LANGHORNE MANOR BOROUGH
ACT 167
STORMWATER MANAGEMENT
ORDINANCE

Implementing the requirements of the
Neshaminy Creek and Delaware River South Watersheds
Act 167 Stormwater Management Plan

ORDINANCE NO. 2022-

LANGHORNE MANOR BOROUGH, BUCKS COUNTY,

PENNSYLVANIA

Adopted at a Public Meeting Held on

September 13, 2022

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ARTICLE I. GENERAL PROVISIONS

Section 101. Short Title

This Ordinance shall be known and may be cited as the "Langhorne Manor Borough Act 167 Stormwater Management Ordinance".

Section 102. Statement of Findings

The Governing Body of the Municipality finds that:

A. Inadequate management of accelerated stormwater runoff resulting from development 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 municipality 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).

Section 103. Purpose

The purpose of this Ordinance is to promote the public health, safety, and welfare within Langhorne Manor Borough 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 93 to protect, maintain, reclaim, and restore the existing and designated uses of the waters of this Commonwealth.

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 Municipality.

Section 104. Statutory Authority

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

A. Pennsylvania Municipalities Planning Code, Act 247, as amended.

B. Borough Code, Act of February 1, 1966 (1965 P.L. 1656, Mo. 581), as amended - 53 P.S. § 45101, as amended.

Section 105. Applicability/Regulated Activities

All Regulated Activities and all activities that may affect 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.

Section 106. Exemptions – Neshaminy Creek Watershed

A. Regulated Activities that create impervious surfaces smaller than or equal to 1,000 square feet are exempt from the peak rate control requirements and the SWM Site Plan preparation located in Section IV of this Ordinance unless the activity is found to be a significant contributor of pollution to the waters of this Commonwealth.

B. Regulated Activities that create impervious surfaces between 1,001 square feet up to and including 5,000 square feet are exempt only from the peak rate control requirements of this Ordinance.

C. Regulated Activities as part of a residential project that create impervious surfaces between 1,001 square feet up to and including 5,000 square feet, and less than 1 acre of earth disturbance, are exempt from the peak rate control requirements and the SWM Site Plan preparation located in Section IV of this Ordinance provided a Small Project Stormwater Management Site Plan, prepared in accordance with Appendix I, is submitted to and approved by the Municipality.

Table 106.1 Impervious Surface Exemption Thresholds for the Neshaminy Creek Watershed

Ordinance Article or Section	Type of Project	Proposed Impervious Surface		
		0 – 1,000 sq. ft.	1,001 – 5000 sq. ft.	5,000 + sq. ft.
Article IV SWM Site Plan Requirements	Development	Exempt	Not Exempt, except for small residential projects satisfying Appendix I	Not Exempt
Section 303 Volume Control Requirements	Development	Not Exempt	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. PADEP requires an engineered post-construction SWM Plan with projects proposing earth disturbance greater than 1 acre.			

D. 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.

E. 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.

F. Any aspect of BMP maintenance to an existing SWM system made in accordance with plans and specifications approved by Langhorne Manor Borough is exempt.

G. The use of land for gardening for home consumption is exempt from the requirements of this ordinance.

H. Exemptions from any provisions of this Ordinance shall not relieve the applicant from the requirements in Section 301.D through L.

I. 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 Municipality may deny exemptions.

3. Exemptions are limited to specific portions of this Ordinance.

4. HQ and EV Streams – The municipality may deny exemptions in high quality (HQ) or exceptional value (EV) waters and Source Water Protection Areas (SWPA).

Section 107. Exemptions – Delaware River South Watershed

Any regulated activity that meets the exception criteria in the following table is exempt from the provisions of this section of the ordinance. This criterion shall apply to the total development even if development is to take place in phases. The date of the municipal ordinance adoption (March 1, 2005) shall be the starting point from which to consider tracts as "parent tracts" in which future subdivisions and respective impervious area computations shall be cumulatively considered. An exemption shall not relieve the applicant from implementing such measures as are necessary to protect health, safety, and property. This exemption shall not relieve the applicant from meeting the special requirements for watersheds drainage to high quality (HQ) or exceptional value (EV) waters and requirements for groundwater recharge (Section 308), water quality (Section 307) and streambank erosion (Section 309).

Stormwater Management Exemption Criteria

Total Parcel Size	Impervious Area Exemption (sq. ft.)
≤ 1/4 acre	1,200 sq. ft.
>1/4 to 1 acre	2,500 sq. ft.
>1 acre	5,000 sq. ft.

Exemptions shall be at the discretion of the municipality upon review of site conditions, topography, soils, and other factors as deemed appropriate.

Section 108. Repealer

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

Section 109. Severability

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

Section 110. Compatibility with Other Ordinance or Legal Requirements

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

Section 111. Erroneous Permit

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

Section 112. Waivers

A. If the Municipality determines that a requirement under this Ordinance cannot be achieved for a unique circumstance activity, the Municipality may, after an evaluation of alternatives, approve other measures other than those in this Ordinance, subject to Section 110, paragraphs B and C.

B. Waivers or modifications of the requirements of this Ordinance may be approved by the Municipality only because of peculiar conditions pertaining to the land in question, provided that the modifications will not be contrary to the public interest and that the purpose of the Ordinance is preserved. Cost or financial burden shall not be considered a hardship. Modification will only be considered if an alternative standard or approach will provide equal or better achievement of the purpose of the Ordinance within the limits of the specific circumstance. A request for modifications shall be in writing and accompany the Stormwater Management Site Plan submission. The request shall provide the facts on which the request is based, the provision(s) of the Ordinance involved and the proposed modification.

C. No waiver or modification of any regulated stormwater activity involving earth disturbance greater than or equal to one acre may be granted by the Municipality unless that action is approved in advance by the Department of Environmental Protection (DEP) or the delegated county conservation district.

ARTICLE II. DEFINITIONS

Section 201. Interpretation

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

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

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

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

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

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

Section 202. Definitions

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

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 Bucks 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 Bucks County, Bucks County Conservation District, and/or agent of the Governing Body involved with the administration, review, or enforcement of any provisions of this Ordinance by contract or memorandum of understanding.

Design Professional (Qualified) – A Pennsylvania Registered Professional Engineer, Registered Landscape Architect 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.

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.

Development Site – The specific tract or parcel of land where any regulated activity set forth in Section 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 municipality 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.

Governing Body – Council of the Borough of Langhorne Manor, Bucks County, Pennsylvania

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 and Delaware River South watersheds 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.

Impoundment – 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 (Ia): 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;

(ii) A subdivision of land;

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

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

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 and Delaware River South hydrologic models.

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

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

Municipality – Langhorne Manor Borough, Bucks 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 municipality'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.

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

Planning Commission – The planning commission of Langhorne Manor Borough.

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 municipality are planned, conducted or maintained.

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

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 reproducibles, 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 and/or open channels that convey intercepted runoff and stormwater from other sources, 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 Creek watershed adopted by Bucks and Montgomery Counties as required by the Act of October 4, 1978, P.L. 864 (Act 167) or the plan for managing stormwater runoff in the Delaware River South watershed adopted by Bucks County as required by the Act of October 4, 1978, P.L. 864 (Act 167), and known as the "Delaware River South Watershed Act 167 Stormwater Management Plan".

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 402.

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

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

Waters of the Commonwealth – Any and all rivers, streams, creeks, rivulets, 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.

ARTICLE III. STORMWATER MANAGEMENT

Section 301. General Requirements

A. Applicants proposing Regulated Activities in Langhorne Manor Borough that do not fall under the exemption criteria shown in Sections 106 and 107 shall submit a Stormwater Management (SWM) Site Plan consistent with this Ordinance to the Municipality 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 Municipality issues written approval of a SWM Site Plan, which demonstrates compliance with the requirements of this Ordinance.

