

**LOWER NAZARETH TOWNSHIP
NORTHAMPTON COUNTY, PENNSYLVANIA**

ORDINANCE NO. 229-10-18

**MONOCACY CREEK WATERSHED
ACT 167 STORMWATER MANAGEMENT ORDINANCE**

**ARTICLE 1
GENERAL PROVISIONS**

SECTION 101. SHORT TITLE

The Ordinance shall be known and may be cited as the "Monocacy Creek Watershed Act 167 Stormwater Management Ordinance."

SECTION 102. STATEMENT OF FINDINGS

The governing body of the municipality finds that:

- A. Inadequate management of accelerated runoff of stormwater resulting from development throughout a watershed increases flood flows and velocities, contributes to erosion and sedimentation, changes the natural hydrologic patterns, destroys aquatic habitat, elevates aquatic pollutant concentrations and loadings, overtaxes the carrying capacity of streams and storm sewers, greatly increases the cost of public facilities to carry and control stormwater, undermines floodplain management and flood control efforts in downstream communities, reduces groundwater recharge, and threatens public health and safety.
- B. A comprehensive program of stormwater management, including reasonable regulation of development and activities causing accelerated erosion and loss of natural infiltration, is fundamental to public health, safety, and welfare and the protection of the people of the municipality and all of the people of the Commonwealth, their resources and the environment.
- C. Stormwater can be an important resource by providing groundwater recharge for water supplies and baseflow of streams, which also protects and maintains surface water quality.
- D. Public education on the control of pollution from stormwater is an essential component in successfully addressing stormwater.
- E. Federal and State regulations require certain municipalities to implement a program for 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).
- F. Non-stormwater discharges to municipal separate storm sewer systems can contribute to pollution of the waters of the Commonwealth.

SECTION 103.PURPOSE

The purpose of this Ordinance is to promote the public health, safety and welfare within the Monocacy Creek Watershed by minimizing the damages and maximizing the benefits described in Section 102 of this Ordinance by provisions designed to:

- A. Manage stormwater runoff impacts at their source by regulating activities which cause stormwater problems.
- B. Utilize and preserve the desirable existing natural drainage systems.
- C. Encourage infiltration of stormwater, where appropriate, to maintain groundwater recharge, to prevent degradation of surface and groundwater quality, and to otherwise protect water resources.
- D. Maintain the existing flows and quality of waterways and wetlands in the municipality and the Commonwealth.
- E. Preserve and restore the flood carrying capacity of streams.
- F. Provide for proper maintenance of all permanent stormwater management BMPs that are implemented in the municipality.
- G. Provide review procedures and performance standards for stormwater planning, design, and management.
- H. Manage stormwater impacts close to the runoff source which requires a minimum of structures and relies on natural processes.
- I. Meet legal water quality requirements under State law, including regulations at 25 Pa. Code Chapter 93.4a to protect and maintain "existing uses" and maintain the level of water quality to support those uses in all streams, and to protect and maintain water quality in "special protection" streams.
- J. Prevent scour and erosion of streambanks and streambeds.
- K. Provide standards to meet the NPDES permit requirements.

SECTION 104.STATUTORY AUTHORITY

The municipality is empowered to regulate these activities by the authority of the Act of October 4, 1978, P.L. 864 (Act 167). 32 P.S. Section 680.1, et seq., as amended, the "Stormwater Management Act", Act 247, the Pennsylvania Municipalities Planning Code of July 31, 1968, P.L. 805; 53 P.S. §10101, as reenacted and amended, and the [appropriate municipal code].

SECTION 105. APPLICABILITY

This Ordinance shall only apply to those areas of the municipality which are located within the Monocacy Creek Watershed as delineated on an official map available for inspection at the municipal office. A map of the Monocacy Creek Watershed at a reduced scale is included in Appendix A for general reference.

All activities that may affect stormwater runoff, including land development and earth disturbance activity, are subject to regulation by this Ordinance. Regulated activities include:

- A. Land development.
- B. Subdivision.
- C. Construction of new or additional impervious surfaces (driveways, parking lots, etc.).
- D. Construction of new buildings or additions to existing buildings.
- E. Diversion or piping of any natural or man-made stream or channel.
- F. Installation of stormwater systems or appurtenances thereto.
- G. Regulated Earth Disturbance Activities.
- H. Other than that included in 105.A through G, any Earth Disturbance Activities or any activities that include the alteration or development of land in a manner that may affect stormwater runoff onto adjacent property.

SECTION 106. EXEMPTIONS

- A. Impervious Cover – Any proposed Regulated Activity, except those defined in Section 105.E through 105.H, which would create 10,000 square feet or less of additional impervious cover is exempt from the Drainage Plan preparation provisions of this Ordinance. If a site has previously received an exemption and is proposing additional development such that the total impervious cover on the site exceeds 10,000 square feet, and the currently proposed impervious cover is at least 1,000 square feet, a Drainage Plan shall be required for the new proposal.
 - 1. The date of the municipal Ordinance adoption of the original Monocacy Creek Act 167 Stormwater Management Ordinance, March 1989 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.
 - 2. For development taking place in stages, the entire development plan must be used in determining conformance with these criteria.
 - 3. For a parent tract with a prior exemption, the current Drainage Plan shall control the runoff from only the impervious cover currently proposed, unless the proposed impervious cover is on a building lot from the previous exemption; in such case, all impervious cover proposed on that building lot since the ordinance adoption shall meet the ordinance provisions.
 - 4. Additional impervious cover shall include, but not be limited to, additional indoor living spaces, decks, patios, garages, driveways, storage sheds and similar structures, and roof, parking or driveway areas, and any new streets and sidewalks constructed as part of or for the proposed Regulated Activity.
 - 5. Any additional areas proposed initially to be gravel, crushed stone, porous pavement, etc., shall be assumed to be impervious for the purposes of comparison to the exemption criteria. Any existing gravel, crushed stone or hard-packed soil areas on a site shall be considered as pervious cover for the purpose of exemption evaluation.

If a Drainage Plan is required, the pre- and post-development calculations should be based on actual cover conditions regardless of any assumptions made for purposes of exemption evaluation.

- B. Prior Drainage Plan Approval – Any Regulated Activity for which a Drainage Plan was previously prepared as part of a subdivision or land development proposal that received preliminary plan approval from the municipality prior to the effective date of this Ordinance is exempt from the Drainage Plan preparation provisions of this Ordinance, except as cited in Section 106.D, provided that the approved Drainage Plan included design of stormwater facilities to control runoff from the site currently proposed for Regulated Activities consistent with ordinance provisions in effect at the time of approval, and the approval has not lapsed under the Municipalities Planning Code. If significant revisions are made to the Drainage Plan after both the preliminary plan approval and the effective date of this Ordinance, preparation of a new Drainage Plan, subject to the provisions of this Ordinance, shall be required. Significant revisions would include a change in control methods or techniques, relocation or redesign of control measures, or changes necessary because soil or other conditions are not as stated on the original Drainage Plan.
- C. Activities associated with 105.H shall be exempt from the Drainage Plan preparation requirements of the Ordinance unless the municipality determines that the activity could create a new or relocated concentrated drainage discharge. Agricultural activity as may be covered by Section 105.H are exempt from the Drainage Plan provisions of this Ordinance.
- D. These exemptions shall not relieve the applicant from implementing such measures as are necessary to protect health, safety and property, and to meet State Water Quality Requirements. These measures include adequate and safe conveyance of stormwater on the site and as it leaves the site. These exemptions do not relieve the applicant from the responsibility to secure permits or approvals for activities regulated by any other applicable code, rule, act, or ordinance.
- E. No exemptions shall be provided for Regulated Activities as defined in Sections 105.E through 105.G.
- F. Agricultural activity is exempt from the rate control and Drainage Plan preparation requirements of this Ordinance provided the activities are performed according to the requirements of 25 Pa. Code 102.
- G. Timber harvesting activities are exempt from the rate control and Drainage Plan preparation requirements of this Ordinance provided the activities are performed according to the requirements of 25 Pa. Code 102.
- H. The municipality may deny or revoke any exemption pursuant to this Section at any time for any project that the municipality believes may pose a threat to public health, safety, property or the environment.

SECTION 107. REPEALER

Any ordinance of the municipality inconsistent with any of the provisions of this Ordinance is hereby repealed to the extent of the inconsistency only.

SECTION 108. SEVERABILITY

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

SECTION 109. COMPATIBILITY WITH OTHER ORDINANCE 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 110. DUTY OF PERSONS ENGAGED IN THE DEVELOPMENT OF LAND

Notwithstanding any provisions of this Ordinance, including exemption and waiver provisions, any landowner and any person engaged in the alteration or development of land which may affect stormwater runoff characteristics shall implement such measures as are reasonably necessary to prevent injury to health, safety, or other property. Such measures shall include such actions as are required to manage the rate, volume, direction and quality of resulting stormwater runoff in a manner which otherwise adequately protects health and property from possible injury.

ARTICLE 2 DEFINITIONS

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

Accelerated Erosion – The removal of the surface of the land through the combined action of human activities and natural processes, at a rate greater than would occur because of the natural processes 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.

Best Management Practice (BMP) – Activities, facilities, measures or procedures used to manage stormwater quantity and quality impacts from the Regulated Activities listed in Section 105, to meet State Water Quality Requirements, to promote groundwater recharge and to otherwise meet the purposes of this Ordinance.

Best Management Practice Operations and Maintenance Plan – Documentation, included as part of a Drainage Plan, detailing the proposed BMPs, how they will be operated and maintained and who will be responsible.

Bioretention – Densely vegetated, depressed features that store stormwater and filter it through vegetation, mulch, planting soil, etc. Ultimately stormwater is evapotranspired, infiltrated or discharged. Optimal bioretention areas mimic natural forest ecosystems in terms of species diversity, density, distribution, use of native plants, etc.

Buffer – (1) Streamside Buffer – A zone of variable width located along a stream that is vegetated and is designed to filter pollutants from runoff.

(2) Special Geologic Feature Buffer – A required isolation distance from a special geologic feature to a proposed BMP needed to reduce the risk of sinkhole formation due to stormwater management activities.

Capture/Reuse – Stormwater management techniques such as cisterns and rain barrels which direct runoff into storage devices, surface or sub-surface, for later reuse, such as for irrigation of gardens and other planted areas.

Carbonate Bedrock – Rock consisting chiefly of carbonate minerals, such as limestone and dolomite; specifically a sedimentary rock composed of more than 50% by weight of carbonate minerals that underlies soil or other unconsolidated, superficial material.

Cistern – An underground reservoir or tank for storing rainwater.

Closed Depression – A distinctive bowl-shaped depression in the land surface. It is characterized by internal drainage, varying magnitude and an unbroken ground surface.

Concentrated Drainage Discharge – Stormwater runoff leaving a property via a point source.

Conservation District – The Lehigh or Northampton County Conservation District, as applicable.

Constructed Wetlands – Constructed wetlands are similar to wet ponds (see below) and consist of a basin which provides for necessary stormwater storage as well as a permanent pool or water level, planted with wetland vegetation. To be successful, constructed wetlands must have adequate natural hydrology (both runoff inputs as well as soils and water table which allow for maintenance of a permanent pool of water). In these cases, the permanent pool must be designed carefully, usually with shallow edge benches, so that water levels are appropriate to support carefully selected wetland vegetation.

Culvert – A pipe, conduit or similar structure including appurtenant works which carries surface water.

Dam – An artificial barrier, together with its appurtenant works, constructed for the purpose of impounding or storing water or another fluid or semifluid or a refuse bank, fill or structure for highway, railroad or other purposes which does or may impound water or another fluid or semifluid.

DEP – The Pennsylvania Department of Environmental Protection.

Design Storm – The depth and time distribution of precipitation from a storm event measured in probability of occurrence (e.g., 100-yr. storm) and duration (e.g., 24-hour) and used in computing stormwater management control systems.

Detention Basin – A basin designed to retard stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate.

Developer – A person, partnership, association, corporation or other entity, or any responsible person therein or agent thereof, that undertakes any Regulated Activity of this Ordinance.

Development Site (Site) – The specific tract of land for which a Regulated Activity is proposed.

Diffused Drainage – See Sheet Flow.

Direct Recharge/Subsurface BMP – A BMP designed to direct runoff to groundwater recharge without providing for vegetative uptake. Examples include infiltration trenches, seepage beds, drywells and stormwater drainage wells such that nearly all runoff becomes recharge to groundwater.

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

Drainage Plan – The documentation of the proposed stormwater quantity and quality management controls to be used for a given development site, including a BMP Operations and Maintenance Plan, the contents of which are established in Section 403.

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

Erosion – The removal of soil particles by the action of water, wind, ice or other geological agents.

Existing Uses – Those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards. (25 Pa. Code Chapter 93.1)

Fill – Man-made deposits of natural soils or rock products and waste materials.

Filter Strips – See Vegetated Buffers.

Freeboard – The incremental depth in a stormwater management structure, provided as a safety factor of design, above that required to convey the design runoff event.

Groundwater Recharge – Replenishment of existing natural underground water supplies.

Hardship Waiver Request – A written request for a waiver alleging that the provisions of this Ordinance inflict unnecessary hardship upon the applicant. A Hardship Waiver does not apply to and is not available from the water quality provisions of this Ordinance and should not be granted.

