
- A minimum of 6" of topsoil is placed over trench and vegetated.
- The discharge or overflow from the Infiltration Trench should be properly designed for anticipated flows.
- Cleanouts or inlets should be installed at both ends of the Infiltration Trench and at appropriate intervals to allow access to the perforated pipe.
- Volume of facility = Depth x Width x Length x Void Space of the gravel bed (assume 40%).

Maintenance:

- Catch basins and inlets should be inspected and cleaned at least two times a year.
- The vegetation along the surface of the infiltration trench should be maintained in good condition and any bare spots should be re-vegetated as soon as possible.
- Vehicles should not be parked or driven on the trench and care should be taken to avoid soil compaction by lawn mowers.

Figure 3: Infiltration Trench Diagram



Source: PA BMP Guidance Manual, Chapter 6, page 42.

Figure 4: Example of Infiltration Trench Installation



Source: PA BMP Guidance Manual, Chapter 6, Page 46.

Sizing Example for Infiltration Trench

1. Determine Total Impervious Surface to drain to Infiltration Trench:

Garage Roof (Left)	6 ft. x 24 ft.	=	144 sq ft
Driveway	12 ft. x 50 ft.	=	1000 sq ft
Walkway	4 ft. x 20 ft.	=	80 sq ft

2. Determine the required infiltration volume:

$$(1224 \text{ sq. ft.} \times 2 \text{ inches of runoff}) / 12 \text{ ft.} = 204 \text{ cu. ft.} / 0.4^* = 510 \text{ cu. ft.}$$

(*0.4 assumes 40% void ratio in gravel bed)

3. Sizing the infiltration trench facility:

$$\text{Volume of Facility} = \text{Depth} \times \text{Width} \times \text{Length}$$

Set Depth to 3 feet and determine required surface area of trench.

$$510 \text{ cu. ft.} / 3 \text{ ft} = 170 \text{ sq ft.}$$

The width of the trench should be greater than 2 times its depth (2 x D), therefore in this example the trench width of 6 feet selected.

$$\text{Determine trench length: } L = 170 \text{ sq. ft.} / 6 \text{ ft.} = 28.3 \text{ ft.}$$

Final infiltration trench dimensions: 3 ft. (D) x 6 ft. (W) x 28.3 ft. (L)

2. Rain Garden

A Rain Garden is a planted shallow depression designed to catch and filter rainfall runoff. The garden captures rain from a downspout or a paved surface. The water sinks into the ground, aided by deep rooted plants that like both wet and dry conditions. The ideal location for a rain garden is between the source of runoff (roofs and driveways) and the runoff destination (drains, stream, low spots, etc).

Design Considerations:

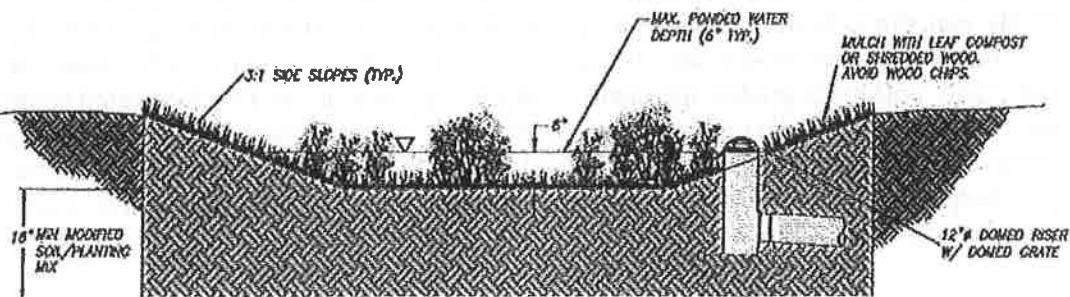
- A maximum of 3:1 side slope is recommended.
- The depth of a rain garden can range from 6 - 8 inches. Pondered water should not exceed 6 inches.
- The rain garden should drain within 72 hours.
- The garden should be at least 10-20 feet from a building's foundation and 25 feet from septic system drainfields and wellheads.
- If the site has clay soils, soil should be amended with compost or organic material.
- Choose native plants. See http://pa.audubon.org/habitat/PDFs/RGBrochure_complete.pdf for a native plant list. To find native plant sources go to www.pawildflower.org.