B. SWM Site Plans approved by the Municipality, in accordance with Article IV, shall be on-site throughout the duration of the Regulated Activity.

C. The Municipality 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 in the Neshaminy Creek Watershed, implementation of the volume controls in Section 303 of this Ordinance is required.

F. For all Regulated Activities in the Delaware River South Watershed, all stormwater runoff shall be pretreated for water quality prior to discharge to surface or groundwater and post-construction water quality protection shall be addressed as required by Section 307 of this Ordinance.

G. 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.

H. Stormwater flows onto adjacent property shall not be created, increased, decreased, relocated, or otherwise altered without written notification of the adjacent property owner(s) by the Developer. Such stormwater flows shall be subject to the requirements of this Ordinance.

I. 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.

J. 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.

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

L. 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.

M. 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/

N. 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.

O. Various BMPs and their design standards are listed in the *Pennsylvania Stormwater Best Management Practices Manual* (PA BMP Manual).

Section 302. Permit Requirements by Other Governmental Entities

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

Section 303. Volume Control – Neshaminy Creek Watershed

(For Delaware River South requirements see Sections 307, 308 and 309)

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 305.A.

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 x Area x 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, the applicant is required to submit a SWM Site Plan shall determine the total acreage of protected area where no disturbance is proposed. 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 municipality'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.

Required Volume Control (ft^3)	–	Nonstructural Volume Control (ft^3)	=	Structural Volume Requirement (ft^3)

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 (24″) inches 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 2.

d. If on-lot infiltration structures are proposed, it must be demonstrated to the municipality 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 municipality.

Section 304. 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 and Delaware River South watersheds.

A. Standards for managing runoff from each subarea in the Neshaminy Creek and Delaware River South Watersheds for the 2-, 5-, 10-, 25-, 50-, and 100-year design storms are shown in Tables 304.1 and 304.2. 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 Tables 304.1 and 304.2 on the following page.

Table 304.1
Peak Rate Runoff Control Standards by Stormwater Management Districts
In The Neshaminy Creek Watershed

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

Table 304.2
Peak Rate Runoff Control Standards by Stormwater Management Districts
In The Delaware River South Watershed

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	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 Langhorne Manor Borough:

1. Meet the full requirements specified by Tables 304.1 and 304.2, and Sections 304.A through 304.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.

Section 305. 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 sites considered redevelopment, 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 305.1 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 Municipality 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 305.1
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 Municipality and/or Municipal Engineer.
Other Methods	Varies	Other computation methodologies approved by the Municipality 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 municipality 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 municipality.

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 municipality may approve the use of any generally accepted full hydrograph approximation technique that shall use a total runoff volume that is consistent with the volume from a method that produces a full hydrograph.

Section 306. 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.

Section 307. Water Quality – Delaware River South Watershed

In addition to the performance standards and design criteria requirements of this Article, the applicant SHALL comply with the following water quality requirements of this Article.

A. Adequate storage and treatment facilities will be provided to capture and treat stormwater runoff from developed or disturbed areas. The Recharge Volume computed under Section 308 may be a component of the Water Quality Volume if the applicant chooses to manage both components in a single facility. If the Recharge Volume is less than the Water Quality Volume, the remaining Water Quality Volume may be captured and treated by methods other than recharge/infiltration BMPs. The required Water Quality Volume (WQv) is the storage capacity needed to capture and to treat a portion of stormwater runoff from the developed areas of the site produced from 90 percent of the average annual rainfall (P).

To achieve this goal, the following criterion is established:

The following calculation formula is to be used to determine the water quality storage volume, (WQv), in acre-feet of storage for the Delaware River South watershed:

WQv = [(P)(Rv)(A)]/12 Equation: 307.1

WQv = Water Quality Volume (acre-feet)
P = Rainfall Amount equal to 90% of events producing this rainfall (in)
A = Area of the project contributing to the water quality BMP (acres)
Rv = 0.05 + 0.009(I) where I is the percent of the area that is impervious surface (impervious area/A*100)

The P value for the five PennDOT rainfall regions is shown in Figure B-2 in Appendix B of the Model Ordinance within the Plan. Since the Delaware River South is in PennDOT Region 5, the P value to be utilized to meet this requirement is 2.04 inches.

B. Design of BMPs used for water quality control shall be in accordance with design specifications outlined in the *Stormwater Best Management Practices Manual* or other applicable manuals. The following factors SHALL be considered when evaluating the suitability of BMPs used to control water quality at a given development site:

1. Total contributing drainage area.
2. Permeability and infiltration rate of the site soils.
3. Slope and depth to bedrock.
4. Seasonal high water table.
5. Proximity to building foundations and well heads.
6. Erodibility of soils.
7. Land availability and configuration of the topography.
8. Peak discharge and required volume control.
9. Stream bank erosion.
10. Efficiency of the BMPs to mitigate potential water quality problems.
11. The volume of runoff that will be effectively treated.
12. The nature of the pollutant being removed.
13. Maintenance requirements.
14. Creation/protection of aquatic and wildlife habitat.
15. Recreational value.
16. Enhancement of aesthetic and property value.

C. To accomplish the above, the applicant shall submit original and innovative designs to the municipality for review and approval. Such designs may achieve the water quality objectives through a combination of BMPs (best management practices).

D. No regulated earth disturbance activities within the Municipality shall commence until approval by the Municipality of a plan which demonstrates compliance with State Water Quality Requirements post-construction is complete.

E. The BMPs shall be designed, implemented and maintained to meet State Water Quality Requirements, and any other more stringent requirements as determined by the Municipality.

F. To control post-construction stormwater impacts from regulated earth disturbance ctivities, 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:

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

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

3. Streambank and Streambed Protection: management of volume and rate of postconstruction stormwater discharges to prevent physical degradation of receiving waters (e.g., from scouring).

G. Evidence of any necessary permit(s) for regulated earth disturbance activities from the appropriate DEP regional office must be provided to the Municipality. The issuance of an NPDES Construction Permit (or permit coverage under the statewide General Permit (PAG-2) satisfies the requirements of subsection 307.D.

Section 308. Groundwater Recharge (Infiltration) – Delaware River South Watershed

A. Infiltration BMPs shall meet the following minimum requirements:

Regulated activities will be required to recharge (infiltrate) a portion of the runoff created by the development as part of an overall stormwater management plan designed for the site. The volume of runoff to be recharged shall be determined from sections 308.A.2.a. or 308.A.2.b. depending upon demonstrated site conditions.

1. Infiltration BMPs intended to receive runoff from developed areas shall be selected based on suitability of soils and site conditions (see Table B-6 in Ordinance Appendix B for a list of Infiltration BMPs) and shall be constructed on soils that have the following characteristics:

   a. A minimum depth of 24 inches between the bottom of the BMP and the limiting zone.

   b. An infiltration rate sufficient to accept the additional stormwater load and drain completely as determined by field tests conducted by the applicant's design professional. 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. The recharge facility shall be capable of completely infiltrating the recharge volume within four days (96 hours).

   d. Pretreatment shall be provided prior to infiltration.

   e. The requirements for recharge are applied to all *disturbed areas*, even if they are ultimately to be an undeveloped land use such as grass, since studies have found that compaction of the soils during disturbance reduces their infiltrative capacity.

2. The recharge volume (Re) shall be computed by first obtaining the infiltration requirement using methods in either section 308.A.2.a. or 308.A.2.b. then multiplying by the total proposed impervious area. The overall required recharge volume for a site

is computed by multiplying total impervious area by the infiltration requirement.

a. NRCS Curve Number Equation

The following criteria shall apply.

The NRCS runoff shall be utilized to calculate infiltration requirements (P) in inches.