Hot Spot Land Uses – A land use or activity that generates higher concentrations of hydrocarbons, trace metals or other toxic substances than typically found in stormwater runoff. These land uses are listed in Appendix H.

Hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS) – The computer-based hydrologic modeling technique developed by the U.S. Army Corps of Engineers and adapted to the Monocacy Creek Watershed for the Act 167 Plan Update. The model was "calibrated" to reflect actual flow values by adjusting key model input parameters.

Hydrologic Soil Group (HSG) – Soils are classified into four HSG's (A, B, C and D) to indicate the minimum infiltration rates, which are obtained for bare soil after prolonged wetting. The Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture defines the four groups and provides a list of most of the soils in the United States and their group classification. Soils become less permeable as the HSG varies from A to D. The soils in the area of the development site may be identified from a web soil survey report that can be accessed at www.websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.

Impervious Surface (Impervious Cover) – A surface which prevents the percolation of water into the ground.

Infiltration Practice – A practice designed to allow runoff an opportunity to infiltrate into the ground (e.g., French drain, seepage pit, seepage trench or bioretention area).

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

Land Development – Any of the following activities:

- (1) The improvement of one lot or two or more contiguous lots, tracts or parcels of land for any purpose involving (i) 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 of tenure; or (ii) the division or allocation of land or space between or among two or more existing or prospective occupants by means of, or for the purpose of streets, common areas, leaseholds, condominiums, building groups or other features.
- (2) A subdivision of land.
- (3) Development in accordance with Section 503 (1.1) of the Pennsylvania Municipalities Planning Code.

Loading Rate – The ratio of the land area draining to the system, as modified by the weighting factors in Section 308.B. compared to the base area of the infiltration system.

Low Impact Development – A development approach that promotes practices that will minimize post-development runoff rates and volumes thereby minimizing needs for artificial conveyance and storage facilities. Site design practices include preserving natural drainage features, minimizing impervious surface area, reducing the hydraulic connectivity of impervious surfaces and protecting natural depression storage.

“Local” Runoff Conveyance Facilities – Any natural channel or man-made conveyance system which has the purpose of transporting runoff from the site to the Mainstem.

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

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

Maryland Stormwater Design Manual – A stormwater design manual written by the Maryland Department of the Environment and the Center for Watershed Protection. The Manual can be obtained through the following web site: www.mde.state.md.us.

Minimum Disturbance/Minimum Maintenance Practices (MD/MM) – Site design practices in which careful limits are placed on site clearance prior to development allowing for maximum retention of existing vegetation (woodlands and other), minimum disturbance and compaction of existing soil mantle and minimum site application of chemicals post-development. Typically, MD/MM includes disturbance setback criteria from buildings as well as related site improvements such as walkways, driveways, roadways, and any other improvements. These criteria may vary by community context as well as by type of development being proposed. Additionally, MD/MM shall include provisions (e.g., deed restrictions, conservation easements) to protect these areas from future disturbance and from application of fertilizers, pesticides and herbicides.

Municipality – Lower Nazareth Township, Northampton County, Pennsylvania.

No Harm Runoff Quantity Option – The option of using a less restrictive runoff quantity control if it can be shown that adequate and safe runoff conveyance exists and that the less restrictive control would not adversely affect health, safety and property.

NPDES – National Pollutant Discharge Elimination System.

NRCS – Natural Resources Conservation Service - U.S. Department of Agriculture. (Formerly the Soil Conservation Service.)

Oil/Water Separator – A structural mechanism designed to remove free oil and grease (and possibly solids) from stormwater runoff.

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

Owner – One with an interest in and often dominion over a property.

Peak Discharge – The maximum rate of flow of stormwater runoff at a given location and time resulting from a specified storm event.

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

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.

Preliminary Site Investigation – The determination of the depth to bedrock, the depth to the seasonal high water table and the soil permeability for a possible infiltration location on a site through the use of published data and on-site surveys. In carbonate bedrock areas, the location of special geologic features must also be determined along with the associated buffer distance to the possible infiltration area. See Appendix G.

Pre-treatment – Measures implemented for Hot Spot Land Uses designed to reduce the concentration of hydrocarbons, trace metals and other toxic substances to levels typically found in stormwater runoff.

Public Water Supplier – A person who owns or operates a Public Water System.

Public Water System – A system which provides water to the public for human consumption which has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year. (See 25 Pa. Code Chapter 109)

Qualified Geotechnical Professional – A licensed professional geologist or a licensed professional engineer who has a background or expertise in geology or hydrogeology.

Rational Method – A method of runoff calculation using a standardized runoff coefficient (rational ‘c’), acreage of tract and rainfall intensity determined by return period and by the time necessary for the entire tract to contribute runoff. The rational method formula for peak rate calculation is stated as follows: $Q = ciA$, where “Q” is the calculated peak flow rate in cubic feet per second, “c” is the dimensionless runoff coefficient (see Appendix C), “i” is the rainfall intensity in inches per hour, and “A” is the area of the tract in acres. The Rational method formula for runoff volume calculation is as follows: $V = cPA/12$ where “c” and “A” are as noted above, “P” is the total depth of precipitation for the design event in inches, and “V” is the total runoff volume in acre-feet.

Reach – Any of the natural or man-made runoff conveyance channels used for watershed runoff modeling purposes to connect the subareas and transport flows downstream.

Regulated Activities – All activities that may affect stormwater runoff, including land development and earth disturbance activity, which are subject to regulation by this Ordinance.

Regulated Earth Disturbance Activities – Activity involving earth disturbance, other than agricultural activity, subject to regulation under 25 Pa. Code 92, 25 Pa. Code 102, or the Clean Streams Law.

Release Rate – The percentage of the pre-development peak rate of runoff for a development site to which the post-development peak rate of runoff must be controlled to avoid peak flow increases throughout the watershed.

Return Period – An expression of the intensity of an event based on its statistical chance of being equaled or exceeded in any given year. An event with a 1% chance in any given year is stated to have a 100-year return period. An event with a 50% chance is stated to have a 2-year return period. Over a very long period of record, events might be expected to recur on average in accordance with their return period.

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.

Runoff – That part of precipitation which flows over the land.

Runoff BMP – A BMP designed for essentially the full volume of runoff entering the BMP to be discharged off-site.

Sediment Traps/Catch Basin Sumps – Chambers which provide storage below the outlet in a storm inlet to collect sediment, debris and associated pollutants, typically requiring periodic clean out.

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

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.

Sheet Flow – Stormwater runoff flowing in a thin layer over the ground surface.

Soil-Cover-Complex Method – A method of runoff computation developed by NRCS which is based upon relating soil type and land use/cover to a runoff parameter called a Curve Number.

Special Geologic Features – Carbonate bedrock features, including but not limited to closed depressions, existing sinkholes, fracture traces, lineaments, joints, faults, caves, pinnacles and geologic contacts between carbonate and non-carbonate bedrock which may exist and must be identified on a site when stormwater management BMPs are being considered.

Spill Prevention and Response Program – A program that identifies procedures for preventing and, as needed, cleaning up potential spills and makes such procedures known and the necessary equipment available to appropriate personnel.

State Water Quality Requirements – As defined under State regulations—protection of designated and existing uses (See 25 Pa. Code Chapters 93 and 96)—including:

- A. Each stream segment in Pennsylvania has a “designated use,” such as “cold water fishes” or “potable water supply,” which is listed in Chapter 93. These uses must be protected and maintained, under State regulations.

- B. "Existing uses" are those attained as of November 1975, regardless whether they have been designated in Chapter 93. Regulated Earth Disturbance Activities must be designed to protect and maintain existing uses and maintain the level of water quality necessary to protect those uses in all streams, and to protect and maintain water quality in special protection streams.
- C. Water quality involves the chemical, biological and physical characteristics of surface water bodies. After Regulated Earth Disturbance Activities are complete, these characteristics can be impacted by addition of pollutants such as sediment, and changes in habitat through increased flow volumes and/or rates as a result of changes in land surface area from those activities. Therefore, permanent discharges to surface waters must be managed to protect the stream bank, streambed and structural integrity of the waterway, to prevent these impacts.

Storage Indication Method – A method of routing or moving an inflow hydrograph through a reservoir or detention structure. The method solves the mass conservation equation to determine an outflow hydrograph as it leaves the storage facility.

Storm Drainage Problem Areas – Areas which lack adequate stormwater collection and/or conveyance facilities and which present a hazard to persons or property. These areas are either documented in Appendix B of this Ordinance or identified by the municipality or municipal engineer.

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

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

Stormwater Drainage Wells – Wells for injection of stormwater to the subsurface that are regulated by the U.S. Environmental Protection Agency to protect underground sources of drinking water.

Stormwater Filters – Any number of structural mechanisms such as multi-chamber catch basins, sand/peat filters, sand filters, and so forth which are installed to intercept stormwater flow and remove pollutants prior to discharge. Typically, these systems require periodic maintenance and clean out.

Stormwater Management Plan – The plan for managing stormwater runoff adopted by Lehigh and/or Northampton County for the Monocacy Creek Watershed as required by the Act of October 4, 1978, P.L. 864, (Act 167), as amended, and known as the "Stormwater Management Act".

Stream – A Watercourse.

Subarea – The smallest unit of watershed breakdown for hydrologic modeling purposes for which the runoff control 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, however, that the subdivision by lease of land for agricultural purposes into parcels of more than ten acres, not involving and new street or easement of access or any residential dwelling, shall be exempted.

Surface Waters – Perennial and intermittent streams, rivers, lakes, reservoirs, ponds, wetlands, springs, natural seeps and estuaries, excluding water at facilities approved for wastewater treatment such as wastewater treatment impoundments, cooling water ponds and constructed wetlands used as part of a wastewater treatment process.

Swale – A low-lying stretch of land which gathers or carries surface water runoff. See also Vegetated Swale.

Technical Best Management Practice Manual & Infiltration Feasibility Report, November 2002 – The report written by Cahill Associates that addresses the feasibility of infiltration in carbonate bedrock areas in the Little Lehigh Creek Watershed. The report is available at the Lehigh Valley Planning Commission offices.

Timber Harvesting Activities – Earth disturbance activities, including the construction of skid trails, logging roads, landing areas and other similar logging or silvicultural practices.

Trash/Debris Collectors – Racks, screens or other similar devices installed in a storm drainage system to capture coarse pollutants (trash, leaves, etc.).

Vegetated Buffers – Gently sloping areas that convey stormwater as sheet flow over a broad, densely vegetated earthen area, possibly coupled with the use of level spreading devices. As water quality BMPs, vegetated buffers serve to filter pollutants from runoff and promote infiltration. Vegetated buffers should be situated on minimally disturbed soils, have low-flow velocities and extended residence times. Vegetated buffers may be, but are not restricted to, use in riparian (streamside) conditions.

Vegetated Roofs – Vegetated systems installed on roofs that generally consist of a waterproof layer, a root-barrier, drainage layer (optional), growth media, and suitable vegetation. Vegetated roofs store and eventually evapotranspire the collected rooftop rainfall; overflows may be provided for larger storms.

Vegetated Swales – Vegetated earthen channels designed to convey and possibly treat stormwater. As water quality BMPs, these are broad, shallow, densely vegetated, earthen channels designed to treat stormwater through infiltration, evapotranspiration, and sedimentation. Swales should be gently sloping with low flow velocities to prevent erosion. Check dams may be added to enhance performance.

Vegetated/Surface BMP – A BMP designed to provide vegetative uptake and soil renovation or surface infiltration of runoff. Capture/reuse BMPs are included if the captured runoff is applied to vegetated areas. Examples include bioretention and surface infiltration basins.

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

Water Quality Inserts – Any number of commercially available devices that are inserted into storm inlets to capture sediment, oil, grease, metals, trash, debris, etc.

Water Quality Volume (WQv) – The increase in runoff volume on a development site associated with a 2-year, 24-hour storm event.

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

Watershed – The entire region or area drained by a river or other body of water, whether natural or artificial.

Wet Detention Ponds – Basins that provide for necessary stormwater storage as well as a permanent pool of water. To be successful, wet ponds must have adequate natural hydrology (both runoff inputs as well as soils and water table which allow for maintenance of a permanent pool of water) and must be able to support a healthy aquatic community so as to avoid creation of mosquito and other health and nuisance problems.