- At the rain garden location, the water table should be at least 2' below the soil level. If water stands in an area for more than one day after a heavy rain you can assume it has a higher water table and is not a good choice for a rain garden.

Maintenance:

- Water plants regularly until they become established.
- Inspect twice a year for sediment buildup, erosion and vegetative conditions.
- Mulch with hardwood when erosion is evident and replenish annually.
- Prune and remove dead vegetation in the spring season.
- Weed as you would any garden.
- Move plants around if some plants would grow better in the drier or wetter parts of the garden.

Figure 5: Rain Garden Diagram



Source: PA BMP Guidance Manual, Chapter 6 Page 50

Sizing Example for Rain Garden

1. Pick a site for the rain garden between the source of runoff and between a low lying area, a.k.a., a drainage area.
2. Perform an infiltration test to determine the depth of the rain garden:
 - Dig a hole 8" x 8"
 - Fill with water and put a popsicle stick at the top of the water level.
 - Measure how far it drains down after a few hours (ideally 4).
 - Calculate the depth of water that will drain out over 24 hours.
3. Determine total impervious surface area to drain to rain garden:

House Roof (Front)	14 ft. x 48 ft.	=	672 sq ft
--------------------	-----------------	---	-----------

4. Sizing the rain garden:

For this example the infiltration test determined 6" of water drained out of a hole in 24 hours. The depth of the rain garden should be set to the results of the infiltration test so 6"

is the depth of the rain garden. The sizing calculation below is based on controlling 1" of runoff. First divide the impervious surface by the depth of the rain garden.

$$(672 \text{ sq ft} / 6 \text{ ft.}) = 112 \text{ sq. ft.}$$

In order to control 2" of runoff volume, the rain garden area needs to be multiplied by 2.

$$112 \text{ sq. ft.} * 2 = 224 \text{ sq. ft.}$$

The rain garden should be about 225 sq. ft. in size and 6" deep.

3. Dry Well (a.k.a., Seepage Pit)

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. By capturing runoff at the source, Dry Wells can dramatically reduce the increased volume of stormwater generated by 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 a larger infiltration area, etc.) will ensure that additional runoff is safely conveyed downstream.

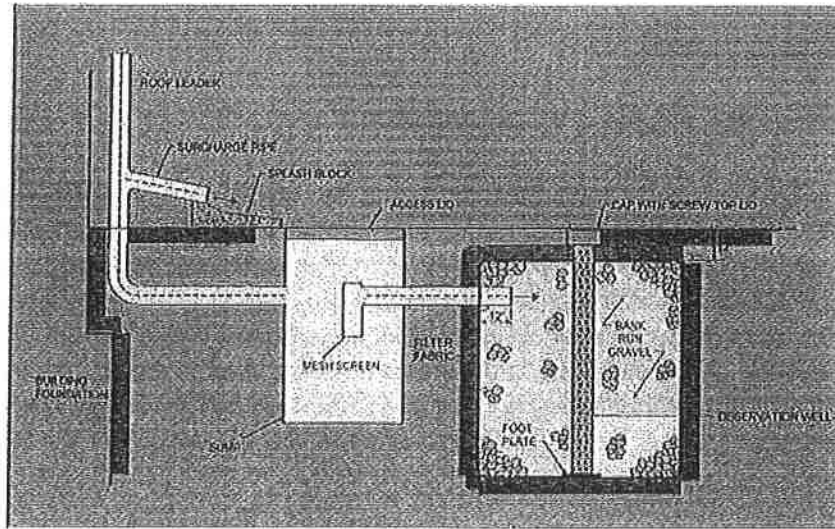
Design Considerations:

- Dry Wells typically consist of 18 to 48 inches of clean washed, uniformly graded aggregate with 40% void capacity (AASHTO No. 3, or similar). "Clean" gravel fill should average one and one-half to three (1.5 – 3.0) inches in diameter.
- Dry Wells are not recommended when their installation would create a significant risk for basement seepage or flooding. In general, 10 - 20 feet of separation is recommended between Dry Wells and building foundations.
- The facility may be either a structural prefabricated chamber or an excavated pit filled with aggregate.
- Depth of dry wells in excess of three-and-a-half (3.5) feet should be avoided unless warranted by soil conditions.
- Stormwater dry wells must never be combined with existing, rehabilitated, or new septic system seepage pits. Discharge of sewage to stormwater dry wells is strictly prohibited.