For zero runoff: P = I (Infiltration) = (200 / CN) - 2 **Equation: 308.1**
where: P = I = infiltration requirement (inches)
CN = SCS (NRCS) curve number of the existing conditions contributing to the recharge facility

This equation can be displayed graphically in, and the infiltration requirement can also be determined from Figure 308-1.

The recharge volume (Re_v) required would therefore be computed as:

Re_v = I * impervious area (SF) / 12 = Cubic Feet (CF) **Equation: 308.2**

b. Annual Recharge Water Budget Approach

It has been determined that infiltrating 0.5 inches of runoff from the impervious areas will aid in maintaining the hydrologic regime of the watershed. If the goals of Section 308.A.2.a cannot be achieved, then 0.5 inches of rainfall shall be infiltrated from all impervious areas, up to an existing site conditions curve number of 81. Above a curve number of 81, Equation 308.1 or the curve in Figure 308.1 should be used to determine the infiltration requirement.

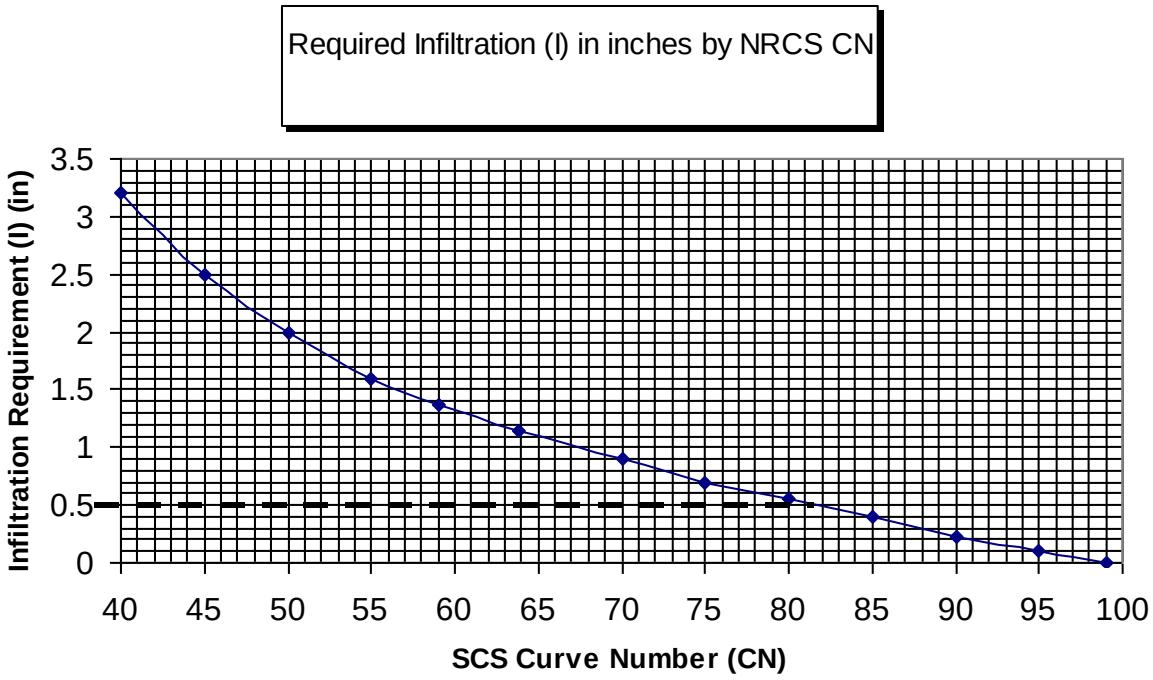
where: I = 0.5 inches

The recharge volume (Re_v) required would therefore be computed as:

Re_v = I * percent impervious area (SF) / 12 = Cubic Feet (CF)

The recharge values derived from these methods are the minimum volumes the applicant must control through an infiltration/recharge BMP facility. However, if a site has areas of soils where additional volume of infiltration can be achieved, the applicant is encouraged to recharge as much of the stormwater runoff from the site as possible.

Figure 308-1. Infiltration Requirement Based Upon NRCS Curve Number.



B. The general process for designing the infiltration BMP shall be:

A detailed soils evaluation of the project site shall be required to determine the suitability of recharge facilities. The evaluation shall be performed by a qualified professional and, at a minimum, address soil permeability, depth to bedrock, and subgrade stability.

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

2. Provide field tests, such as double ring infiltration tests at the level of the proposed infiltration surface to determine the appropriate hydraulic conductivity rate.

3. Design the infiltration structure for the required storm volume based on field determined capacity at the level of the proposed infiltration surface.

4. Where the recharge volume requirement cannot be physically accomplished due to the results of the field soils testing, supporting documentation and justification shall be supplied to the municipality with the drainage plan.

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

C. Extreme caution shall be exercised where infiltration is proposed in geologically susceptible areas such as strip mine or limestone areas. Extreme caution shall also be exercised where salt or chloride would be a pollutant since soils do little to filter this pollutant and it may contaminate the groundwater. Extreme caution shall be exercised where infiltration is proposed in source water protection areas. The qualified design professional shall evaluate the possibility of groundwater contamination from the proposed infiltration/recharge facility and perform a hydrogeologic justification study if necessary. The infiltration requirement in High Quality/Exceptional Value waters shall be subject to the DEP's Title 25: Chapter 93 Antidegradation Regulations. The municipality may require the installation of an impermeable liner in BMP and/or detention basins where the possibility of groundwater contamination exists. A detailed hydrogeologic investigation may be required by the municipality.

D. The municipality shall require the applicant to provide safeguards against groundwater contamination for uses which may cause groundwater contamination, should there be a mishap or spill.

E. Recharge/infiltration facilities shall be used in conjunction with other innovative or traditional BMPs, stormwater control facilities, and nonstructural stormwater management alternatives.

Section 309. Stream Bank Erosion Requirements – Delaware River South Watershed

A. In addition to the water quality volume, to minimize the impact of stormwater runoff on downstream streambank erosion, the requirement is to design the BMP to detain the post-development 2-year, 24-hour design storm to the predevelopment 1-year flow using the SCS Type II distribution. Additionally, provisions shall be made (such as adding a small orifice at the bottom of the outlet structure) so that the postdevelopment 1-year storm takes a minimum of 24 hours to drain from the facility from a point where the maximum volume of water from the 1-year storm is captured. (i.e., the maximum water surface elevation is achieved in the facility.)

B. Release of water can begin at the start of the storm (i.e., the invert of the water quality orifice is at the invert of the facility). The design of the facility shall consider and minimize the chances of clogging and sedimentation. Orifices smaller than 3 inches diameter are not recommended. However, if the design engineer can provide proof that the smaller orifices are protected from clogging by use of trash racks, etc., smaller orifices may be permitted.

ARTICLE IV. STORMWATER MANAGEMENT (SWM) SITE PLAN REQUIREMENTS

Section 401. General Requirements

For any of the activities regulated by this Ordinance, the preliminary or final approval of subdivision and/or land development plans, the issuance of any building or occupancy permit, 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 municipality and an approval of an adequate Erosion and Sediment (E&S) Control Plan review from the municipality or County Conservation District.

Section 402. 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 municipality in a format that is clear, concise, legible, neat, and well organized; otherwise, the SWM Site Plan shall not be accepted for review and shall be returned to the Applicant.

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

A. General

1. General description of the project including plan contents described in Section 402.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 Langhorne Manor Borough, 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 fees under the SALDO or other municipal 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 303.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 301.

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 Langhorne Manor Borough Act 167 Stormwater Management Ordinance."

j. A statement, signed by the Applicant, acknowledging that any revision to the approved SWM Site Plan must be approved by the municipality and that a revised 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.

Section 403. Plan Submission

The municipality 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 municipality accompanied by the requisite municipal review fee, as specified in this Ordinance.