ARTICLE 3
STORMWATER MANAGEMENT REQUIREMENTS

SECTION 301. GENERAL REQUIREMENTS

- A. All Regulated Activities in the municipality shall be subject to the stormwater management requirements of this Ordinance.
- B. Storm drainage systems shall be designed to preserve natural watercourses except as modified by stormwater detention facilities, recharge facilities, water quality facilities, pipe systems or open channels consistent with this Ordinance.
- C. The existing locations of concentrated drainage discharge onto adjacent property shall not be altered without written approval of the affected property owner(s).
- D. Areas of existing diffused drainage discharge onto adjacent property shall be managed such that, at minimum, the peak diffused flow does not increase in the general direction of discharge, except as otherwise provided in this Ordinance. If diffused flow is proposed to be concentrated and discharged onto adjacent property, the developer must obtain the written approval of the affected property owner(s). Areas of existing diffused drainage discharge shall be subject to any applicable release rate criteria in the general direction of existing discharge whether they are proposed to be concentrated or maintained as diffused drainage areas.
- E. Where a site is traversed by watercourses other than those for which a 100-year floodplain is defined by the municipality, there shall be provided drainage easements conforming substantially with the line of such watercourses. The width of any easement shall be adequate to provide for unimpeded flow of storm runoff based on calculations made in conformance with Section 308 for the 100-year return period runoff and to provide a freeboard allowance of one-half (0.5) foot above the design water surface level. The terms of the easement shall prohibit excavation, the placing of fill or structures, and any alterations which may adversely affect the flow of stormwater within any portion of the easement. Also, periodic maintenance of the easement to ensure proper runoff conveyance shall be required. Watercourses for which the 100-year floodplain is formally defined are subject to the applicable municipal floodplain regulations.
- F. Post construction BMPs shall be designed, installed, operated and maintained to meet the requirements of the Clean Streams Law and implementing regulations, including the established practices in 25 Pa. Code Chapter 102 and the specifications of this Ordinance as to prevent accelerated erosion in watercourse channels and at all points of discharge.
- G. No Earth Disturbance Activities associated with any Regulated Activities shall commence until approval by the municipality of a plan which demonstrates compliance with the requirements of this Ordinance.
- H. Techniques described in Appendix F (Low Impact Development Practices) of this Ordinance are encouraged because they reduce the costs of complying with the requirements of this Ordinance and the State Water Quality Requirements.
- I. Infiltration for stormwater management is encouraged where soils and geology permit, consistent with the provisions of this Ordinance and, where appropriate, the Recommendation Chart for Infiltration Stormwater Management BMPs in Carbonate Bedrock in Appendix D.

SECTION 302. PERMIT REQUIREMENTS BY OTHER GOVERNMENT ENTITIES

- A. Other regulations contain independent permit requirements that apply to certain Regulated and Earth Disturbance Activities eligible for authorization by the Municipality in accordance with the permitting requirements in this Ordinance. Permit requirements pursuant to those other regulations must be met prior to commencement, and during the conduct, of such Regulated and Earth Disturbance Activities, as applicable:
 - 1. All Regulated and Earth Disturbance Activities subject to permit requirements by DEP under regulations at 25 Pa. Code Chapter 102.
 - 2. Work within natural drainageways subject to permit by DEP under 25 Pa. Code Chapter 102 and Chapter 105.
 - 3. Any stormwater management facility that would be located in or adjacent to surface waters, including wetlands, subject to permit by DEP under 25 Pa. Code Chapter 105.
 - 4. Culverts, bridges, storm sewers or any other facilities which must pass or convey flows from the tributary area and any facility which may constitute a dam subject to permit by DEP under 25 Pa. Code Chapter 105.
 - 5. Projects that involve use of PennDOT right-of-way, or that involve new discharges onto or toward PennDOT right-of-way, are subject to the requirements, including the permitting requirements, of Title 67, Chapter 441 of the Pennsylvania Code.

SECTION 303. EROSION AND SEDIMENT CONTROL DURING REGULATED EARTH DISTURBANCE ACTIVITIES

- A. No Regulated Earth Disturbance Activities within the municipality shall commence until approval by the municipality of an Erosion and Sediment Control Plan for construction activities. Written approval by DEP or a delegated County Conservation District shall satisfy this requirement.
- B. A written Erosion and Sediment Control Plan is required by DEP regulations for any Earth Disturbance Activity under Pa. Code § 102.4(b).
- C. A DEP NPDES Stormwater Discharges Associated with Construction Activities Permit is required for Regulated Earth Disturbance Activities of one acre or greater under Pa. Code Chapter 92.
- D. Evidence of any necessary permit(s) for Regulated Earth Disturbance Activities from the appropriate DEP regional office or County Conservation District must be provided to the municipality before the commencement of an Earth Disturbance Activity.
- E. A copy of the Erosion and Sediment Control Plan and any permit, as required by DEP regulations, shall be available at the project site at all times.

SECTION 304. POST CONSTRUCTION WATER QUALITY CRITERIA

- A. No Regulated Earth Disturbance Activities within the municipality shall commence until approval by the municipality of a Drainage Plan which demonstrates compliance with this Ordinance.

- B. The Water Quality Volume (WQv) shall be captured and treated with Vegetated/Surface and/or Direct Recharge/Subsurface BMPs. The WQv shall be calculated as the difference in runoff volume from pre-development to post-development for the 24-hour, 2-year return period storm. This may be calculated using either the Soil-Cover-Complex Method or Rational Method using the 2-year rainfall depth as noted in Section 308.I. The effect of closed depressions on the site shall be considered in this calculation. The WQv shall be captured and treated in a manner consistent with the standards outlined in Section 305 of the Ordinance.
- C. The WQv shall be calculated for each post-development drainage direction on a site for sizing BMPs. Site areas having no impervious cover and no proposed disturbance during development may be excluded from the WQv calculations and do not require treatment.
- D. The applicant shall document the bedrock type(s) present on the site from published sources. Any apparent boundaries between carbonate and non-carbonate bedrock shall be verified through more detailed site evaluations by a qualified geotechnical professional.
- E. For each proposed Regulated Activity in the watershed where an applicant intends to use infiltration BMPs, the applicant shall conduct a Preliminary Site Investigation, including gathering data from published sources, a field inspection of the site, a minimum of one test pit and a minimum of two percolation tests, as outlined in Appendix G. This investigation will determine depth to bedrock, depth to the seasonal high water table, soil permeability and location of special geologic features, if applicable. This investigation may be done by a certified Sewage Enforcement Officer (SEO) except that the location(s) of special geologic features shall be verified by a qualified geotechnical professional.
- F. Sites where applicants intend to use infiltration BMPs must meet the following criteria:
- Depth to bedrock below the invert of the BMP greater than or equal to 2 feet.
 - Depth to seasonal high water table below the invert of the BMP greater than or equal to 2 feet; except for infiltration of residential roof runoff where the seasonal high water table must be below the invert of the BMP.
 - Soil permeability (as measured using the standards listed in Appendix C of the Pennsylvania Stormwater Best Practices Manual) greater than or equal to 0.1 inches/hour and less than or equal to 10 inches per hour.
 - Setback distances or buffers as follows:
 - 100 feet from water supply wells, or 50 feet in residential development.
 - 10 feet downgradient or 100 feet upgradient from building foundations.
 - 50 feet from septic system drainfields.
 - 50 feet from a geologic contact with carbonate bedrock unless a Preliminary Site Investigation is done in the carbonate bedrock to show the absence of special geologic features within 50 feet of the proposed infiltration area.
- G. In entirely carbonate areas, where the applicant intends to use infiltration BMPs, the Preliminary Site Investigation described in Appendix G shall be conducted. For infiltration areas that appear feasible based on the Preliminary Site Investigation, the applicant shall conduct the Additional Site Investigation and Testing as outlined in Appendix G. The soil depth, percolation rate and proposed loading rate, each weighted as described in Section 308, along with the buffer from special geologic features shall be compared to the Recommendation Chart for Infiltration Stormwater Management BMPs in Carbonate Bedrock in Appendix D to determine if the site is recommended for infiltration. In addition to the recommendation from Appendix D, the conditions listed in Section 304.F are required for infiltration in carbonate areas.
- H. Site areas proposed for infiltration shall be protected from disturbance and compaction except as necessary for construction of infiltration BMPs.

- I. If infiltration of the entire WQv is not proposed, the remainder of the WQv shall be treated by acceptable BMPs for each discharge location. Acceptable BMPs are listed in Appendix H.
- J. Stormwater runoff from Hot Spot land uses shall be pre-treated. Suggested methods of pre-treatment are listed in Appendix H.
- K. The use of infiltration BMPs is prohibited on Hot Spot land use areas unless the applicant can demonstrate that existing and proposed site conditions, including any proposed runoff pre-treatment, create conditions suitable for runoff infiltration under this Ordinance.
- L. Stormwater infiltration BMPs shall not be placed in or on a special geologic feature(s). Additionally, stormwater runoff shall not be discharged into existing on-site sinkholes.
- M. Stormwater drainage wells may only be used for runoff from roof areas.
- N. Applicants shall request, in writing, Public Water Suppliers to provide the Zone I Wellhead Protection radius, as calculated by the method outlined in the Pennsylvania Department of Environmental Protection Wellhead Protection regulations, for any public water supply well within 400 feet of the site. In addition to the setback distances specified in Section 304.F, infiltration is prohibited in the Zone I radius as defined and substantiated by the Public Water Supplier in writing. If the applicant does not receive a response from the Public Water Supplier, the Zone I radius is assumed to be 100 feet.
- O. The municipality may, after consultation with DEP, approve alternative methods 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.

SECTION 305. GREEN INFRASTRUCTURE AND EXISTING WATER BALANCE PRESERVATION STANDARDS

- A. The entire WQv as calculated in Section 304.B of this Ordinance shall be captured and treated by either Direct Recharge/Subsurface and/or Vegetated/Surface BMPs.
- B. As much proposed impervious area as practical shall be directed to water quality BMPs.
- C. Existing impervious area that is not proposed to be treated by Direct Recharge/Subsurface BMPs should be excluded from all water balance calculations.
- D. Vegetated/Surface BMPs shall be employed "first" for the site to capture the equivalent of a minimum of 0.38 inches of runoff for each square foot of impervious area, unless proven not feasible by the applicant. For proposed impervious cover directed to multiple BMPs, the Vegetated/Surface BMP capture volume chart in Appendix C shall be used to determine overall site compliance. Direct Recharge/Subsurface BMPs may be used "first" for portions of the impervious cover provided the overall Vegetated/Surface BMP "first" standard is met.
- E. A maximum of 30% of the total annual rainfall for a site may be directly recharged to groundwater using Direct Recharge/Subsurface BMPs, for runoff from impervious areas.
 - 1. For development sites with greater than 33% proposed impervious cover:
 - a. If all impervious cover is directed to Vegetated/Surface BMPs to capture the entire 2-year, 24-hour event, the Direct Recharge standard is met.

- b. Up to 33% of the site as impervious cover may be directed to Direct Recharge/Subsurface BMPs designed to capture the entire 2-year, 24-hour event provided the overall Vegetated/Surface BMP "first" standard is met. All remaining impervious cover shall be directed to Vegetated/Surface BMPs designed to capture the remainder of the WQv.
 - c. For Vegetated/Surface and/or Direct Recharge/Subsurface BMPs designed for runoff from impervious areas designed to capture less than the entire 2-year, 24-hour event, Appendix C shall be used to assure that the maximum Direct Recharge standard is met.
2. The maximum 30% Direct Recharge standard applies on an overall site basis, rather than in each drainage direction.

SECTION 306. STORMWATER MANAGEMENT DISTRICTS

- A. Mapping of Stormwater Management Districts - To implement the provisions of the Monocacy Creek Watershed Stormwater Management Plan Update, the municipality is hereby divided into Stormwater Management Districts consistent with the Monocacy Creek Release Rate Map presented in the Plan Update. The boundaries of the Stormwater Management Districts are shown on an official map which is available for inspection at the municipal office. A copy of the official map at a reduced scale is included in Appendix A for general reference.
- B. Release Rate Districts - There are six single release rate districts that differ in the extent to which the post-development runoff must be controlled. The release rate districts are 50%, 60%, 70%, 80%, 90% and 100%. Within a given district, the post-development peak rate of storm runoff must be controlled to the stated percentage of the pre-development peak rate of runoff for each of the 10-, 25-, 50- and 100-year return period storms to protect downstream watershed areas.

There is one dual release rate district. Within this district, the 10-year return period event needs to meet a 30% release rate, and the 25-year and higher return period events need to meet a 100% release rate.
- C. Conditional No Detention Districts - These watershed areas peak very early with respect to the total watershed peak flow and contribute very minimal flow to the watershed peak flow. For that reason, these watershed areas may discharge post-development peak runoff without detention for the 10- through 100-year return periods without adversely affecting the total watershed peak flow. These areas are designated as "conditional" no detention areas because in certain instances the "local" runoff conveyance facilities, which transport runoff from the site to the main channel, may not have adequate capacity to safely transport the peak flows associated with no detention for a proposed development. In those instances, a 100% release rate control would have to be provided or, alternately, the capacity deficiency(ies) would have to be corrected.

SECTION 307. STORMWATER MANAGEMENT DISTRICT IMPLEMENTATION PROVISIONS

- A. Applicants shall provide a comparative pre- and post construction stormwater management hydrograph analysis for each direction of discharge and for the site overall to demonstrate compliance with the provisions of this Ordinance.
- B. Any stormwater management controls required by this Ordinance and subject to release rate criteria shall meet the applicable release rate criteria for each of the 2-, 10-, 25-, 50- and 100-year return period runoff events consistent with the calculation methodology specified in

Section 308.