Maintenance:

- Dry wells should be inspected at least four (4) times annually as well as after large storm events.
- Remove sediment, debris/trash, and any other waste material from a dry well.
- Regularly clean out gutters and ensure proper connections to the dry well.
- Replace the filter screen that intercepts the roof runoff as necessary.

Figure 6: Dry Well Diagram



Source: PA BMP Guidance Manual, Chapter 6, Page 65.

Sizing Example for Dry Wells:

1. Determine contributing impervious surface area:

House Roof (Rear)	14 ft. x 48 ft.	=	672 sq. ft.
-------------------	-----------------	---	-------------

2. Determine required volume control:

$$(672 \text{ sq. ft.} * 2 \text{ inches of runoff}) / 12 \text{ inches} = 112 \text{ cu. ft.}$$

$$112 \text{ cu ft} / 0.4 = 280 \text{ cu. ft. (assuming the 40% void ratio in the gravel bed)}$$

3. Sizing the dry well:

Set depth to 3.5 ft; Set width equal to length for a square chamber.

$$280 \text{ cu. ft.} = 3.5 \text{ ft.} \times L \times L; L = 9 \text{ ft.}$$

$$\text{Dimensions} = 3.5 \text{ ft. (D)} \times 9 \text{ ft. (L)} \times 9 \text{ ft. (W)}$$

Non-Structural BMPs

1. Tree Plantings and Preservation

Trees and forests reduce stormwater runoff by capturing and storing rainfall in the canopy and releasing water into the atmosphere through evapotranspiration. Tree roots and leaf litter also create soil conditions that promote the infiltration of rainwater into the soil. In addition, trees and forests reduce pollutants by taking up nutrients and other pollutants from soils and water through their root systems. A development site can reduce runoff volume by planting new trees or by preserving trees which existed on the site prior to development. The volume reduction calculations either determine the cubic feet to be directed to the area under the tree canopy for infiltration or determine a volume reduction credit which can be used to reduce the size of any one of the planned structural BMPs on the site.

Tree Considerations:

- Existing trees must have at least a 4" trunk caliper or larger.
- Existing tree canopy must be within 100 ft. of impervious surfaces.
- A tree canopy is classified as the continuous cover of branches and foliage formed by a single tree or collectively by the crowns of adjacent trees.
- New tree plantings must be at least 6 ft. in height and have a 2" trunk caliper.
- All existing and newly planted trees must be native to Pennsylvania. See <http://www.dcnr.state.pa.us/forestry/commontr/commontrees.pdf> for a guide book titled *Common Trees of Pennsylvania* for a native tree list.
- When using trees as volume control BMPs, runoff from impervious areas should be directed to drain under the tree canopy.

Determining the required number of planted trees to reduce the runoff volume:

1. Determine contributing impervious surface area:

Garage Roof (Right)	6 ft. x 24 ft.	=	144	Sq ft
---------------------	----------------	---	-----	-------

2. Calculate the required control volume:

$$(144 \text{ sq. ft.} \times 2 \text{ inches of runoff}) / 12 \text{ inches} = 24 \text{ cu. ft.}$$

3. Determine the number of tree plantings:

- A newly planted deciduous tree can reduce runoff volume by 6 cu. ft.
- A newly planted evergreen tree can reduce runoff volume by 10 cu. ft.

$$24 \text{ cu. ft.} / 6 \text{ cu. ft.} = 4 \text{ Deciduous Trees}$$

Determining the volume reduction for preserving existing trees:

1. Calculate approximate area of the existing tree canopy:

~22 sq. ft. x ~23 sq. ft = 500 sq. ft.