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

3. One (1) copy to the municipal engineer (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 municipality or PADEP.

Section 404. Stormwater Management (SWM) Site Plan Review

A. The SWM Site Plan shall be reviewed by a Qualified Professional on behalf of the municipality for consistency with the provisions of this Ordinance. After review, the Qualified Professional shall provide a written recommendation for the municipality 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 municipality 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 municipality. If the municipality disapproves the SWM Site Plan, the municipality shall cite the reasons for disapproval in writing.

Section 405. 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 municipality shall require a resubmission of the modified SWM Site Plan in accordance with this Article.

Section 406. Resubmission of Disapproved SWM Site Plans

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

Section 407. Authorization to Construct and Term of Validity

The municipality'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 Municipality 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 Municipality signs the approval for an SWM Site Plan. If an approved SWM Site Plan is not completed according to Section 407 within the term of validity, the municipality may consider the SWM Site Plan disapproved and may revoke any and all permits. SWM Site Plans that are considered disapproved by the municipality shall be resubmitted in accordance with Section 406 of this Ordinance.

ARTICLE V. INSPECTIONS

Section 501. Inspections

A. The municipality shall inspect all phases of the installation of the Best Management Practices (BMPs) and/or stormwater management (SWM) facilities as deemed appropriate by the municipality.

B. During any stage of the work, if the municipality determines that the BMPs and/or stormwater management facilities are not being installed in accordance with the approved SWM Site Plan, the municipality 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 municipality 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 municipality, shall be submitted to the municipality.

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.

ARTICLE VI. FEES AND EXPENSES

Section 601. Municipal Stormwater Management (SWM) Site Plan Review and Inspection Fee

Fees shall be established by the municipality to cover plan review and construction inspection costs incurred by the municipality. All fees shall be paid by the Applicant at the time of SWM Site Plan submission. A review and inspection fee schedule shall be established by resolution of the municipal governing body based on the size of the Regulated Activity and based on the municipality's costs for reviewing SWM Site Plans and conducting inspections pursuant to Section 501. The municipality shall periodically update the review and inspection fee schedule to ensure that review costs are adequately reimbursed.

Section 602. Expenses Covered by Fees

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

A. Administrative costs.

B. The review of the Stormwater (SWM) Site Plan by the municipality.

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.

ARTICLE VII. MAINTENANCE RESPONSIBILITIES

Section 701. Performance Guarantee

A. For subdivisions and land developments, the Applicant shall provide a financial guarantee to the Municipality 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 Municipality shall require a financial guarantee from the Applicant.

Section 702. 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 the Office of the Recorder of Deeds for Bucks County, within Thirty (30) days of approval of the stormwater facility and BMP O&M plan by the Municipality:

1. The O&M plan, or a summary thereof,

2. O&M agreements under Section 704, and

3. Easements under Section 705.

B. The municipality may suspend or revoke any approvals granted for the project site upon discovery of failure on the part of the owner to comply with this section.

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

1. Map(s) of the project area, in a form that meets the requirements for recording at the offices of the Recorder of Deeds of Bucks County, and shall be submitted on 24-inch x 36-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 facility owner, acknowledging that the stormwater facilities and BMPs are fixtures that can be altered or removed only after approval by the municipality.

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 municipality, stormwater facilities and BMPs may also be offered for dedication to and maintained by the municipality.

2. If a plan includes O&M by single ownership, or if sewers and other public improvements are to be privately owned and maintained, the O&M of stormwater

facilities and BMPs shall be the responsibility of the owner or private management entity.

E. The municipality shall make the final determination on the continuing O&M responsibilities. The municipality 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 municipality may take enforcement actions against an owner for any failure to satisfy the provisions of this Article and this Ordinance.

Section 703. Municipal Review of Stormwater Facilities and BMP Operations and Maintenance (O&M) Plan

A. The municipality 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 municipality shall notify the Applicant in writing whether the Stormwater Facility and BMP O&M Plan is approved.

C. The municipality shall require a "Record Drawing" of all stormwater facilities and BMPs.

Section 704. Operations and Maintenance (O&M) Agreement for Privately Owned Stormwater Facilities and BMPs

A. The owner shall sign an O&M agreement with the municipality covering all stormwater facilities and BMPs that are to be privately owned. The O&M agreement shall be transferred with transfer of ownership. The agreement shall be substantially the same as the agreement 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 municipality.

C. The owner is responsible for the O&M of the SWM BMPs. If the owner fails to adhere to the O&M Agreement, the municipality may perform the services required and charge the owner appropriate fees. Nonpayment of fees may result in a lien against the property.

Section 705. Stormwater Management Easements

1. The owner must obtain all necessary real estate rights to install, operate, and maintain all stormwater facilities in the SWM Site Plan.

2. The owner must provide the municipal easements, or other appropriate real estate rights, to perform inspections and maintenance for the preservation of stormwater runoff conveyance, infiltration, and detention areas.

ARTICLE VIII. PROHIBITIONS

Section 801. 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 or flows from firefighting activities,
2. Discharges from potable water sources including dechlorinated water line and fire hydrant flushing,
3. Irrigation water and landscape 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 and footing drains,
9. Water from lawn watering,
10. De-chlorinated swimming pool discharges (clean, no filter backwash) (per Department of Environmental Protection (PADEP) requirements),
11. Uncontaminated pumped groundwater,
12. Water from individual residential car washing, and/or
13. Diverted stream flows

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

Section 802. Roof Drains

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).

Section 803. 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 an approved maintenance program and written approval of the municipality has been obtained.

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 written approval of the municipality.

ARTICLE IX. ENFORCEMENT AND PENALTIES

Section 901. Right-of-Entry

A. Upon presentation of proper credentials, duly authorized representatives of the municipality may enter at reasonable times upon any property within the municipality to inspect the implementation, condition, or operation and maintenance of the stormwater 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 municipality ready access to all parts of the premises for the purposes of determining compliance with this Ordinance.

C. Persons working on behalf of the municipality shall have the right to temporarily locate on any stormwater facility or BMP in the Municipality such devices as are necessary to conduct monitoring and/or sampling of the discharges from such stormwater facilities or BMP.

Section 902. Inspection

Stormwater Management (SWM) Best Management Practices (BMPs) should be inspected for proper operation by the landowner, or the owner's designee (including the Municipality 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.

Section 903. Enforcement

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

A. Whenever the Municipality finds that a person has violated a prohibition or failed to meet a requirement of this Ordinance, the Municipality may order compliance by written notice to the responsible person. Such notice may, without limitation, require the following remedies:

1. Performance of monitoring, analyses, and reporting;
2. Elimination of prohibited connections or discharges;

3. Cessation of any violating discharges, practices, or operations;

4. Abatement or remediation of stormwater pollution or contamination hazards and the restoration of any affected property;

5. Payment of a fine to cover administrative and remediation costs;

6. Implementation of stormwater 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 Municipality 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 Municipality from pursuing any and all other remedies available in law or equity.

Section 904. Suspension and Revocation of Permits and Approvals

A. Any building, land development, or other permit or approval issued by the municipality may be suspended or revoked, in whole or in part, by the Municipality for:

1. Noncompliance with or failure to implement any provision of the permit;

2. A violation of any provision of this ordinance; or

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 Municipality when:

1. The Municipality has inspected and approved the corrections to the stormwater facilities and BMPs or the elimination of the hazard or nuisance, and;

2. The Municipality is satisfied that all applicable violations in this Ordinance have been corrected.

C. Any permit or approval that has been revoked by the Municipality cannot be reinstated. The Applicant may apply for a new permit under the procedures outlined of this Ordinance.

Section 905. Penalties

A. Any person violating the provisions of this Ordinance shall be subject to penalties that may range from liens against the property to fines for each violation, recoverable with costs. Each day that the violation continues shall constitute a separate offense and the applicable fines are cumulative.