- C. 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 provided as part of the Drainage Plan. The District boundaries as originally drawn coincide with topographic divides or, in certain instances, are drawn from the intersection of the watercourse and a physical feature such as the confluence with another watercourse or a potential flow obstruction (e.g., road, culvert, bridge, etc.). The physical feature is the downstream limit of the subarea, and the subarea boundary is drawn from that point up slope to each topographic divide along the path perpendicular to the contour lines.
- D. Any downstream capacity analysis conducted in accordance with this Ordinance shall use the following criteria for determining adequacy for accepting increased peak flow rates:
 - 1. Natural or man-made channels or swales must be able to convey the increased runoff associated with a 2-year return period event within their banks at velocities consistent with protection of the channels from erosion.
 - 2. Natural or man-made channels, swales, culverts, bridges, storm sewers or any other facilities which must convey flows from the tributary area must be able to convey the increased 25-year return period runoff.
- E. For a proposed development site located within one release rate category subarea, the total runoff from the site shall meet the applicable release rate criteria. For development sites with multiple directions of runoff discharge, individual drainage directions may be designed for up to a 100% release rate so long as the total runoff from the site is controlled to the applicable release rate.
- F. For a proposed development site located within two or more release rate category subareas, the peak discharge rate from any subarea shall be the pre-development peak discharge for that subarea multiplied by the applicable release rate. The calculated peak discharges shall apply regardless of whether the grading plan changes the drainage area by subarea. An exception to the above may be granted if discharges from multiple subareas re-combine in proximity to the site. In this case, peak discharge in any direction may be a 100% release rate provided that the overall site discharge meets the weighted average release rate.
- G. For sites straddling major watershed divides (e.g., Monocacy Creek and Bushkill Creek), runoff volumes shall be managed to prevent diversion of runoff between watersheds, as practicable.
- H. Within a release rate category area, for a proposed development site which has areas which drain to a closed depression(s), the design release from the site will be the lesser of (a) the applicable release rate flow assuming no closed depression(s) or (b) the existing peak flow actually leaving the site. In cases where (b) would result in an unreasonably small design release, the design discharge of less than or equal to the release rate will be determined by the available downstream conveyance capacity to the main channel calculated using Section 307.D and the minimum orifice criteria.
- I. Off-site areas which drain through a proposed development site are not subject to release rate criteria when determining allowable peak runoff rates. However, on-site drainage facilities shall be designed to safely convey off-site flows through the development site using the capacity criteria in Section 307.D and the detention criteria in Section 308. In addition to the criteria in Section 307.D, on-site conveyance systems designed to carry runoff to a detention basin must be able to transport the basin's 100-year tributary flow either in-system, in-gutter or overland.

- J. For development sites proposed to take place in phases, all detention ponds shall be designed to meet the applicable release rate(s) applied to all site areas tributary to the proposed pond discharge direction. All site tributary areas will be assumed as developed, regardless of whether all site tributary areas are proposed for development at that time. An exception shall be sites with multiple detention ponds in series where only the downstream pond must be designed to the stated release rate.
- K. Where the site area to be impacted by a proposed development activity differs significantly from the total site area, only the proposed impact area shall be subject to the release rate criteria. The impact area includes any proposed cover or grading changes.
- L. Development proposals which, through groundwater recharge or other means, do not increase either the rate or volume of runoff discharged from the site compared to pre-development are not subject to the release rate provisions of this Ordinance.
- M. "No Harm" Water Quantity Option - For any proposed development site, the developer has the option of using a less restrictive runoff control if the developer can prove that special circumstances exist for the proposed development site and that "no harm" would be caused by discharging at a higher runoff rate than that specified by this Ordinance. Special circumstances are defined as any hydrologic or hydraulic aspects of the development itself not accommodated by the runoff control standards of this Ordinance. Proof of "no harm" would have to be shown from the development site through the remainder of the downstream drainage network to the confluence of the Monocacy Creek with the Lehigh River. Proof of "no harm" must be shown using the capacity criteria specified in Section 307.D. if downstream capacity analysis is a part of the "no harm" justification.

Attempts to prove "no harm" based upon downstream peak flow versus capacity analysis shall be governed by the following provisions:

1. Any available capacity in the downstream conveyance system as documented by a developer may be used by the developer only in proportion to his development site acreage relative to the total upstream undeveloped acreage from the identified capacity (i.e. if his site is 10% of the upstream undeveloped acreage, he may use up to 10% of the documented downstream available capacity).
2. Developer-proposed runoff controls which would generate increased peak flow rates at storm drainage problem areas would, by definition, be precluded from successful attempts to prove "no harm".
3. Any downstream capacity improvements proposed by the developer as part of a "no harm" justification would be designed using the capacity criteria specified in Section 307.D. Peak flow contributions to the proposed improvements shall be calculated as the larger of: (1) assuming the local watershed is in the existing condition, or (2) assuming that the local watershed is developed per current zoning and using the specified runoff controls.

Any "no harm" justifications shall be submitted by the developer as part of the Drainage Plan submission per Article 4. Developers submitting "no harm" justifications must still meet all of the water quality requirements in Section 304. The municipality will process all eligible "no harm" requests in accordance with Section 304.O.

- N. Capacity Improvements - In certain instances, local drainage conditions may dictate more stringent levels of runoff control than those based upon protection of the entire watershed. In these instances, if the developer could prove that it would be feasible to provide capacity improvements to relieve the capacity deficiency in the local drainage network, then the

capacity improvements could be provided by the developer in lieu of runoff controls on the development site. Peak flow calculations shall be done assuming that the local watershed is in the existing condition and then assuming that the local watershed is developed per current zoning and using the specified runoff controls. Any capacity improvements would be designed using the larger of the above peak flows and the capacity criteria specified in Section 307.D. All new development in the entire subarea(s) within which the proposed development site is located shall be assumed to implement the developer's proposed discharge control, if any.

- O. Release Rates need to be met year round. Designs involving BMPs that function differently in winter versus non-winter conditions (e.g., capture/reuse with spray irrigation shut off for the winter) must still meet release rates during the winter.

SECTION 308. CALCULATION METHODOLOGY

- A. Stormwater runoff from all development sites shall be calculated using either the Rational Method or the Soil-Cover-Complex methodology.
- B. Infiltration BMP loading rate percentages in the Recommendation Chart for Infiltration Stormwater Management BMPs in Carbonate Bedrock in Appendix D shall be calculated as follows:

$$\frac{\text{Area Tributary to infiltration BMP}}{\text{Base Area of infiltration BMP}} * 100\%$$

The area tributary to the infiltration BMP shall be weighted as follows:

All disturbed areas to be made impervious:	weight at 100%
All disturbed areas to be made pervious:	weight at 50%
All undisturbed pervious areas:	weight at 0%
All existing impervious areas:	weight at 100%

- C. The design of any detention basin intended to meet the requirements of this Ordinance shall be verified by routing the design storm hydrograph through the proposed basin using the storage indication method or other methodology demonstrated to be more appropriate. For basins designed using the Rational Method technique, the design hydrograph for routing shall be either the Universal Rational Hydrograph or another Rational hydrograph that closely approximates the volume of the Universal Rational Hydrograph.
- D. BMPs designed to store or infiltrate runoff and discharge to surface runoff or pipe flow shall be routed using the storage indication method.
- E. BMPs designed to store or infiltrate runoff and discharge to surface runoff or pipe flow shall provide storage volume for the full WQv below the lowest outlet invert.
- F. Wet Detention Ponds designed to have a permanent pool for the WQv shall assume that the permanent pool volume below the primary outlet is full at the beginning of design event routing for the purposes of evaluating peak outflows.
- G. All above-ground stormwater detention facilities shall provide a minimum 0.5 feet of freeboard above the maximum pool elevation associated with the 2- through 100-year runoff events, or an additional ten percent of the 100-year storage volume as freeboard volume, whichever is greater. All below-ground stormwater detention and infiltration facilities shall have an additional ten percent of the 100-year storage volume available within the storage medium, as well as a minimum of 0.5 feet of freeboard. The freeboard shall be measured from the maximum pool elevation to the invert of the emergency spillway for above-ground facilities,

and from the maximum pool elevation to the lowest overflow elevation for below-ground facilities. The 2- through 100-year storm events shall be controlled by the primary outlet structure. An emergency spillway for each above-ground basin shall be designed to pass the 100-year return frequency storm peak basin inflow rate with a minimum 0.5 foot freeboard measured to the top of basin. The freeboard criteria shall be met considering any off-site areas tributary to the basin as developed, as applicable. Exceptions to the freeboard requirements are as follows:

1. Bioretention BMPs with a ponded depth less than or equal to 0.5 feet are exempt from the freeboard requirements.
2. Small detention basins, with a ponded depth less than or equal to 1.5 feet or having a depth to the top of the berm less than or equal to 2.5 feet, may provide twenty percent additional storage volume measured from the maximum ponded depth to the invert of the emergency spillway in lieu of the above requirements. The depth of the emergency spillway must be sufficient to pass either two times the 100-year peak or the 100-year peak with 0.2' of freeboard to the top of berm, whichever is greater.
3. Small infiltration basins, with a ponded depth less than or equal to 1.5 feet or having a depth to the top of the berm less than or equal to 2.5 feet, may provide twenty percent additional storage volume measured from the maximum ponded depth to the top of the berm in lieu of the above requirements. In this case, an emergency spillway is only necessary if runoff in excess of the basin volume would cause harm to downstream owners. If a spillway is necessary, it must be sufficiently sized to pass the 100-year peak inflow.

If this detention facility is considered to be a dam as per DEP Chapter 105, the design of the facility must be consistent with the Chapter 105 regulations, and may be required to pass a storm greater than the 100-year event.

- H. The minimum circular orifice diameter for controlling discharge rates from detention facilities shall be three (3) inches. Designs where a lesser size orifice would be required to fully meet release rates shall be acceptable with a 3-inch orifice provided that as much of the site runoff as practical is directed to the detention facilities. The minimum 3-inch diameter does not apply to the control of the WQv.
- I. Runoff calculations using the Soil-Cover-Complex method shall use the Natural Resources Conservation Service Type II 24-hour rainfall distribution. The 24-hour rainfall depths for the various return periods to be used consistent with this Ordinance may be taken from NOAA Atlas 14, Precipitation Frequency Atlas of the United States, current volume, or the Pennsylvania Department of Transportation Drainage Manual, 2015 Edition for Region 4. The following values are taken from the Drainage Manual:

<u>Return Period</u>	<u>24-Hour Rainfall Depth</u>
1-year	2.64 inches
2-year	3.16 inches
5-year	3.91 inches
10-year	4.57 inches
25-year	5.60 inches
50-year	6.53 inches
100-year	7.63 inches

A graphical and tabular presentation of the Type II-24 hour distribution is included in Appendix C.

- J. Runoff calculations using the Rational Method shall use rainfall intensities consistent with appropriate times of concentration and return periods and NOAA Atlas 14, Precipitation Frequency Atlas of the United States Precipitation and Intensity Charts, current volume, as presented in Appendix C.
- K. Runoff Curve Numbers (CN's) to be used in the Soil-Cover-Complex method shall be based upon the table presented in Appendix C.
- L. Runoff coefficients for use in the Rational Method shall be based upon the table presented in Appendix C.
- M. All time of concentration calculations shall use a segmental approach which may include one or all of the flow types below:
 - 1. Sheet Flow (overland flow) calculations shall use either the NRCS average velocity chart (Figure 3-1, Technical Release-55, 1975) or the modified kinematic wave travel time equation (equation 3-3, NRCS TR-55, June 1986). If using the modified kinematic wave travel time equation, the sheet flow length shall be limited to 50 feet for designs using the Rational Method and limited to 150 feet for designs using the Soil-Cover-Complex method.
 - 2. Shallow Concentrated Flow travel times shall be determined from the watercourse slope, type of surface and the velocity from Figure 3-1 of TR-55, June 1986.
 - 3. Open Channel Flow travel times shall be determined from velocities calculated by the Manning Equation. Bankfull flows shall be used for determining velocities. Manning 'n' values shall be based on the table presented in Appendix C.
 - 4. Pipe Flow travel times shall be determined from velocities calculated using the Manning Equation assuming full flow and the Manning 'n' values from Appendix C.
- N. If using the Rational Method, all pre-development calculations for a given discharge direction shall be based on a common time of concentration considering both on-site and any off-site drainage areas. If using the Rational Method, all post-development calculations for a given discharge direction shall be based on a common time of concentration considering both on-site and any off-site drainage areas.
- O. When conditions exist such that a proposed detention facility may experience a tailwater effect, the basin shall be analyzed without any tailwater effect for all storm events for comparison against the required Release Rates. An additional routing of the 100-year storm with the full tailwater effect shall be performed to check that the basin has sufficient storage to contain the 100-year tributary flow and meet freeboard requirements.
- P. The Manning Equation shall be used to calculate the capacity of watercourses. Manning 'n' values used in the calculations shall be consistent with the table presented in Appendix C or other appropriate standard engineering 'n' value resources. Pipe capacities shall be determined by methods acceptable to the municipality.
- Q. The Pennsylvania DEP, Chapter 105, Rules and Regulations, apply to the construction, modification, operation or maintenance of both existing and proposed dams, water obstructions and encroachments throughout the watershed. Criteria for design and construction of stormwater management facilities according to this Ordinance may differ from the criteria that are used in the permitting of dams under the Dam Safety Program.

ARTICLE 4 DRAINAGE PLAN REQUIREMENTS

SECTION 401. GENERAL REQUIREMENTS

For any of the Regulated Activities of this Ordinance, prior to the final approval of subdivision and/or land development plans, or the issuance of any permit, or the commencement of any Regulated Earth Disturbance Activity, the owner, subdivider, developer or his agent shall submit a Drainage Plan and receive municipal approval of the Plan.