2. Measure distance from impervious surface to tree canopy: 35 ft.
3. Calculate the volume reduction credit by preserving existing trees:

- For Trees within 20 feet of impervious cover:
Volume Reduction cu. ft. = (Existing Tree Canopy sq. ft. x 1 inch) / 12
- For Trees beyond 20 feet but not farther than 100 feet from impervious cover:
Volume Reduction cu. ft. = (Existing Tree Canopy sq. ft. x 0.5 inch) / 12

$$(500 \text{ sq. ft.} \times 0.5 \text{ inches}) / 12 = 21 \text{ cu. ft.}$$

This volume credit can be utilized in reducing the size of any one of the structural BMPs planned on the site. For example, the 21 cu. ft. could be subtracted from the required infiltration volume when sizing the infiltration trench;

$$510 \text{ cu. ft.} - 21 \text{ cu. ft.} = 489 \text{ cu. ft.}$$

$$489 \text{ cu. ft.} / 3 \text{ ft (Depth)} = 163 / 6 \text{ ft. (Width)} = 27.1 \text{ ft (Length)}$$

Using the existing trees for a volume credit would decrease the length of the infiltration trench to 27.1 ft. instead of 28.3 ft.

2. Minimize Soil Compaction and Replant with Lawn or Meadow

When soil is overly compacted during construction it can cause a drastic reduction in the permeability of the soil and rarely is the soil profile completely restored. Runoff from vegetative areas with highly compacted soils similarly resembles runoff from an impervious surface. Minimizing soil compaction and re-planting with a vegetative cover like meadow or lawn, not only increases the infiltration on the site, but also creates a friendly habitat for a variety of wildlife species.

Design Considerations:

- Area shall not be stripped of topsoil.
- Vehicle movement, storage, or equipment/material lay down shall not be permitted in areas preserved for minimum soil compaction.
- The use of soil amendments and additional topsoil is permitted.
- Meadow should be planted with native grasses. Refer to *Meadows and Prairies: Wildlife-Friendly Alternatives to Lawn* at <http://pubs.cas.psu.edu/FreePubs/pdfs/UH128.pdf> for reference on how to properly plant the meadow and for a list of native species.

Determining the volume reduction by minimizing soil compaction and planting a meadow:

1. Calculate approximate area of preserved meadow:

$$\sim 22 \text{ sq. ft.} \times \sim 23 \text{ sq. ft.} = 500 \text{ sq. ft.}$$

2. Calculate the volume reduction credit by minimizing the soil compaction and planting a lawn/meadow:

- For Meadow Areas: Volume Reduction (cu. ft.) = (Area of Min. Soil Compaction (sq. ft.) x 1/3 inch of runoff) / 12

$$(500 \text{ sq. ft.} \times 1/3 \text{ inch of runoff}) / 12 = 13.8 \text{ cu. ft.}$$

- For Lawn Areas: Volume Reduction (cu. ft.) = (Area of Min. Soil Compaction (sq. ft.) x 1/4 inch of runoff) / 12

$$(500 \text{ sq. ft.} \times 1/4 \text{ inch of runoff}) / 12 = 10.4 \text{ cu. ft.}$$

This volume credit can be used to reduce the size of any one of the structural BMPs on the site. See explanation under the volume credit for preserving existing trees for details.

Alternative BMP to Capture and Reuse Stormwater

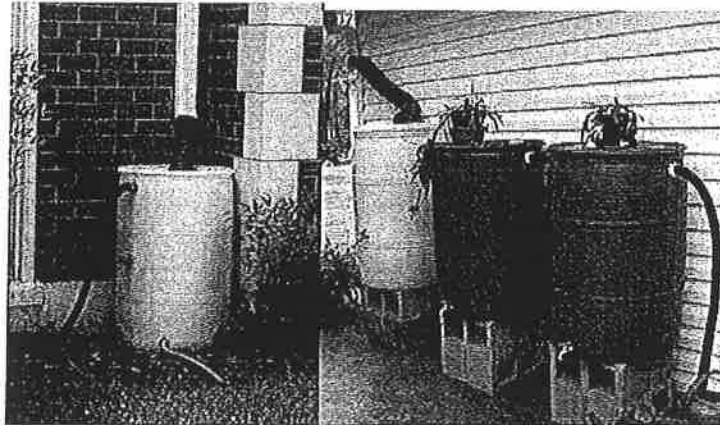
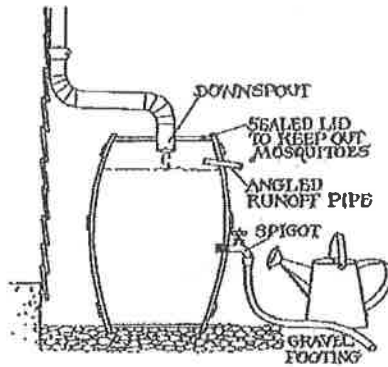
Rain Barrels