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

Section 906. Appeals

A. As per the Pennsylvania Municipalities Planning Code (MPC), Section 909.1(9), any person aggrieved by any action pursuant to this Ordinance may appeal to the Langhorne Manor Borough Zoning Hearing Board within thirty (30) days of that action.

B. Any person aggrieved by any decision of Langhorne Manor Borough Zoning Hearing Board, relevant to the provisions of this Ordinance may appeal to the County Court of Common Pleas in the County where the activity has taken place within thirty (30) days of the municipal decision.

ARTICLE X. EFFECTIVE DATE

Section 1001. Effective Date

A. This Ordinance shall take effect immediately upon adoption.

LANGHORNE MANOR BOROUGH ACT 167 STORMWATER MANAGEMENT ORDINANCE ENACTMENT

ENACTED and ORDAINED as Ordinance No._____at a duly advertised, convened and official meeting of the Council of the Borough of Langhorne Manor, Bucks County, Pennsylvania on this 13th of September 2022.

_____
Dawn Seader, Council President

ATTEST:

_____
Bonnie McGoldrick, Secretary/Treasurer

Approved this 13th day of September 2022

_____
Robert Byrne, Mayor

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"), and _____, _____ County, Pennsylvania, (hereinafter "Municipality");

WITNESSETH

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

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

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

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

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

BMP – "Best Management Practice;" activities, facilities, designs, measures or procedures used to manage stormwater impacts from land development, to protect and maintain water quality and groundwater recharge and to otherwise meet the purposes of the Municipal Stormwater Management Ordinance, including but not limited to infiltration trenches, seepage

pits, filter strips, bioretention, wet ponds, permeable paving, rain gardens, grassed swales, forested buffers, sand filters and detention basins.

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

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

1. The BMPs shall be constructed by the Landowner in accordance with the plans and specifications identified in the Plan.

2. The Landowner shall operate and maintain the BMP(s) as shown on the Plan in good working order acceptable to the Municipality and in accordance with the specific maintenance requirements noted on the Plan.

3. The Landowner hereby grants permission to the Municipality, its authorized agents and employees, to enter upon the property, at reasonable times and upon presentation of proper identification, to inspect the BMP(s) whenever it deems necessary. Whenever possible, the Municipality shall notify the Landowner prior to entering the property.

4. In the event the Landowner fails to operate and maintain the BMP(s) as shown on the Plan in good working order acceptable to the Municipality, the Municipality or its representatives may enter upon the Property and take whatever action is deemed necessary to maintain said BMP(s). This provision shall not be construed to allow the Municipality to erect any permanent structure on the land of the Landowner. It is expressly understood and agreed that the Municipality is under no obligation to maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the Municipality.

5. In the event the Municipality, pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner shall reimburse the Municipality for all expenses (direct and indirect) incurred within 10 days of receipt of invoice from the Municipality.

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

7. The Landowner, its executors, administrators, assigns, and other successors in interests, shall release the Municipality's employees and designated representatives from all damages, accidents, casualties, occurrences or claims which might arise or be asserted against said employees and representatives from the construction, presence, existence, or maintenance of the BMP(s) by the Landowner or Municipality. In the event that a claim is asserted against the Municipality, its designated representatives or employees, the Municipality shall promptly notify the Landowner and the Landowner shall defend, at his own expense, any suit based on the claim. If any judgment or claims against the Municipality's employees or designated representatives shall be allowed, the Landowner shall pay all costs and expenses regarding said judgment or claim.

8. The Municipality shall inspect the BMP(s) at a minimum of once every three years to ensure their continued functioning.

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

ATTEST:

WITNESS the following signatures and seals:

(SEAL) For the Municipality:

(SEAL) For the Landowner:

ATTEST:

_____ (City, Borough, Township)

County of _____, Pennsylvania

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

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

_____ _____

NOTARY PUBLIC **(SEAL)**

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)

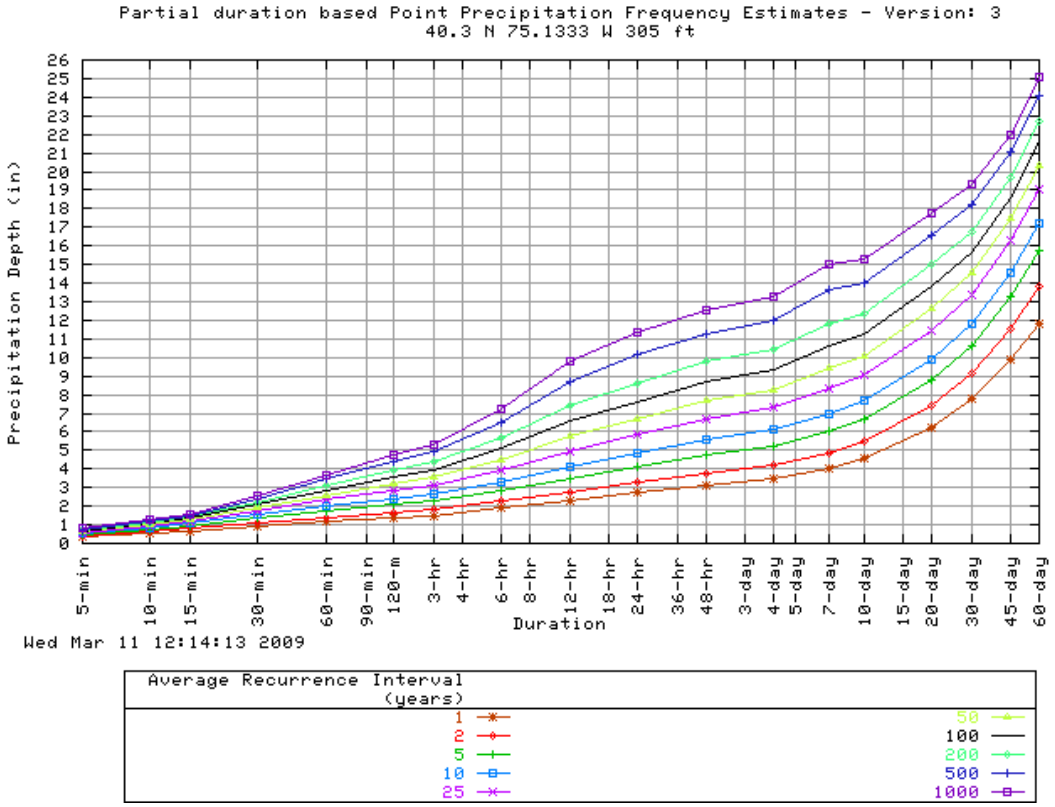


TABLE B-2: NATURAL RESOURCE PROTECTION STORMWATER MANAGEMENT CONTROLS

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) 89		92	94	95	
Industrial (72% Impervious) 81		88	91	93	
Institutional (50% Impervious) 71		82	88	90	
Residential districts by average lot size:					
	% Impervious				
1/8 acre or less *	65	77	85	90	92
(town houses)					
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 Volume (in)**	*** 1/12 =**	**Volume Reduction(ft^3)**
Use of Natural Drainage Feature					
Utilize natural flow pathways	_____sq ft		* 1/4"	* 1/12 =	_____cu ft
Minimum Soil Compaction					
Lawn	_____sq ft		* 1/4"	* 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

Required Volume Control (ft^3) (Table B-3) **– Nonstructural Volume Control (ft^3)** (Table B-5) **= Structural Volume Requirement (ft^3)**

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 B-7. RATIONAL RUNOFF COEFFICIENTS

By Hydrologic Soils Group and Overland Slope (%)