SECTION 402. EXEMPTIONS

Exemptions from the Drainage Plan Requirements are as specified in Section 106.

SECTION 403. DRAINAGE PLAN CONTENTS

The following items shall be included in the Drainage Plan:

- A. General
 - 1. General description of project.
 - 2. General description of proposed permanent stormwater controls.
 - 3. The name and address of the project site, the name and address of the owner of the property and the name of the individual or firm preparing the Drainage Plan.
- B. Map(s) of the Project Area Showing:
 - 1. The location of the project relative to highways, municipalities or other identifiable landmarks.
 - 2. Existing contours at intervals of two (2) feet. In areas of steep slopes (greater than 15%), five-foot contour intervals may be used. Off-site drainage areas impacting the project including topographic detail.
 - 3. Streams, lakes, ponds or other bodies of water within the project area.
 - 4. Other features including flood hazard boundaries, existing drainage swales, wetlands, closed depressions, sinkholes and areas of natural vegetation to be preserved.
 - 5. Locations of proposed underground utilities, sewers and water lines. The locations of all existing and proposed utilities, sanitary sewers and water lines within 50 feet of property lines of the project site.
 - 6. An overlay showing soil types and boundaries based on the county soil survey, as applicable, latest edition. Any hydric soils present on the site should be identified as such.
 - 7. An overlay showing geologic types, boundaries and any special geologic features present on the site.
 - 8. Proposed changes to land surface and vegetative cover.

9. Proposed structures, roads, paved areas and buildings.
 10. Final contours at intervals of two (2) feet. In areas of steep slopes (greater than 15%), five-foot contour intervals may be used.
 11. Stormwater Management District boundaries applicable to the site.
 12. Clear identification of the location and nature of permanent stormwater BMPs.
 13. An adequate access easement around all stormwater BMPs that would provide municipal ingress to and egress from a public right-of-way.
 14. A schematic showing all tributaries contributing flow to the site and all existing man-made features beyond the property boundary that would be affected by the project.
 15. The location of all public water supply wells within 400 feet of the project and all private water supply wells within 100 feet of the project.
- C. Stormwater Management Controls and BMPs
1. All stormwater management controls and BMPs shall be shown on a map and described, including:
 - a. Groundwater recharge methods such as seepage pits, beds or trenches. When these structures are used, the locations of septic tank infiltration areas and wells shall be shown.
 - b. Other control devices or methods such as roof-top storage, semi-pervious paving materials, grass swales, parking lot ponding, vegetated strips, detention or retention ponds, storm sewers, etc.
 2. All calculations, assumptions and criteria used in the design of the BMPs shall be shown.
 3. All site testing data used to determine the feasibility of infiltration on a site.
 4. All details and specifications for the construction of the stormwater management controls and BMPs.
- D. The BMP Operations and Maintenance Plan, as required in Article 7, describing how each permanent stormwater BMP will be operated and maintained and the identity of the person(s) responsible for operations and maintenance. A statement must be included, signed by the landowner, acknowledging that the stormwater BMPs are fixtures that cannot be altered or removed without approval by the municipality.

SECTION 404.PLAN SUBMISSION

- A. For Regulated Activities specified in Sections 105.A. and 105.B:
1. The Drainage Plan shall be submitted by the developer to the municipal secretary (or other appropriate person) as part of the Preliminary Plan submission for the subdivision or land development.
 2. Four (4) copies of the Drainage Plan shall be submitted.

3. Distribution of the Drainage Plan will be as follows:
 - a. One (1) copy to the municipal governing body.
 - b. One (1) copy to the municipal engineer.
 - c. Two (2) copies to the Lehigh Valley Planning Commission (LVPC), except for Drainage Plans involving less than 10,000 square feet of additional impervious cover.
 4. Drainage Plans involving more than 10,000 square feet of additional impervious cover shall be submitted by the developer (possibly through the municipality) to the LVPC as part of the Preliminary Plan submission. The LVPC will conduct an advisory review of the Drainage Plan for consistency with the Monocacy Creek Watershed Stormwater Management Plan. The LVPC will not review details of the Erosion and Sedimentation Plan or the BMP Operations and Maintenance Plan.
 - a. Two (2) copies of the Drainage Plan shall be submitted.
 - b. The LVPC will provide written comments to the developer and the municipality, within a time frame consistent with established procedures under the Municipalities Planning Code, as to whether the Drainage Plan has been found to be consistent with the Stormwater Management Plan.
- B. For Regulated Activities specified in Sections 105.C. and 105.D, the Drainage Plan shall be submitted by the developer to the municipal building permit officer as part of the building permit application.
 - C. For Regulated Activities specified in Sections 105.E, 105.F. and 105.G:
 1. The Drainage Plan shall be submitted by the developer to the Lehigh Valley Planning Commission for coordination with the DEP permit application process, as needed, under Chapter 105 (Dam Safety and Waterway Management), Chapter 106 (Flood Plain Management) of DEP's Rules and Regulations and the NPDES regulations.
 2. One (1) copy of the Drainage Plan shall be submitted.
 - D. Earthmoving for all Regulated Activities under Section 105 shall be conducted in accordance with the current Federal and State regulations relative to the NPDES and DEP Chapter 102 regulations.

SECTION 405.DRAINAGE PLAN REVIEW

- A. The municipality shall review the Drainage Plan, including the BMP Operations and Maintenance Plan, for consistency with this Ordinance. The municipality shall also review the Drainage Plan against any additional storm drainage provisions contained in the municipal subdivision and land development or zoning ordinance, as applicable.
- B. The municipality shall notify the applicant in writing whether the Drainage Plan, including the BMP Operations and Maintenance Plan, is approved, consistent with time frames as established by the current Pennsylvania Municipalities Planning Code.
- C. The municipality shall not approve any subdivision or land development (Regulated Activities 105.A. and 105.B.) or building permit application (Regulated Activities 105.C. and 105.D.) if the Drainage Plan has been found to be inconsistent with this Ordinance.

- D. The municipality may require an "As-Built Survey" of all stormwater BMPs and an explanation of any discrepancies with the Drainage Plan.

SECTION 406. MODIFICATION OF PLANS

A modification to a Drainage Plan for a proposed development site which involves a change in control methods or techniques, or which involves the relocation or redesign of control measures, or which is necessary because soil or other conditions are not as stated on the Drainage Plan (as determined by the municipality) shall require a resubmission of the modified Drainage Plan consistent with Section 404 subject to review per Section 405 of this Ordinance.

SECTION 407. HARDSHIP WAIVER PROCEDURE

The municipality may hear requests for waivers where it is alleged that the provisions of this Ordinance inflict unnecessary hardship upon the applicant. The waiver request shall be in writing and accompanied by the requisite fee based upon a fee schedule adopted by the municipality. A copy of the waiver request shall be provided to each of the following: municipality, municipal engineer, municipal solicitor and Lehigh Valley Planning Commission. The request shall fully document the nature of the alleged hardship.

The municipality may accept a waiver request provided that the Municipality determines that in each case the request satisfies all of the following findings:

1. That there are unique physical circumstances or conditions, including irregularity of lot size or shape, or exceptional topographical or other physical conditions peculiar to the particular property, and that the unnecessary hardship is due to such conditions, and not the circumstances or conditions generally created by the provisions of this Ordinance in the Stormwater Management District in which the property is located;
2. That because of such physical circumstances or conditions, there is no possibility that the property can be developed in strict conformity with the provisions of this Ordinance, and that the authorization of a waiver is therefore necessary to enable the reasonable use of the property;
3. That such unnecessary hardship has not been created by the applicant;
4. That the waiver, if authorized, will represent the minimum waiver that will afford relief and will represent the least modification possible of the regulation in issue; and
5. That financial hardship is not the criteria for granting of a hardship waiver.

In processing any waiver request, the municipality may attach such conditions and safeguards as it may deem necessary to implement the purposes of this Ordinance. If a Hardship Waiver is granted, the applicant must still manage the quantity, velocity, direction and quality of resulting storm runoff as is necessary to prevent injury to health, safety or other property.

- A. For Regulated Activities described in Section 105.A. and B., the [municipal governing body] shall hear requests for and decide on hardship waiver requests on behalf of the municipality.
- B. For Regulated Activities in Section 105.C, D., E., F. and G., the Zoning Hearing Board shall hear requests for and decide on hardship waiver requests on behalf of the municipality.
- C. The municipality will process all eligible waiver requests in accordance with the provisions of Section 304.O.

ARTICLE 5 INSPECTIONS

SECTION 501. SCHEDULE OF INSPECTIONS

- A. DEP or its designees (e.g., County Conservation District) normally ensure compliance with any permits issued, including those for stormwater management. In addition to DEP compliance programs, the municipality or its designee may inspect all phases of the construction, operations, maintenance and any other implementation of stormwater BMPs.
- B. During any stage of the Regulated Earth Disturbance Activities, if the municipality or its designee determines that any BMPs are not being implemented in accordance with permit conditions or this Ordinance, the municipality may suspend or revoke any existing permits issued by the municipality or other approvals issued by the municipality until the deficiencies are corrected.

ARTICLE 6 FEES AND EXPENSES

SECTION 601. GENERAL

The municipality may charge a reasonable fee for review of the Drainage Plan, including the BMP Operations and Maintenance Plan, to defray review costs incurred by the municipality. The applicant shall pay all such fees.

SECTION 602. EXPENSES COVERED BY FEES

The fees required by this Ordinance shall at a minimum cover:

- A. The review of the Drainage Plan, including the BMP Operations and Maintenance Plan, by the municipality.
- B. The site inspection.
- C. The inspection of required controls and improvements during construction.
- D. The final inspection upon completion of the controls and improvements required in the plan.
- E. Any additional work required to monitor and enforce any permit provisions, regulated by this Ordinance, correct violations, and assure the completion of stipulated remedial actions.
- F. Administrative and clerical costs.

ARTICLE 7 STORMWATER BMP OPERATIONS AND MAINTENANCE PLAN REQUIREMENTS

SECTION 701. GENERAL REQUIREMENTS

- A. No Regulated Earth Disturbance Activities within the municipality shall commence until approval by the municipality of the BMP Operations and Maintenance Plan which describes how the permanent (e.g., post construction) stormwater BMPs will be properly operated and maintained.

SECTION 702. RESPONSIBILITIES FOR OPERATIONS AND MAINTENANCE OF BMPS

- A. The BMP Operations and Maintenance Plan for the project site shall establish responsibilities for the continuing operation and maintenance of all permanent stormwater 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 BMPs may also be dedicated to and maintained by the municipality.
 - 2. If a Plan includes operations and maintenance by a single owner or if sewers and other public improvements are to be privately owned and maintained, then the operation and maintenance of stormwater BMPs shall be the responsibility of the owner or private management entity.
- B. The municipality shall make the final determination on the continuing operations and maintenance responsibilities. The municipality reserves the right to accept or reject the operations and maintenance responsibility for any or all of the stormwater BMPs.

SECTION 703. ADHERENCE TO APPROVED BMP OPERATIONS AND MAINTENANCE PLAN

It shall be unlawful to alter or remove any permanent stormwater BMP required by an approved BMP Operations and Maintenance Plan or to allow the property to remain in a condition which does not conform to an approved BMP Operations and Maintenance Plan unless an exception is granted in writing by the municipality.

SECTION 704. OPERATIONS AND MAINTENANCE AGREEMENT FOR PRIVATELY- OWNED STORMWATER BMPS

- A. The property owner shall sign an operations and maintenance agreement with the municipality covering all stormwater BMPs that are to be privately- owned. The agreement shall be substantially the same as the agreement in Appendix E of this Ordinance.
- B. Other items may be included in the agreement where determined by the municipality to be reasonable or necessary to guarantee the satisfactory operation and maintenance of all permanent stormwater BMPs. The agreement shall be subject to the review and approval of the municipality.

SECTION 705. STORMWATER MANAGEMENT EASEMENTS

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

SECTION 706. RECORDING OF APPROVED BMP OPERATIONS AND MAINTENANCE PLAN AND RELATED AGREEMENTS

- A. The owner of any land upon which permanent BMPs will be placed, constructed or implemented, as described in the BMP Operations and Maintenance Plan, shall record the following documents in the county Office of the Recorder of Deeds for Lehigh or Northampton County, as applicable, within 90 days of approval of the BMP Operations and Maintenance Plan by the municipality:
 - 1. The Operations and Maintenance Plan or a summary thereof.
 - 2. Operations and Maintenance Agreements under Section 704.

3. Easements under Section 705.
- B. The municipality may suspend or revoke any approvals granted for the project site upon discovery of the failure of the owner to comply with this Section.

SECTION 707. MUNICIPAL STORMWATER BMP OPERATIONS AND MAINTENANCE FUND

- A. Persons installing stormwater BMPs shall be required to pay a specified amount to the Municipal Stormwater BMP Operations and Maintenance Fund to help defray costs of operations and maintenance activities. The amount may be determined as follows:
1. If the BMP is to be privately-owned and maintained, the amount shall cover the cost of periodic inspections by the municipality in perpetuity, as determined by the municipality.
 2. If the BMP is to be owned and maintained by the municipality, the amount shall cover the estimated costs for operation and maintenance in perpetuity, as determined by the municipality.
 3. The amount shall then be converted to present worth of the annual series values.
- B. If a BMP is proposed that also serves as a recreation facility (e.g., ball field, lake), the municipality may adjust the amount due accordingly.