Rain barrels are large containers that collect drainage from roof leaders and temporarily store water to be released to lawns, gardens, and other landscaped areas after the rainfall has ended. Rain barrels are typically between 50 and 200 gallons in size. It is not recommended for rain barrels to be used as a volume control BMP because infiltration is not guaranteed after each storm event. For this reason, a rain barrel is not utilized in the site plan example. However, the information is included to provide an alternative for a homeowner to utilize when considering capture and reuse stormwater methods.

Design Considerations:

- Rain barrels should be directly connected to the roof gutter/spout.
- There must be a means to release the water stored between storm events to provide the necessary storage volume for the next storm.
- When calculating rain barrel size, rain barrels are typically assumed to be 25% full because they are not always emptied before the next storm.
- Use screens to filter debris and cover lids to prevent mosquitoes.
- An overflow outlet should be placed a few inches below the top with an overflow pipe to divert flow away from structures.
- It is possible to use a number of rain barrels jointly for an area.

Figure 2: Rain Barrel Diagram and Examples



Sources: (top picture) <http://www.citywindsor.ca/DisplayAttach.asp?AttachID=12348>
 (bottom picture on left) <http://repurposinglife.blogspot.com/2009/05/rainwater-harvesting.html>
 (bottom picture on right) <http://www.floridata.com/tracks/transplantedgardener/Rainbarrels.cfm>

Sizing Example for a Rain Barrel

1. Determine contributing impervious surface area:

Garage Roof (Right)	6 ft. x 24 ft.	=	144 sq ft
---------------------	----------------	---	-----------

2. Determine the amount of rainfall to be captured by the Rain Barrel. A smaller storm, no more than 2", is recommended to calculate the runoff to be captured. This example chose the 1" storm event.
3. Calculate the volume to be captured and reused:
 $(144 \text{ sq. ft.} \times 1 \text{ inch of runoff}) / 12 \text{ inches} = 12 \text{ cu. ft.}$
4. Size the rain barrel:
 $1 \text{ cu. ft.} = 7.48 \text{ gallons}$
 $12 \text{ cu. ft.} \times 7.48 = 90 \text{ gallons}$

90 gallons x (0.25*) = 22.5 gallons (*assuming that the rain barrel is always at least 25% full)

90 gallons + 22.5 gallons = 112 gallons

The rain barrel or barrels should be large enough hold at least 112 gallons of water.

REFERENCES:

Center for Watershed Protection and US Forest Service. (2008). *Watershed Forestry Resource Guide*. Retrieved on May 26, 2010 from <http://www.forestsforwatersheds.org/reduce-stormwater/>.

Department of Environmental Protection. (2006). *Pennsylvania Stormwater Best Management Practices Manual*.

Wissahickon Watershed Partnership. *Pennsylvania Rain Garden Guide*. Retrieved on May 4, 2010 from http://pa.audubon.org/habitat/PDFs/RGBrochure_complete.pdf.

Building a Backyard Rain Garden. North Carolina Cooperative Extension. Retrieved on May 4, 2010 from <http://www.bae.ncsu.edu/topic/raingarden/Building.htm>

Delaware County Planning Commission. (2010). *Draft Crum Creek Watershed Act 167 Stormwater Management Plan. Ordinance Appendix B. Simplified Approach to Stormwater Management for Small Projects*.