Land Use	A			B			C			D		
	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+
Cultivated Land	0.08[a]	0.13	0.16	0.11	0.15	0.21	0.14	0.19	0.26	0.18	0.23	0.31
	0.14[b]	0.18	0.22	0.16	0.21	0.28	0.20	0.25	0.34	0.24	0.29	0.41
Pasture	0.12	0.20	0.30	0.18	0.28	0.37	0.24	0.34	0.44	0.30	0.40	0.50
	0.15	0.25	0.37	0.23	0.34	0.45	0.30	0.42	0.52	0.37	0.50	0.62
Meadow	0.10	0.16	0.25	0.14	0.22	0.30	0.20	0.28	0.36	0.24	0.30	0.40
	0.14	0.22	0.30	0.20	0.28	0.37	0.26	0.35	0.44	0.30	0.40	0.50
Forest	0.05	0.08	0.11	0.08	0.11	0.14	0.10	0.13	0.16	0.12	0.16	0.20
	0.08	0.11	0.14	0.10	0.14	0.18	0.12	0.16	0.20	0.15	0.20	0.25
Residential												
Lot Size 1/8 Acre	0.25	0.28	0.31	0.27	0.30	0.25	0.30	0.33	0.38	0.33	0.36	0.42
	0.33	0.37	0.40	0.35	0.39	0.44	0.38	0.42	0.49	0.41	0.45	0.54
Lot Size 1/4 Acre	0.22	0.26	0.29	0.24	0.29	0.33	0.27	0.31	0.36	0.30	0.34	0.40
	0.30	0.34	0.37	0.33	0.37	0.42	0.36	0.40	0.47	0.38	0.42	0.52
Lot Size 1/3 Acre	0.19	0.23	0.26	0.22	0.26	0.30	0.25	0.29	0.34	0.28	0.32	0.39
	0.28	0.32	0.35	0.30	0.35	0.39	0.33	0.38	0.45	0.36	0.40	0.50
Lot Size 1/2 Acre	0.16	0.20	0.24	0.19	0.23	0.28	0.22	0.27	0.32	0.26	0.30	0.37
	0.25	0.29	0.32	0.28	0.32	0.36	0.31	0.35	0.42	0.34	0.38	0.48
Lot Size 1 Acre	0.14	0.19	0.22	0.17	0.21	0.26	0.20	0.25	0.31	0.24	0.29	0.35
	0.22	0.26	0.29	0.24	0.28	0.34	0.28	0.32	0.40	0.31	0.35	0.46
Industrial	0.67	0.68	0.68	0.68	0.68	0.69	0.68	0.69	0.69	0.69	0.69	0.70
	0.85	0.85	0.86	0.85	0.86	0.86	0.86	0.86	0.87	0.86	0.86	0.88
Commercial	0.71	0.71	0.72	0.71	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.90	0.89	0.89	0.90
Streets	0.70	0.71	0.71	0.71	0.72	0.74	0.72	0.73	0.76	0.73	0.75	0.78
	0.76	0.77	0.79	0.80	0.82	0.84	0.84	0.85	0.89	0.89	0.91	0.95
Open Space	0.05	0.10	0.14	0.08	0.13	0.19	0.12	0.17	0.24	0.16	0.21	0.28
	0.11	0.16	0.20	0.14	0.19	0.26	0.18	0.23	0.32	0.22	0.27	0.39
Parking	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87
	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97

[a] Runoff coefficients for storm recurrence intervals less than 25 years.

[b] Runoff coefficients for storm recurrence intervals of 25 years or more.

Source : Rawls, W.J., S.L. Wong and R.H. McCuen, 1981, "Comparison of Urban Flood Frequency Procedures", Preliminary Draft, U.S. Department

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 75 mm × 25 mm (3 in × 1 in) Corrugations 125 mm × 25 mm (5 in × 1 in) Corrugations 150 mm × 50 mm (6 in × 2 in) Corrugations	 0.024 0.027 0.025 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 600 mm (24 in) Diameter 900 mm (36 in) Diameter 1200 mm (48 in) Diameter 1500 mm (60 in) Diameter or larger b. Higher Coefficients**	 0.014 0.016 0.019 0.020 0.021 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) b. Dense Growth of Weeds c. Some Weeds (Heavy brush on banks)	 0.030 - 0.035 0.035 - 0.050 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.

APPENDIX C-1: SAMPLE SWM SITE PLAN APPLICATION

Application is hereby made for review of the LANGHORNE MANOR BOROUGH ACT 167 and NPDES STORMWATER MANAGEMENT ORDINANCE and related data as submitted herewith in accordance with the Langhorne Manor Borough Stormwater Management and Earth Disturbance 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:

____ Single-Family Lots	____ Townhouses	____ Commercial (Multi-Lot)
____ Two Family Lots	____ Garden Apartments	____ Commercial (One-Lot)
____ Multi-Family Lots	____ Mobile-Home Park	____ Industrial (Multi-Lot)
____ Cluster Type Lots	____ Campground	____ Industrial (One-Lot)
____ Planned Residential Development	____ Other (_____)	

6. Linear feet of new road proposed_____ L.F.

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

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

8. Stormwater

   a. Does the peak rate of runoff from proposed conditions exceed that flow which occurred for existing conditions for the designated design storm?_____

   b. Design storm utilized (on-site conveyance systems) (24 hr.)_____
      No. of Subarea_____
      Watershed Name_____

      Explain:_____
      _____
      _____

   c. Does the submission and/or district meet the criteria for the applicable Management District?_____

   d. Number of subarea(s) from Ordinance Appendix D of the Langhorne Manor Borough Act 167 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 Bucks County Conservation District?_____

b. Total area of earth disturbance _____S.F. or Acres

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_____.

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 Municipality)

_____ (Name of) Municipality official submission receipt:

Date complete application received _____Plan Number_____

Fees _____ date fees paid _____ received by_____

Official submission receipt date _____

Received by_____

_____
Municipality

APPENDIX C-2: SWM SITE PLAN CHECKLIST

Project:_____
Municipality: _____
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 or Delaware River South watersheds? ☐ 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 Langhorne Manor Borough Act 167 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 or Sections 307, 308 and 309

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	☐ Yes	☐ No	☐ Unknown
Ponds / Lakes / Vernal Pools	☐ Yes	☐ No	☐ Unknown
Streams	☐ Yes	☐ No	☐ Unknown
Wetlands	☐ Yes	☐ No	☐ Unknown
Hydric Soils	☐ Yes	☐ No	☐ Unknown
Flood plains	☐ Yes	☐ No	☐ Unknown
Stream Buffer Zones	☐ Yes	☐ No	☐ Unknown
Hydrologic Soil Groups A or B	☐ Yes	☐ No	☐ Unknown
Recharge Areas	☐ Yes	☐ No	☐ Unknown
Others: _____	☐ Yes	☐ No	☐ Unknown

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

☐ Yes ☐ No, Explain_____

_____

_____

_____

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 (ft^3) required to be controlled from the post-development site? _____(ft^3)

C. Stormwater runoff control measures

1. What is the level of runoff volume (ft^3) controlled through nonstructural BMPs? _____(ft^3)

2. What is the level of runoff volume (ft^3) controlled through structural BMPs? _____(ft^3)

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 V: PEAK RATES

Reference: Section 304

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

☐	A
☐	B
☐	C

2. Does the Proposed Conditions Runoff meet the Criteria established in Tables 304.1 or 304.2?

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

_____

SECTION VI: 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 IX: 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 X: FACILITY OPERATION AND MAINTENANCE PLAN