ARTICLE 8 PROHIBITIONS

SECTION 801. PROHIBITED DISCHARGES AND CONNECTIONS

- A. Any drain or conveyance, whether on the surface or subsurface, that allows any non-stormwater including sewage, process wastewater, and wash water to enter a regulated small municipal separate storm sewer (MS4) or to enter the surface waters of this Commonwealth is prohibited.
- B. No person shall allow, or cause to allow, discharges into a regulated small MS4, or discharges into waters of this Commonwealth, which are not composed entirely of stormwater, except (1) as provided in paragraph C below and (2) discharges authorized under a state or federal permit.
- C. The following discharges are authorized unless they are determined to be significant contributors to pollution a regulated small MS4 or to the waters of this Commonwealth:
1. Discharges or flows from firefighting activities.
 2. Discharges from potable water sources including water line flushing and fire hydrant flushing, if such discharges do not contain detectable concentrations of Total Residual Chlorine (TRC).
 3. Non-contaminated irrigation water, water from lawn maintenance, landscape drainage and flows from riparian habitats and wetlands.
 4. Diverted stream flows and springs.
 5. Non-contaminated pumped ground water and water from foundation and footing drains and crawl space pumps.
 6. Non-contaminated HVAC condensation and water from geothermal systems.
 7. Residential (i.e., not commercial) vehicle wash water where cleaning agents are not utilized.

8. Non-contaminated hydrostatic test water discharges, if such discharges do not contain detectable concentrations of TRC.
- D. In the event that the municipality or DEP determines that any of the discharges identified in Subsection C significantly contribute pollutants to a regulated small MS4 or to the waters of this Commonwealth, the municipality or DEP will notify the responsible person(s) to cease the discharge.

SECTION 802.ROOF DRAINS AND SUMP PUMPS

Roof drains and sump pumps shall discharge to infiltration or vegetative BMPs wherever feasible.

SECTION 803.ALTERATION OF STORMWATER MANAGEMENT BMPs

No person shall modify, remove, fill, landscape, or alter any stormwater management BMPs, facilities, areas, or structures that were installed as a requirement of this Ordinance without the written approval of the Municipality.

ARTICLE 9 RIGHT OF ENTRY, NOTIFICATION AND ENFORCEMENT

SECTION 901.RIGHT OF ENTRY

- A. Upon presentation of proper credentials and with the consent of the land owner, 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 BMPs or to investigate or ascertain the condition of the subject property in regard to any aspect regulated by this Ordinance.
- B. In the event that the land owner refuses admission to the property, duly authorized representatives of the municipality may seek an administrative search warrant issued by a district justice to gain access to the property.

SECTION 902.NOTIFICATION

- 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 require without limitation:
 1. The name of the owner of record and any other person against whom the municipality intends to take action.
 2. The location of the property in violation.
 3. The performance of monitoring, analyses and reporting.
 4. The elimination of prohibited connections or discharges.
 5. Cessation of any violating discharges, practices or operations.
 6. The abatement or remediation of stormwater pollution or contamination hazards and the restoration of any affected property.
 7. Payment of a fine to cover administrative and remediation costs.
 8. The implementation of stormwater BMPs.
 9. Operation and maintenance of stormwater BMPs.

- B. Such notification shall set forth the nature of the violation(s) and establish a time limit for correction of the violation(s). Said notice may further advise that should the violator fail to take the required action within the established deadline, the work will be done by the municipality or designee and the expense thereof, together with all related lien and enforcement fees, charges and expenses, shall be charged to the violator.
- C. Failure to comply within the time specified shall also subject such person to the penalty provisions of this Ordinance. All such penalties shall be deemed cumulative and shall not prevent the municipality from pursuing any and all other remedies available in law or equity.

SECTION 903. PUBLIC NUISANCE

- A. The violation of any provision of this Ordinance is hereby deemed a Public Nuisance.
- B. Each day that an offense continues shall constitute a separate violation.

SECTION 904. SUSPENSION AND REVOCATION OF PERMITS AND APPROVALS

- A. Any building, land development or other permit or approval issued by the municipality may be suspended or revoked by the municipality for:
 - 1. Non-compliance with or failure to implement any provision of the permit.
 - 2. A violation of any provision of this Ordinance.
 - 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 or property of others.
- B. A suspended permit or approval shall be reinstated by the municipality when:
 - 1. The municipality or designee has inspected and approved the corrections to the stormwater BMPs or the elimination of the hazard or nuisance.
 - 2. The municipality is satisfied that the violation of the ordinance, law or rule and regulation has been corrected.
 - 3. Payment of all municipal fees, costs and expenses related to or arising from the violation has been made.
- C. A permit or approval which has been revoked by the municipality cannot be reinstated. The applicant may apply for a new permit under the procedures outlined in this Ordinance.

SECTION 905. PENALTIES

- A. Any person, partnership or corporation who or which has violated the provisions of this Ordinance shall, upon being found liable therefore in a civil enforcement proceeding commenced by the municipality, pay a judgment of not more than Five Hundred (\$500.00) Dollars plus all court costs, including reasonable attorney's fees incurred by the municipality as a result thereof. No judgment shall commence or be imposed, levied or payable until the date of the determination of a violation by the district justice. If the defendant neither pays nor timely appeals the judgment, the municipality may enforce the judgment pursuant to a separate violation, unless the district justice, determining that there has been a violation, further determines that there was a good faith basis for the person, partnership, or corporation violating this Ordinance to have believed that there was no such violation, in which event there shall be deemed to have been only one such violation until the fifth (5th) day following the date of the determination of a violation by the district justice and thereafter each day that a violation continues shall constitute a separate violation.

- B. The court of common pleas, upon petition, may grant an order of stay upon cause shown, tolling the per diem judgment pending a final adjudication of the violation and judgment.
- C. Nothing contained in this Section shall be construed or interpreted to grant to any person or entity other than the municipality the right to commence any action for enforcement pursuant to this Section.
- D. District justices shall have initial jurisdiction in proceedings brought under this Section.
- E. In addition, the municipality, through its solicitor, 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

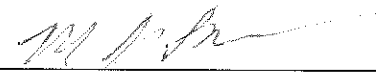
Any person aggrieved by any action of the municipality or its designee relevant to the provisions of this Ordinance may appeal using the appeal procedures established in the Pennsylvania Municipalities Planning Code.

DULY APPROVED this 10 day of October, 2018 by the Board of Supervisors of Lower Nazareth Township, Northampton County, Pennsylvania.

BOARD OF SUPERVISORS

ATTEST:


 TAMMI DRAVECZ, Secretary

By: 
 JAMES PENNINGTON, Chairman
 Martin Rouillon Vice

APPENDIX A

- A1: Municipal Map of Stormwater Release Rates*
- A2: Release Rate Summary Table

APPENDIX B

- B1: Map of Storm Drainage Problem Areas*
- B2: Description of Storm Drainage Problem Areas

APPENDIX C

- C1: NRCS Type II 24-Hour Rainfall Distribution (Graphic and Tabular)
- C2: Precipitation Intensity and Depth Charts
- C3: Runoff Curve Numbers and Percent Imperviousness Values
- C4: Runoff Coefficients for the Rational Method
- C5: Manning 'n' Values
- C6: Percent Direct Recharge per Fraction Impervious versus Storage Curve
- C7: Percent Direct Recharge per Fraction Impervious versus Storage Curve Usage Instructions
- C8: Percent Annual Rainfall versus Vegetated/Surface BMP Design Runoff Chart

APPENDIX D

- D1: Recommendation Chart for Infiltration Stormwater Management BMPs in Carbonate Bedrock

APPENDIX E

- E1-3: Stormwater Best Management Practices Operations and Maintenance Agreement

APPENDIX F

- F1-2: Low Impact Development Practices

APPENDIX G

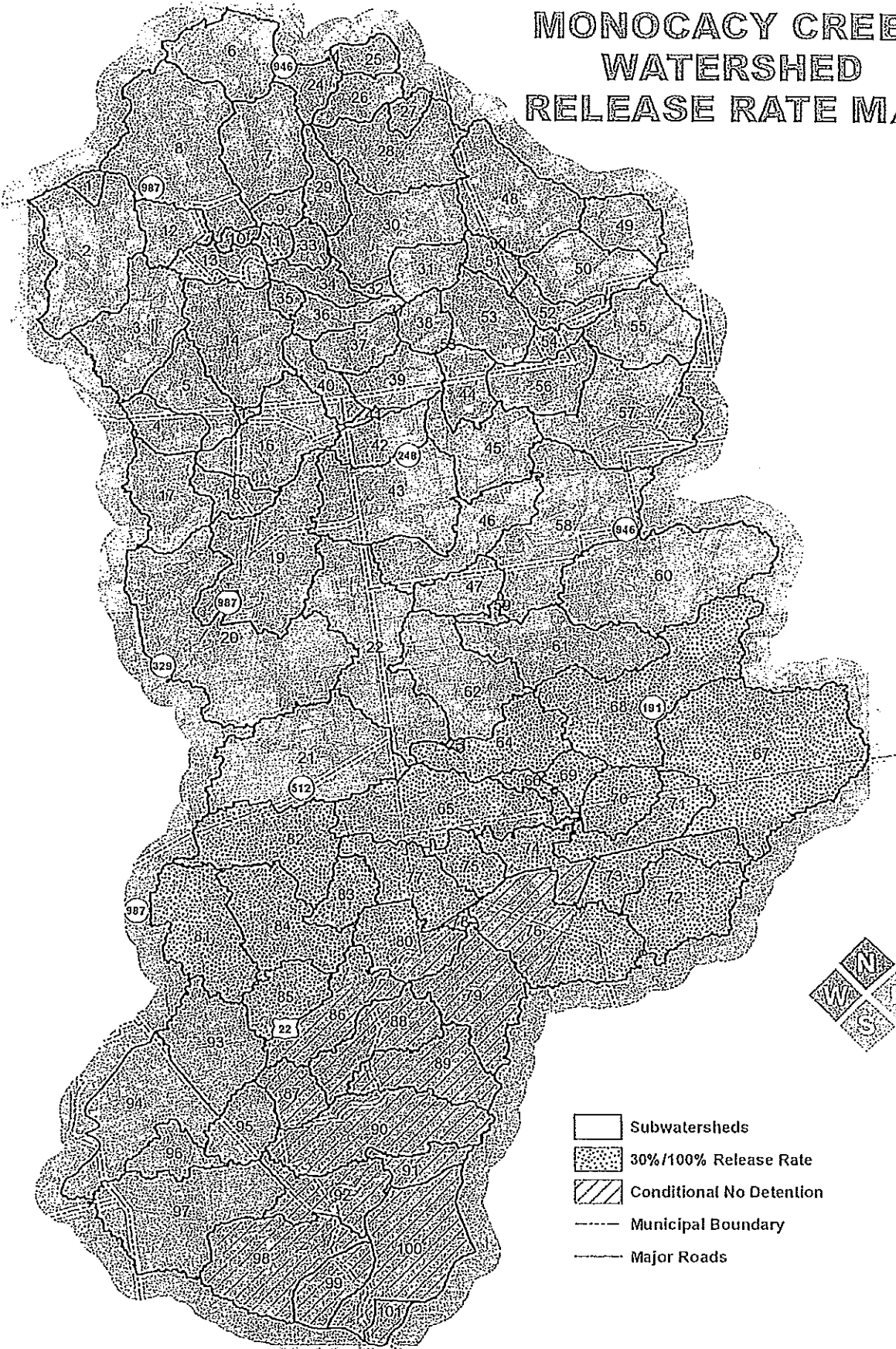
- G1-3: Preliminary Site Investigation and Testing Requirements

APPENDIX H

- H1-3: List of Acceptable BMPs

* Individual Municipal maps available from the Lehigh Valley Planning Commission upon request