Solebury Township. (2008). *Solebury Township Stormwater Management Ordinance. "Appendix J Simplified Stormwater Management Procedures for Existing Single Family Dwelling Lots"*

Stormwater Management Ordinance

APPENDIX J: Fee-In-Lieu-Of Option

The Fee-In-Lieu-Of (FILO) Option was prepared to address municipal concerns regarding the economic impact of the Plan to residents who wish to undertake a small project involving a minimal amount of impervious surface. At the same time, the Pennsylvania Department of Environmental Protection (DEP) requires that water quality in receiving streams must be protected during and after construction from sediment that may originate on the project site. The FILO Option outlined here is the result of several drafts reviewed over several meetings between a Borough of Hatfield, Bucks and Montgomery County staff, and with input from DEP. The FILO has been developed for relatively unique conditions, and is justified for small projects based on the number and distribution of storm basins in the Borough of Hatfield, existing municipal stormwater policy and programs, and the proposal to establish a capital fund for stormwater facilities improvements separate from the standard maintenance budget. These points are outlined below.

Montgomery Township worked with the two counties in developing the FILO option. Using Montgomery Township, The justification and process for implementing the FILO is provided here:

Montgomery Township Example

Number and Distribution of Basins

Montgomery Township is unique among municipalities in that the great majority of development in the part of the township within the Neshaminy watershed has occurred since the early 1990s, when stormwater regulations requiring volume control were in place. There are 61 basins owned by the township, and many more private basins. The number and distribution of the basins is such that runoff from existing residential development (where small projects would occur) is intercepted by a basin before it reaches the creek (see attached map). These basins would provide water quality protection and enhancement benefits to the Neshaminy creek during and after installation of a small project.

There are a few areas of the township where stormwater conveyance and basins are present, but not as numerous. These, however, are in the lowest density zoning districts (½ to 1 acre lots). There are a few basins in these areas, and the remainder of the stormwater travels as overland flow for a considerable distance before reaching part of the Neshaminy Creek. Between the benefits of retention in the basins and the filtering and infiltration aspects overland flow, water quality in the Neshaminy/Little Neshaminy should be protected from any relatively small amount of sediment that might originate from a small project.

Township Basin Naturalization Policy

The township developed and implemented a policy for its basins in 2009 that allows the basins to naturalize. In each basin to be naturalized, the township maintains a clear access for inlet and outlet structures. Some basins have naturalized on their own. Others, at the recommendation to the Board of Supervisors by the Shade Tree Commission and Boucher and James, Landscape Engineer, have been naturalized by the township. Education and promotion is part of the naturalization effort, to stress the water quality and habitat benefits of naturalization. After the first year the naturalized basin is evaluated, and additional action is taken if needed.

Stormwater BMP Capital Fund

The township is prepared to make improvements and implement stormwater BMPs through its fee in lieu of (FILO) program. Maintenance, including sediment removal, is conducted regularly, and is paid for through a separate budget. Through the FILO, the township envisions a capital fund for stormwater BMP implementation. The funds gathered through the FILO would be a distinct fund, separate from the maintenance fund.

FILO Criteria

The proposed FILO does not supersede requirements for erosion and sediment control. Also the township's MS4 program includes street sweeping and tree planting, which reduce sediment in stormwater. These factors emphasize that water quality will not be degraded by the implementation of the FILO option.

The FILO option has been developed jointly by Montgomery Township, Montgomery County, and Bucks County, with periodic input from PADEP. The FILO option, including the Criteria for Determining If the Fee-In-Lieu-Of Option can be Adopted by a Borough of Hatfield and the text of the Fee-In-Lieu Of Option, has been added to the appendix of the Neshaminy Creek Watershed Stormwater Management Plan, where the small projects option is located. It is available to any Borough of Hatfield in the watershed. However, the specific criteria listed below would have to be met before a Borough of Hatfield could employ the FILO. The criteria have been developed to ensure that water quality is protected during and after construction of the small project.

Criteria for Determining If the Fee-In-Lieu-Of Option can be Adopted by a Borough of Hatfield:

- **The basins must be municipally owned, or subject to perpetual easement and/or deed restrictions, to facilitate regular maintenance and to ensure access to the basin for naturalization or installation of other BMPs.**
- The basins must provide complete or very nearly complete coverage of the watershed, in terms of stormwater management. Additional BMPs may be used to achieve more complete coverage.
- A municipal program for implementation of BMPs and basin improvements must be developed and adopted by the Borough of Hatfield prior to adoption of the FILO option.
- The applicant may use the FILO option only after approval of the (Board of Supervisors, Borough Council) is obtained.