Reference: Section 702

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

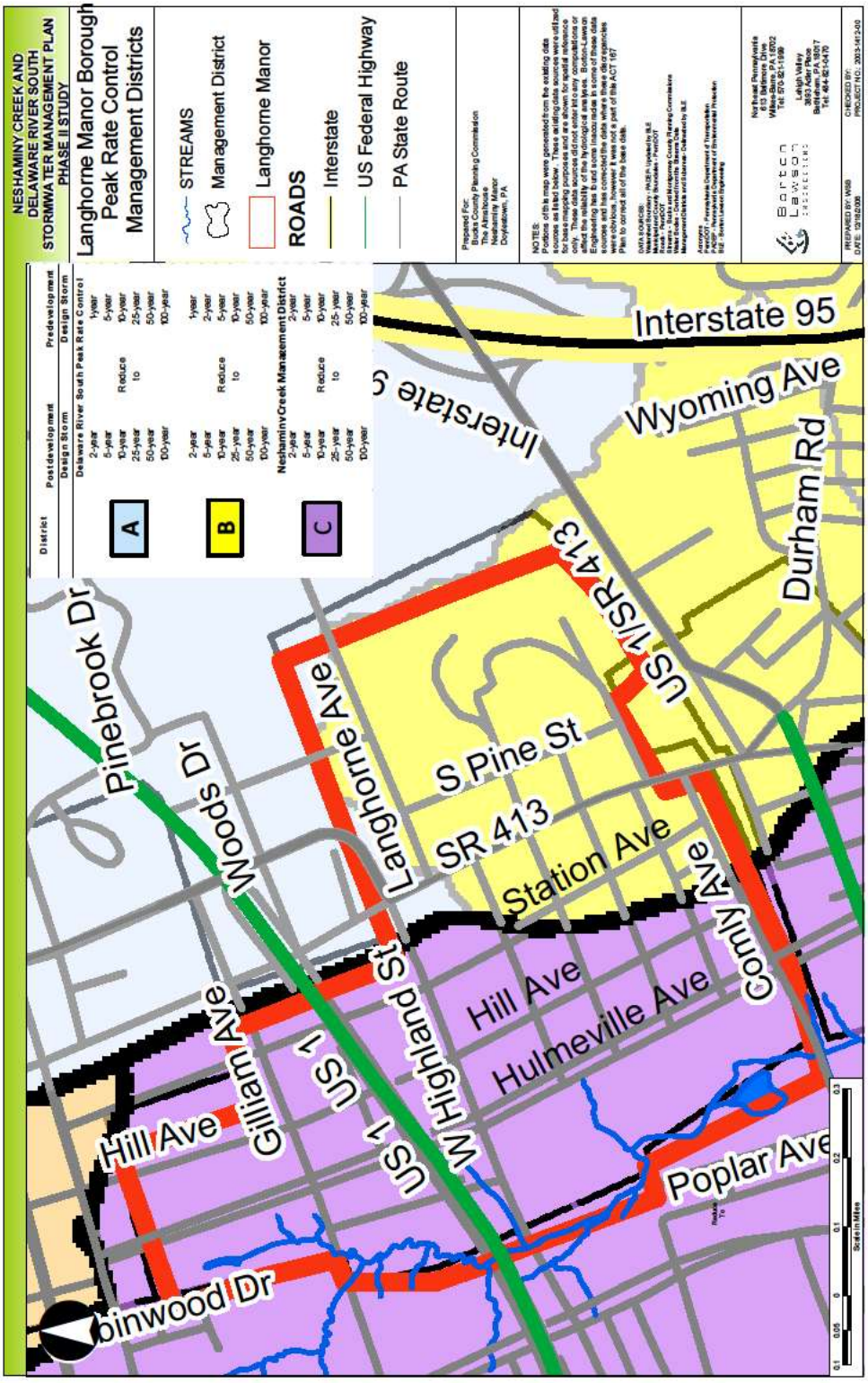
   ☐ Yes ☐ No, Explain _____

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

   ☐ Municipality ☐ Homeowner Association

   ☐ Private Owner ☐ Other _____

APPENDIX D. MAP OF MANAGEMENT DISTRICTS



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 municipality should consider examining their ordinances and amending the sections which limit LID techniques. For example, a municipality 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.

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.

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 *An Integrated Design Approach*, 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

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 Monroe County continues 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.

APPENDIX I: SMALL PROJECT STORMWATER MANAGEMENT (SWM) 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* 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.

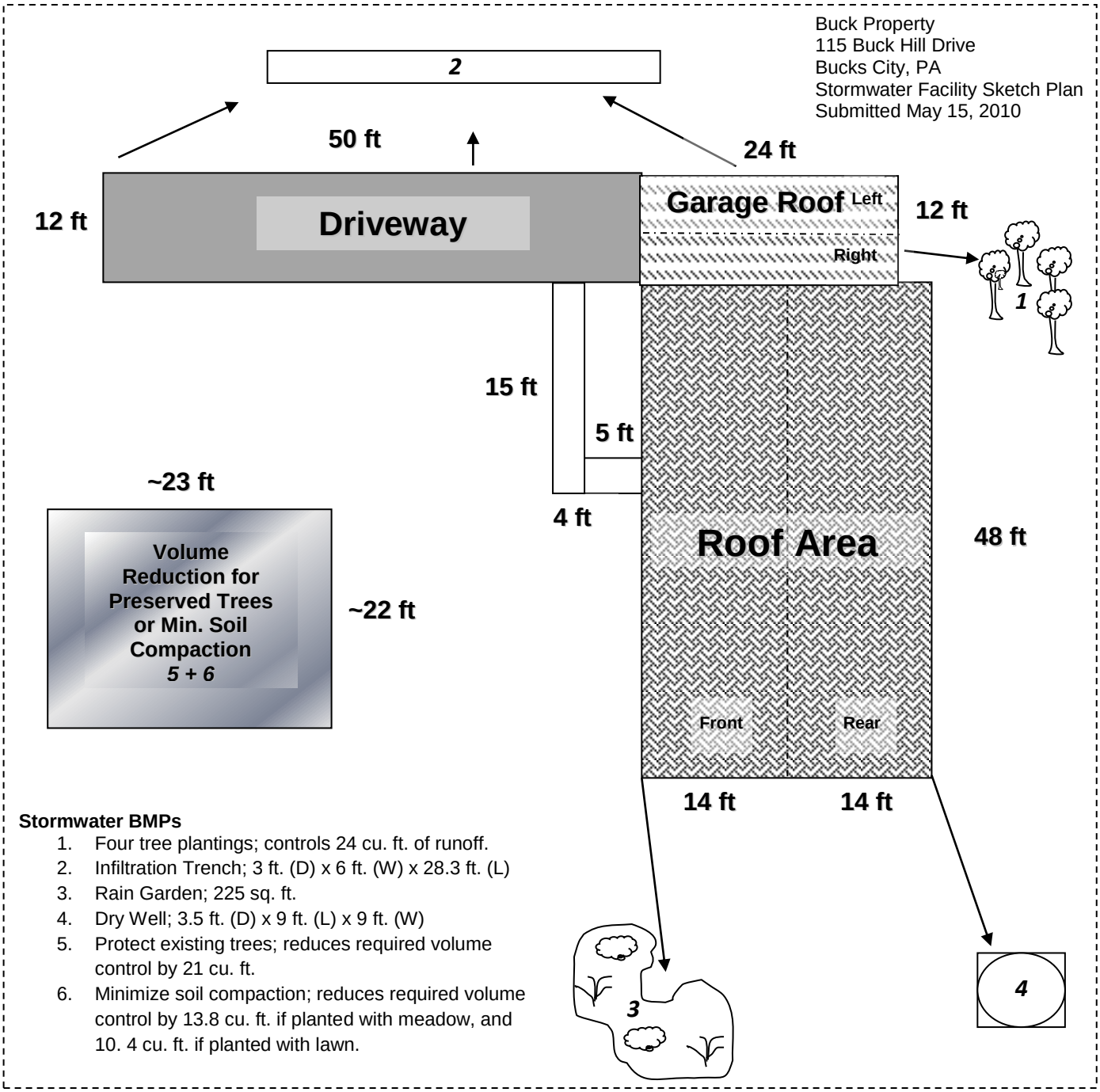
Site Plan Example: Controlling runoff volume from a proposed home site