MONOCACY CREEK WATERSHED RELEASE RATE MAP



RELEASE RATE SUMMARY TABLE

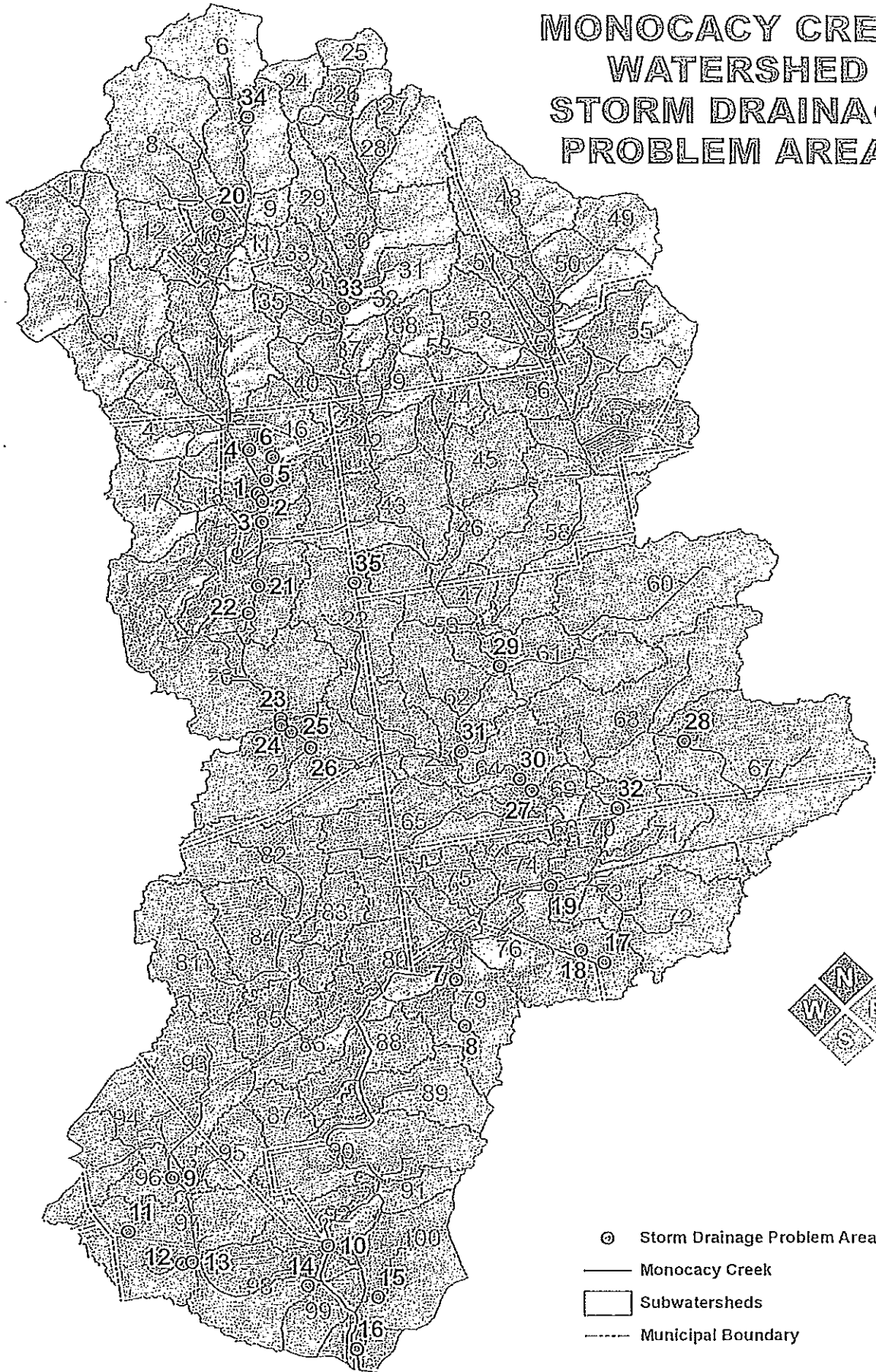
10-year through 100-year return periods

Subarea	Release Rate %	Subarea	Release Rate %	Subarea	Release Rate %
1	90	34	80	67	30/100*
2	90	35	80	68	30/100*
3	90	36	80	69	30/100*
4	80	37	70	70	30/100*
5	70	38	80	71	30/100*
6	100	39	70	72	30/100*
7	80	40	70	73	See Map
8	90	41	70	74	See Map
9	80	42	70	75	30/100*
10	80	43	50	76	See Map
11	80	44	80	77	30/100*
12	90	45	50	78	CND**
13	70	46	50	79	CND**
14	70	47	50	80	See Map
15	70	48	100	81	30/100*
16	70	49	90	82	30/100*
17	80	50	70	83	30/100*
18	50	51	80	84	30/100*
19	50	52	70	85	30/100*
20	50	53	80	86	See Map
21	50	54	60	87	CND**
22	50	55	80	88	CND**
23	100	56	60	89	CND**
24	100	57	50	90	CND**
25	100	58	50	91	CND**
26	90	59	50	92	CND**
27	90	60	50	93	50
28	90	61	50	94	100
29	80	62	50	95	90
30	80	63	100	96	90
31	80	64	30/100*	97	80
32	80	65	30/100*	98	CND**
33	80	66	30/100*	99	CND**
				100	CND**
				101	CND**

*The 30% release rate applies to the 10-year return period event, and the 100% release rate applies to the 25-year and higher events.

** Conditional No Detention

MONOCACY CREEK WATERSHED STORM DRAINAGE PROBLEM AREAS



Storm Drainage Problem Areas

1. Northampton St. Bridge (#117)
Municipality: Borough of Bath
Problem: Street and Property Flooding
Subarea: 16
Reach Number: 15
Proposed Solution: Creek dredging/restoration
2. Main Street
Municipality: Borough of Bath
Problem: Street and Property Flooding
Subarea: 18
Reach Number: 16
Proposed Solution: Creek dredging/restoration
3. Mill Street
Municipality: Borough of Bath
Problem: Street and Property Flooding
Subarea: 19
Reach Number: 18
Proposed Solution: Creek dredging/restoration
4. Creek Road at North Chestnut Street
Municipality: Borough of Bath
Problem: Street and Property Flooding
Subarea: 16
Reach Number: 15
Proposed Solution: Completed creek restoration/water pipe replacement (fall 2016)
5. 151 N. Chestnut Street
Municipality: Borough of Bath
Problem: Street and Property Flooding
Subarea: 16
Reach Number: N/A
Proposed Solution: Attempting underground pipe repairs (spring 2017)
6. 100 Block on Sleepy Hollow Road
Municipality: Borough of Bath
Problem: Street and Property Flooding
Subarea: 16
Reach Number: N/A
Proposed Solution: Replace existing drain tile from 12" to 36" or greater
7. Pine Top Trail/Fox Drive/Bierys Bridge Road
Municipality: City of Bethlehem
Problem: Property Flooding
Subarea: 79
Reach Number: N/A
Proposed Solution: Improve channel capacity
8. Johnston Drive
Municipality: City of Bethlehem
Problem: Street Flooding
Subarea: 79
Reach Number: N/A
Proposed Solution: None proposed
9. Valley Park South Apartments
Municipality: City of Bethlehem
Problem: Property Flooding
Subarea: 96
Reach Number: 94
Proposed Solution: Additional detention upstream
10. Schoenersville Road
Municipality: City of Bethlehem
Problem: Street Flooding
Subarea: 98
Reach Number: 92
Proposed Solution: None proposed
11. Pinehurst Road
Municipality: City of Bethlehem
Problem: Street and Property Flooding
Subarea: 97
Reach Number: N/A
Proposed Solution: Detention facility
12. Homestead Avenue
Municipality: City of Bethlehem
Problem: Street and Rear Yard Flooding
Subarea: 97
Reach Number: N/A
Proposed Solution: None proposed
13. Highland and Eaton Avenues
Municipality: City of Bethlehem
Problem: Street and Property Flooding
Subarea: 97
Reach Number: N/A
Proposed Solution: None proposed
14. 5th Avenue at Route 378
Municipality: City of Bethlehem
Problem: Property Flooding
Subarea: 98
Reach Number: N/A
Proposed Solution: Diversion of runoff to Route 378
15. Goepf Street
Municipality: City of Bethlehem
Problem: Street Flooding
Subarea: 100
Reach Number: N/A
Proposed Solution: Additional inlets and relief pipe system
16. Historical Bethlehem Tannery Building
Municipality: City of Bethlehem
Problem: Property Flooding
Subarea: 100
Reach Number: 99
Proposed Solution: None proposed
17. Oakland Road
Municipality: Bethlehem Township
Problem: Street Flooding
Subarea: 76
Reach Number: N/A
Proposed Solution: None proposed

18. Nijaro Road and Fornance Road
Municipality: Bethlehem Township
Problem: Street flooding
Subarea: 76
Reach Number: N/A
Proposed Solution: None proposed

19. Christian Spring Road
Municipality: Bethlehem Township
Problem: Street Flooding
Subarea: 74
Reach Number: 73
Proposed Solution: None proposed

20. Yost Road and 5th Street
Municipality: Borough of Chapman
Problem: Street and Property Flooding
Subarea: 8
Reach Number: N/A
Proposed Solution: None proposed

21. Railroad Bridge
Municipality: East Allen Township
Problem: Property Flooding
Subarea: 19
Reach Number: 18
Proposed Solution: None proposed

22. Private Road
Municipality: East Allen Township
Problem: Street Flooding
Subarea: 19
Reach Number: 18
Proposed Solution: None proposed

23. Railroad Bridge
Municipality: East Allen Township
Problem: Property Flooding
Subarea: 20
Reach Number: 19
Proposed Solution: None proposed

24. Route 512
Municipality: East Allen Township
Problem: Street Flooding
Subarea: 20, 21
Reach Number: 20
Proposed Solution: None proposed

25. Railroad Bridge
Municipality: East Allen Township
Problem: Property Flooding
Subarea: 21
Reach Number: 20
Proposed Solution: None proposed

26. Railroad Bridge
Municipality: East Allen Township
Problem: Property Flooding
Subarea: 21
Reach Number: 20
Proposed Solution: None proposed

27. Hanoverville Road
Municipality: Lower Nazareth Township
Problem: Street Flooding

Subarea: 66
Reach Number: 64
Proposed Solution: None proposed

28. Hecktown Road
Municipality: Lower Nazareth Township
Problem: Street Flooding
Subarea: 67
Reach Number: N/A
Proposed Solution: Culvert installation

29. Georgetown Road at Ash Drive
Municipality: Lower Nazareth Township
Problem: Street Flooding
Subarea: 61
Reach Number: 60
Proposed Solution: None proposed

30. Georgetown Road
Municipality: Lower Nazareth Township
Problem: Street Flooding
Subarea: 64
Reach Number: 63
Proposed Solution: Bridge replacement on Georgetown Road in progress

31. Steuben Road
Municipality: Lower Nazareth Township
Problem: Street Flooding
Subarea: 62, 64
Reach Number: 61
Proposed Solution: Both bridges replaced in 2016

32. PA Route 191
Municipality: Lower Nazareth Township
Problem: Property Flooding
Subarea: 70
Reach Number: 69
Proposed Solution: Bridges along Route 191 replaced several years ago

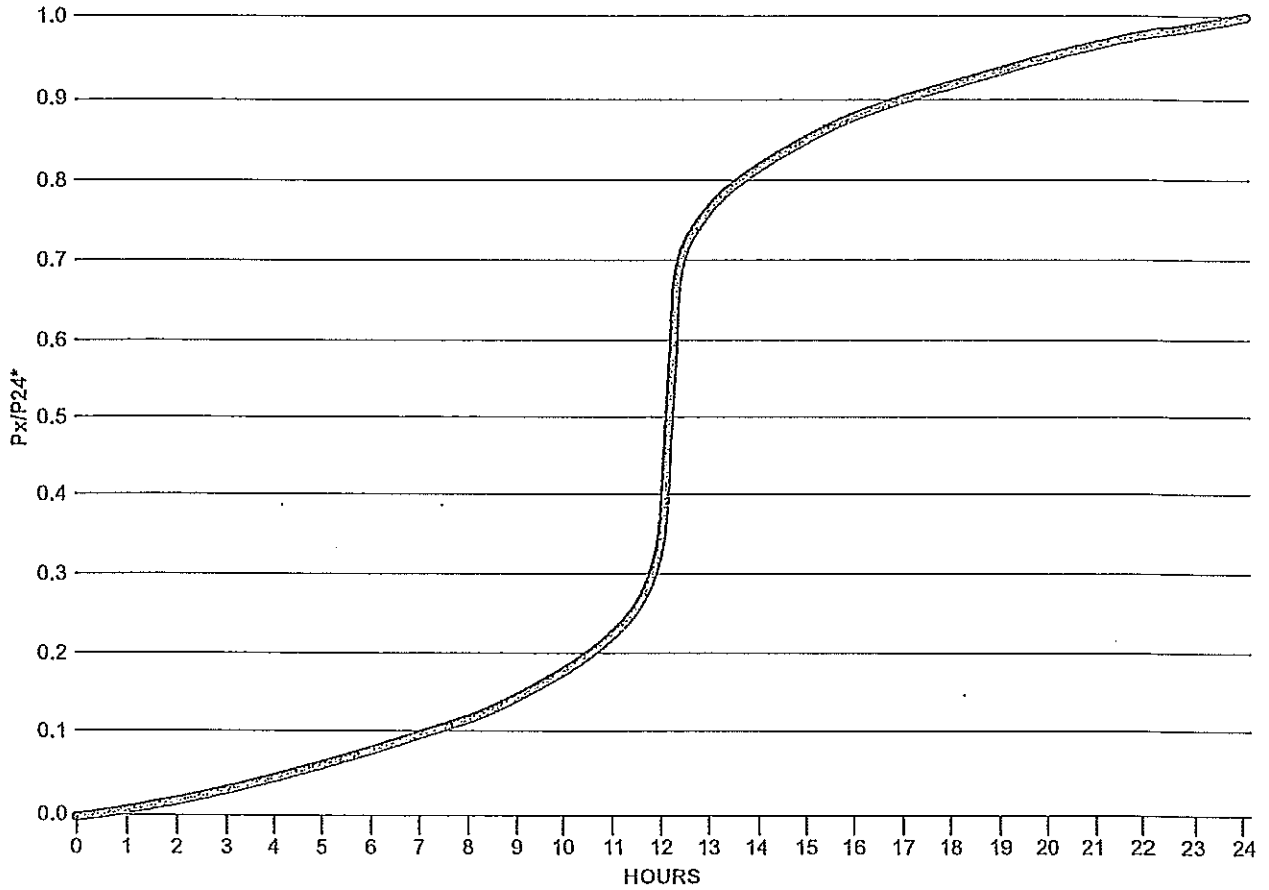
33. Keeler Road
Municipality: Moore Township
Problem: Localized Flooding
Subarea: 36
Reach Number: 34
Proposed Solution: Install new pipe. Permit received