The following text may be added to the Neshaminy Creek Watershed Stormwater Management Plan, should the Borough of Hatfield wish to provide the FILO option.

Fee-In-Lieu Of Alternative for Small Projects.

- (1) In order to address flooding and erosion problems found in the Neshaminy Creek watershed in BOROUGH OF HATFIELD, applicants proposing a small project, as defined in the

Neshaminy Creek Watershed Stormwater Management Plan, may pay a fee-in-lieu of stormwater conveyance/detention/storage facilities as an alternative to the construction of stormwater conveyance/detention/storage facilities, with the approval of the (Board of Supervisors, Borough Council). When fees are offered by an applicant, the Borough of Hatfield may, but shall not be required to, accept the fees, provided that the proposed stormwater solution meets the requirements in (stormwater ordinance reference).

- (2) These fees shall be used to construct or make improvements to stormwater facilities that are either municipally-owned or have a perpetual easement or deed restriction that would ensure access, and that are located in the Borough of Hatfield within the same watershed as the project paying the fee. Additionally, such fees may be used for the acquisition of land and rights-of-way, engineering, legal and planning costs and all other costs, including debt service, related to the construction or improvement of necessary stormwater control facilities.

Applicability

- (1) In order to ensure that water quality protection and stormwater management is provided during and after the construction of the proposed activity, the FILO alternative shall be available where the following conditions apply:
 - a. The proposed activity is located in a residential zoning district.
 - b. The project site is located in a watershed for which an Act 167 stormwater management plan has been prepared by the county and approved by PADEP.
- (2) In addition to the criteria in 1(A), the project site must meet at least one of the following two criteria:
 - a. The project site is located in a subdivision that is served by storm sewers discharging to a stormwater basin or other stormwater management facility which infiltrates, evaporates or detains stormwater for a period of time prior to discharge, or
 - b. The following conditions exist on the site, in the opinion of the municipal engineer:
 1. The surface conditions on the site will encourage overland sheet flow of stormwater, as opposed to concentrated flow, and
 2. The project site is located at a sufficient distance from the receiving stream such that runoff from the project will be filtered by vegetation and given opportunity to infiltrate as it flows across the land to the stream.

Fees

- (1) Applicants shall pay the following fees-in-lieu of stormwater facilities:
 - a. Fees-in-lieu of stormwater detention/storage facilities on a single-family dwelling lot shall be based on the cubic feet of required storage capacity generated by the entire area of the proposed impervious surface, when that area is greater than 1000 square feet and less than 5,000 square feet, in accordance with (municipal ordinance reference). Such fee shall be established and updated periodically by resolution of the (Board of Supervisors, Borough Council) and shall be based on an average cost of providing stormwater control facilities per cubic foot of storage capacity.
 - b. Fees collected by the Borough of Hatfield shall be deposited in an interest-bearing account in a bank authorized to receive deposits of municipal funds. Interest earned by the account shall be credited to that account and shall be used for the same purposes as money deposited in the account.

c. Fee-in-lieu payments shall be collected when the land development agreement is finalized or, if no land development agreement is required, before final permits are issued.

Fee-in-lieu credit

- (1) Each cubic foot of stormwater storage capacity compensated by a fee-in-lieu payment shall be credited as the actual construction of this stormwater storage when sites are proposed for development in the future.

Stormwater Management Ordinance

APPENDIX K: REFERENCES

Articles / Books

- DeBarry, P.A., Yang, E., Traver, R. G., Newman, B., *Determination of Appropriate Infiltration Requirements For Land Development Using the Water Budget Approach – the Darby – Cobbs Experience.*
- Low, D.J., Hippie, D.J., Yannacci, D. (2002). *Geohydrology of Southeastern Pennsylvania.* Water-Resources Investigations Report 00-4166.
- Jarrett, A.R. (1995). *Water Management.* Dubuque, Iowa. Kendall/Hunt Publishing Co.
- Olmsted, F. H. & Hely, A.G. (1962). *Relation between Ground Water and Surface Water in Brandywine Creek Basin, Pennsylvania.* Geological Survey Professional Paper, 417-A, A-1-A-21
- Risser, D. W., Cogner, R. W. Ulrich, J.E., and Asmussen, M.P. (2005). *Estimates of Ground-Water Recharge Based on Streamflow - Hydrograph methods, Pennsylvania.* U.S. Geological Survey Open File Report 1005-1333.
- United States Environmental Protection Agency. (rev December 2005). *Stormwater Phase II Final Rule Small MS4 Stormwater Program Review.* Fact Sheet 2.0. EPA 833-F-00-002. <http://www.epa.gov/npdes/pubs/fact2-0.pdf>