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)	6 ft. 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:

Volume (cu. ft.) = (Total impervious area in square feet x 2 inches of runoff) /12 inches

(3,000 sq. ft. x 2 inches of runoff) /12 inches = 500 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:

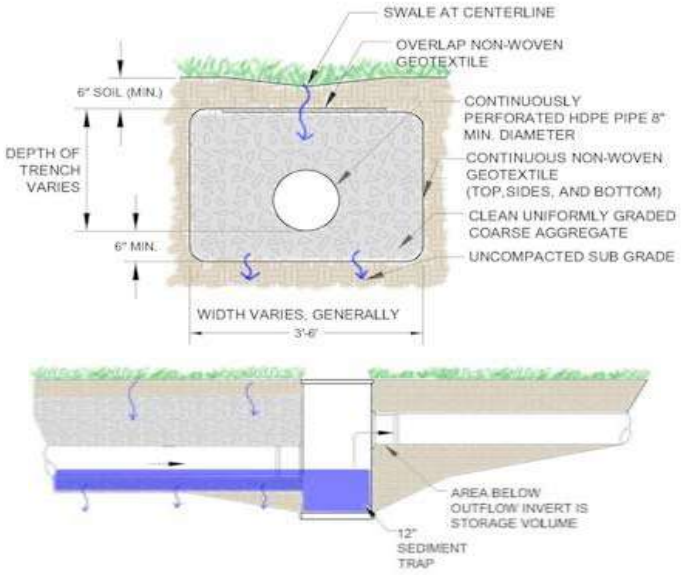
- Although the width and depth can vary, it is recommended that Infiltration Trenches be limited in depth to not more than six (6) feet of stone.
- Trench is wrapped in nonwoven geotextile (top, sides, and bottom).
- Trench needs to be placed on uncompacted soils.
- Slope of the Trench bottom should 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 sq. ft. x 2 inches of runoff)/12 ft. = 204 cu. ft. / 0.4* = 510 cu. ft.
   (*0.4 assumes 40% void ratio in gravel bed)

3. Sizing the infiltration trench facility:

   Volume of Facility = Depth x Width x Length

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

   510 cu. ft / 3 ft = 170 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.

   Determine trench length: L = 170 sq. ft. / 6 ft. = 28.3 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:

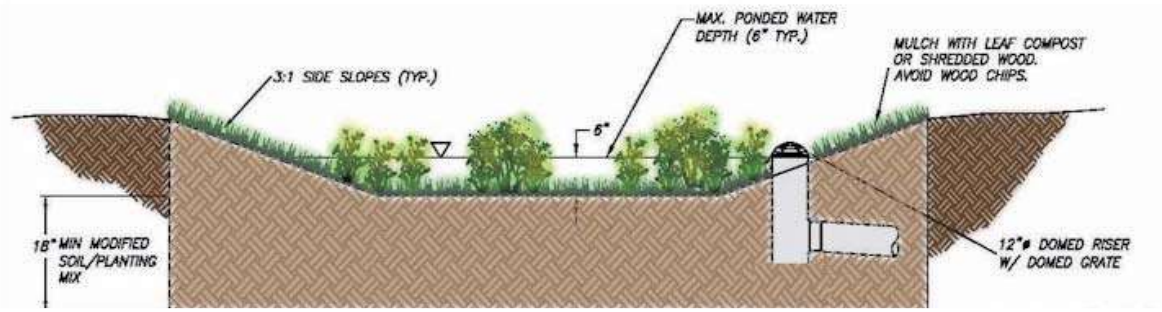
- A maximum of 3:1 side slope is recommended.
- The depth of a rain garden can range from 6 - 8 inches. Ponded water should not exceed 6 inches.
- The rain garden should drain within 72 hours.
- The garden should be at least 10-20 feet from a building's foundation and 25 feet from septic system drainfields 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 sq ft * 1 inch/6 inches) = 112 sq. ft.

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

   112 sq. ft. * 2 = 224 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 are, etc.) will ensure that additional runoff is safely conveyed downstream.

Design Considerations:

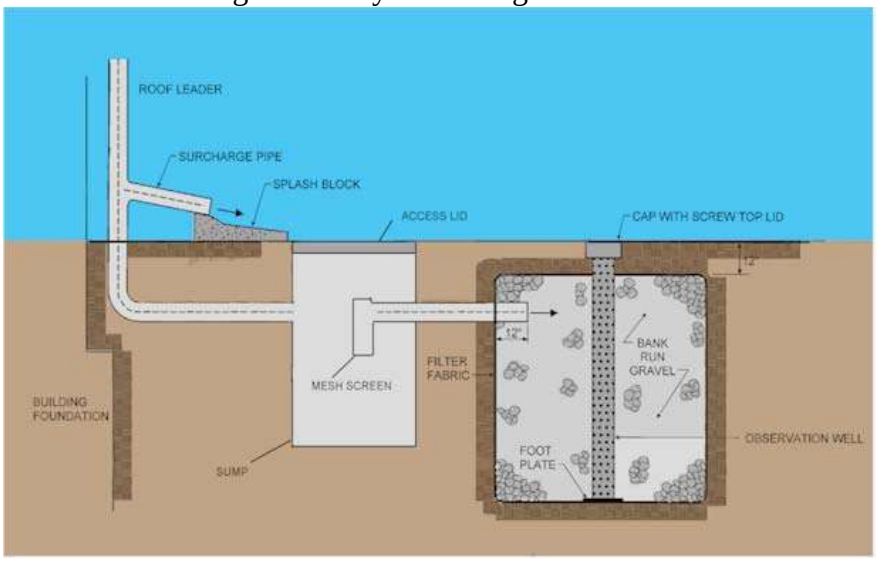
- Dry Wells typically consist of a depth of 18 to 48 inches of clean washed, uniformly graded aggregate with 40% void capacity (AASHTO No. 3, or similar). “Clean” gravel fill should average one and one-half to three (1.5 – 3.0) inches in diameter.
- Dry Wells are not recommended when their installation 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 sq. ft. * 2 inches of runoff) / 12 inches = 112 cu. ft.

   112 cu ft / 0.4 = 280 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 cu. ft. = 3.5 ft. x L x L; L = 9 ft.

   Dimensions = 3.5 ft. (D) x 9 ft. (L) x 9 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	ft

2. Calculate the required control volume:

   (144 sq. ft. x 2 inches of runoff) / 12 inches = 24 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 cu. ft. / 6 cu. ft. = 4 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 sq. ft. x 0.5 inches) / 12 = 21 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 cu. ft – 21 cu. ft. = 489 cu. ft.

   489 cu. ft. / 3 ft (Depth) = 163 / 6 ft. (Width) = 27.1 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:

   ~22 sq. ft. x ~23 sq. ft = 500 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 sq. ft. x 1/3 inch of runoff) / 12 = 13.8 cu. ft.

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

     (500 sq. ft. x 1/4 inch of runoff) / 12 = 10.4 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

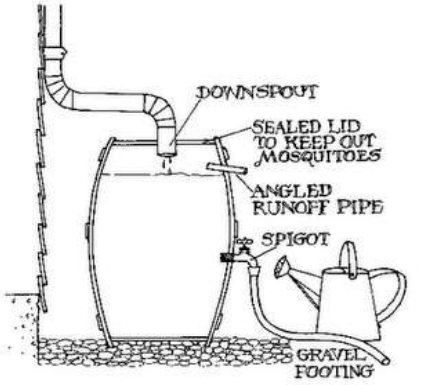
Rain Barrels

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 sq. ft. x 1 inch of runoff) / 12 inches = 12 cu. ft.

4. Size the rain barrel:

   1 cu. ft. = 7. 48 gallons

   12 cu. ft. x 7.48 = 90 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.

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