ACT 167 PLANS

- Bucks County Planning Commission & Bucks County Conservation District. (1992). *Neshaminy Creek Watershed Stormwater Management Plan, Volume I.*
- Lehigh Valley Planning Commission. (2009). *Perkiomen Creek Headwaters Stormwater Management Plan.*

BMP Manuals

California

California Stormwater BMP Handbook: New Development and Redevelopment (January 2003) – separate file available at <http://www.cabmphandbooks.org/Development.asp>

Georgia

Georgia Stormwater Management Manual Volume 2: Technical Handbook (August 2001) separate file (<http://www.georgiastormwater.com/>)

Maryland

2000 Maryland Stormwater Design Manual –

http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/stormwater_design/index.asp

Massachusetts

Stormwater Management, Volume Two: Stormwater Technical Handbook (Massachusetts, 1997) – separate file available at <http://www.mass.gov/dep/water/laws/swmpolv2.pdf>

Minnesota

Minnesota Urban Small Sites BMP Manual: Stormwater Best Management Practices for Cold Climates (July 2001) – <http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm>

New Jersey

STORMWATER Best Management Practices Manual

http://www.nj.gov/dep/stormwater/bmp_manual2.htm

New York

New York State Stormwater Management Design Manual (2001) –

<http://www.dec.ny.gov/chemical/29072.html>

Pennsylvania

Pennsylvania Stormwater Best Management Practices (2006) –

<http://164.156.71.80/WXOD.aspx?fs=2087d8407c0e00008000071900000719&ft=1>

Washington

Stormwater Management Manual for Western Washington (August 2001) –

<http://www.ecy.wa.gov/programs/wq/stormwater/manual.html>

Federal

Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring (FHWA) – <http://www.fhwa.dot.gov/environment/ultraurb/3fs1.htm>

USEPA Infiltration Trench Fact Sheet (September 1999) –

<http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm>

Riparian Buffer References

Alliance for the Chesapeake Bay, Pennsylvania Department of Environmental Protection, September 2000. *Forest Buffer Toolkit*, Stream ReLeaf Program.

Fike, Jean, June 1999. *Terrestrial & Palustrine Plant Communities of Pennsylvania*, Pennsylvania Natural Diversity Inventory, The Nature Conservancy, Western Pennsylvania Conservancy, and Pennsylvania Department of Conservation and Natural Resources.

Palone, R. S. and A. H. Todd (eds), 1997. *Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers*. Chesapeake Bay Program and

Northeastern Area State and Private Forestry. Natural Resources Conservation Service Cooperative State Research Education and Extension Services.

Penn State College of Agricultural Sciences, 1996. *Establishing Vegetative Buffer Strips Along Streams to Improve Water Quality*. Publication # AGRS-67.

Pennsylvania Association of Conservation Districts, Inc., Keystone Chapter, Soil and Water Conservation Society, Pennsylvania Department of Environmental Protection, Natural Resources Conservation Service, 1998. *Pennsylvania Handbook of Best Management Practices for Developing Areas*. Prepared by CH2MHill.

The Federal Interagency Stream Restoration Working Group (FISRWG, 10/1998). *Stream Corridor Restoration Principles, Processes, and Practices*. GPO Item No. 0120-A; SuDocs No. A57.6/2:EN3/PT.653. ISBN-0-934213-59-3. Published October 1998. Revised August 2000.

Modeling Data

The SCS Type II rainfall curve ~ National Oceanic and Atmospheric Administration (NOAA) Atlas 14 rain data corresponding to the Doylestown rain gage. This data may be retrieved from the Atlas 14 website: http://hdsc.nws.noaa.gov/hdsc/pfds/orb/pa_pfds.html