34. Trach Road at South Summit Road
Municipality: Moore Township
Problem: Street Flooding
Subarea: 7
Reach Number: 6
Proposed Solution: Rebuild Trach Road, install storm pipe crossing on South Summit Road

35. Township Line Road at White Fence Lane
Municipality: Upper Nazareth Township
Problem: Street Flooding
Subarea: 22
Reach Number: N/A
Proposed Solution: Minor regrading/clean-up, continued monitoring and maintenance

APPENDIX C

NRCS TYPE II RAINFALL DISTRIBUTION



* Px/P24 equals cumulative percentage rainfall as a fraction of the total 24 hour rainfall

Hour/Min	Px/P24	Hour/Min	Px/P24	Hour/Min	Px/P24	Hour/Min	Px/P24
1 00	.0107	8 20	.1270	12 20	.6925	16 20	.8866
2 00	.0222	8 40	.1356	12 40	.7361	16 40	.8940
3 00	.0345	9 00	.1449	13 00	.7639	17 00	.9009
4 00	.0479	9 20	.1549	13 20	.7850	17 20	.9075
5 00	.0626	9 40	.1659	13 40	.8023	17 40	.9138
6 00	.0790	10 00	.1781	14 00	.8170	18 00	.9199
6 20	.0849	10 20	.1918	14 20	.8299	19 00	.9365
6 40	.0910	10 40	.2077	14 40	.8415	20 00	.9515
7 00	.0975	11 00	.2266	15 00	.8520	21 00	.9651
7 20	.1043	11 20	.2506	15 20	.8616	22 00	.9776
7 40	.1114	11 40	.2843	15 40	.8705	23 00	.9892
8 00	.1190	12 00	.3773	16 00	.8788	24 00	1.0000

PRECIPITATION INTENSITY AND DEPTH CHARTS*

Partial duration series-based point precipitation intensity frequency estimates (in inches/hour)
Average recurrence interval (years)

Duration	1	2	5	10	25	50	100
5-min	3.85	4.57	5.38	5.99	6.76	7.32	7.88
10-min	3.07	3.66	4.31	4.79	5.36	5.80	6.23
15-min	2.55	3.06	3.62	4.02	4.52	4.89	5.24
30-min	1.75	2.11	2.56	2.91	3.34	3.66	4.00
60-min	1.09	1.32	1.64	1.89	2.22	2.48	2.75
2-hr	0.650	0.785	0.984	1.14	1.36	1.54	1.74
3-hr	0.476	0.575	0.716	0.829	0.988	1.12	1.26
6-hr	0.303	0.364	0.451	0.523	0.627	0.715	0.812
12-hr	0.186	0.224	0.278	0.325	0.393	0.453	0.519
24-hr	0.109	0.131	0.164	0.191	0.232	0.266	0.304

Partial duration series-based point precipitation depth frequency estimates (in inches)
Average recurrence interval (years)

Duration	1	2	5	10	25	50	100
5-min	0.321	0.381	0.448	0.499	0.563	0.610	0.657
10-min	0.511	0.610	0.718	0.798	0.894	0.966	1.04
15-min	0.638	0.764	0.905	1.00	1.13	1.22	1.31
30-min	0.873	1.05	1.28	1.45	1.67	1.83	2.00
60-min	1.09	1.32	1.64	1.89	2.22	2.48	2.75
2-hr	1.30	1.57	1.97	2.28	2.72	3.09	3.48
3-hr	1.43	1.73	2.15	2.49	2.97	3.36	3.79
6-hr	1.82	2.18	2.70	3.13	3.75	4.28	4.86
12-hr	2.24	2.70	3.35	3.91	4.74	5.46	6.26
24-hr	2.62	3.14	3.93	4.59	5.56	6.39	7.30

*Source: NOAA Atlas 14, Volume 2, Version 3

RUNOFF CURVE NUMBERS AND PERCENT IMPERVIOUSNESS VALUES*

Cover Description	Average Percent Impervious Area	Curve numbers for hydrologic soil group**			
		A	B	C	D
Open space (lawns, parks, golf courses, cemeteries, etc.): Good condition (grass cover greater than 75%)		39	61	74	80
Impervious areas: Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Urban districts:					
Commercial and business	85%	89	92	94	95
Industrial	72%	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (townhouses)	65%	77	85	90	92
1/4 acre	38%	61	75	83	87
1/3 acre	30%	57	72	81	86
1/2 acre	25%	54	70	80	85
1 acre	20%	51	68	79	84
2 acre	12%	46	65	77	82
Woods		30	55	70	77
Agriculture		Refer to Table 2-2b in source document (TR55) by crop type and treatment			
Meadow: Continuous grass, protected from grazing and generally mowed for hay		30	58	71	78

*Source: Natural Resources Conservation Service Technical Release No. 55, Second Edition, June 1986

**Hydrologic Soil Group based on the USDA Soil Survey

RUNOFF COEFFICIENTS FOR THE RATIONAL METHOD*
HYDROLOGIC SOIL GROUP AND SLOPE RANGE**

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 ^A	0.18 ^a	0.23	0.28	0.24	0.29	0.33	0.30	0.34	0.38	0.33	0.37	0.41
	0.23 ^b	0.29	0.34	0.30	0.36	0.40	0.36	0.41	0.45	0.39	0.44	0.48
Pasture ^B	0.09	0.13	0.17	0.19	0.24	0.29	0.27	0.31	0.36	0.31	0.35	0.39
	0.12	0.17	0.23	0.24	0.30	0.36	0.33	0.38	0.43	0.37	0.42	0.46
Meadow, Lawn ^C	0.05	0.08	0.12	0.15	0.20	0.24	0.23	0.28	0.32	0.28	0.32	0.36
	0.07	0.12	0.17	0.19	0.25	0.30	0.28	0.34	0.39	0.33	0.39	0.43
Forest, Woods	0.03	0.05	0.08	0.11	0.16	0.20	0.20	0.25	0.29	0.25	0.30	0.34
	0.04	0.08	0.12	0.15	0.21	0.26	0.25	0.31	0.36	0.31	0.37	0.41
Gravel	0.24	0.29	0.33	0.32	0.36	0.40	0.35	0.39	0.43	0.37	0.41	0.44
	0.30	0.36	0.40	0.38	0.43	0.47	0.42	0.46	0.50	0.44	0.48	0.51
Parking, other Impervious	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
Residential, Commercial, Industrial and Other "Developed"	Runoff coefficients should be calculated based upon weighted average of impervious area coefficients and pervious area coefficients from above based upon soil type, slope and the particular development proposal.											

*Coefficients for all land uses except parking and other impervious cover are based on the Rossmiller Equation for translating NRCS curve numbers into Rational Method 'c' values. The source for the parking and other impervious cover coefficients is RAWLS, W.J., S.L. WONG and R.H. McCUEN, 1981. Comparison of urban flood frequency procedures. Preliminary draft report prepared for the Soil Conservation Service, Beltsville, M.D.

**Hydrologic Soil Group based on the USDA Soil Survey.

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

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

^A Represents average of cultivated land with and without conservation treatment from TR-55, January 1975. These values are consistent with several categories of cultivated lands from TR-55, June 1986.

^B Represents grasslands in fair condition with 50% to 75% grass cover.

^C Represents grasslands in good condition with greater than 75% grass cover.

MANNING 'n' VALUES BY TYPICAL REACH DESCRIPTION

Reach Description	Manning 'n'
Natural stream, clean, straight, no rifts or pools	0.030
Natural stream, clean, winding, some pools and shoals	0.040
Natural stream, winding, pools, shoals stony with some weeds	0.050
Natural stream, sluggish with deep pools and weeds	0.070
Natural stream, or swale, very weedy or with timber under brush	0.100
Concrete pipe, culvert or channel	0.012
Corrugated metal pipe	0.012-0.027*

*Depending upon type and diameter

ROUGHNESS COEFFICIENTS (MANNING 'n') FOR SHEET FLOW

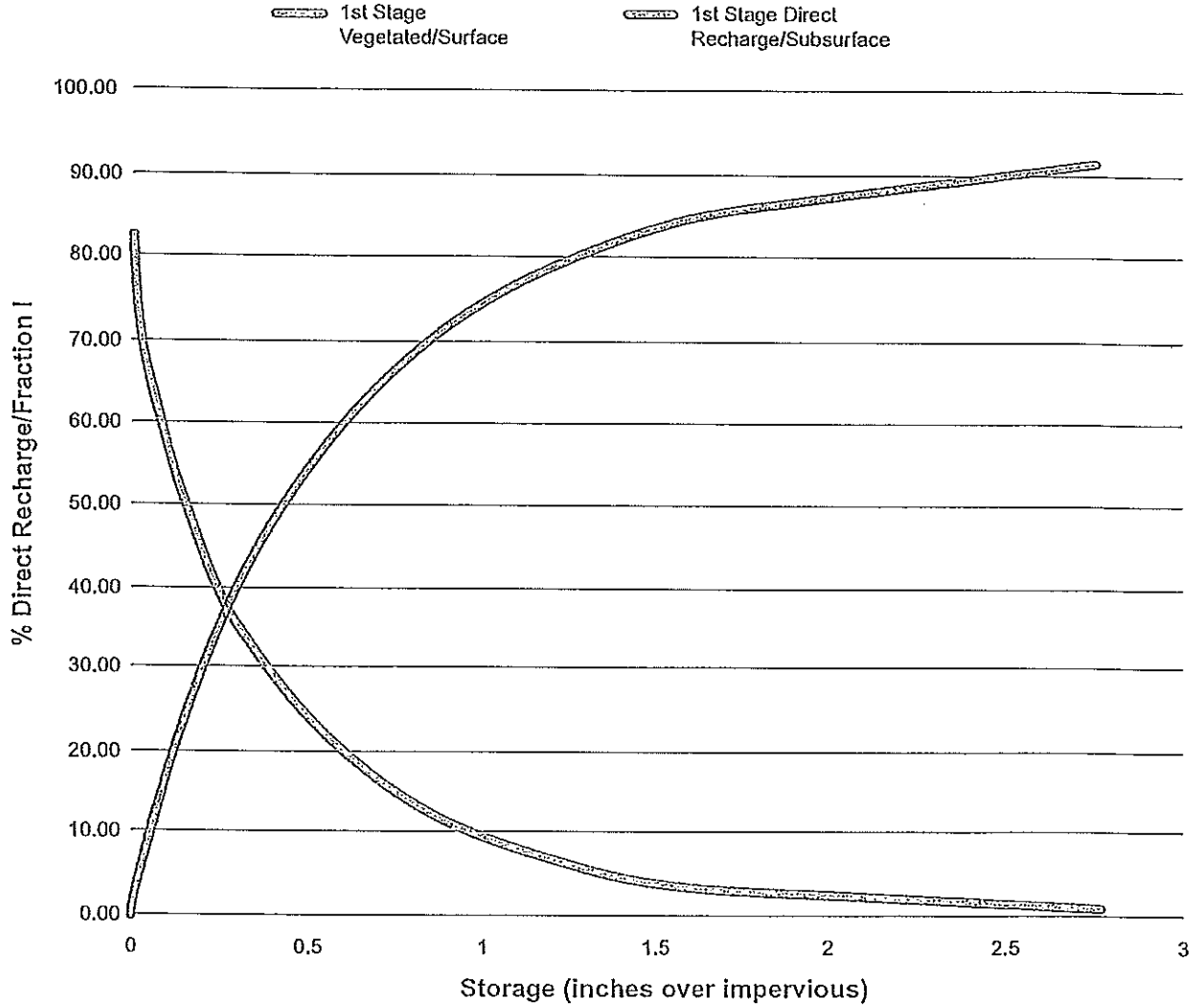
Surface Description	Manning 'n' ¹
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.050
Cultivated soils:	
Residue cover <= 20%	0.060
Residue cover > 20%	0.170
Grass:	
Short grass prairie	0.150
Dense grasses ²	0.240
Bermuda grass	0.410
Range (natural)	0.130
Woods: ³	
Light underbrush	0.400
Dense underbrush	0.800

¹ The 'n' values are a composite of information compiled by Engman (1986).

² Includes species such as weeping lovegrass, bluegrass, buffaloe grass, blue grama grass and native grass mixtures.

³ When selecting 'n', consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

PERCENT DIRECT RECHARGE PER FRACTION IMPERVIOUS VS. STORAGE



Note: See C7 for instruction on how to use the chart

PERCENT DIRECT RECHARGE PER FRACTION IMPERVIOUS VERSUS STORAGE CURVE USAGE INSTRUCTIONS

The "1st Stage Direct Recharge" curve is based on impervious areas being diverted first to a Direct Recharge/Subsurface BMP designed to capture less than the 2-year event, with the remaining 2-year runoff overflowing into a Vegetated/Surface BMP. The "1st stage Vegetated/Surface" curve is based on reversing the above. The curves may be used for the whole site, or for pieces of a site to achieve successful designs as follows:

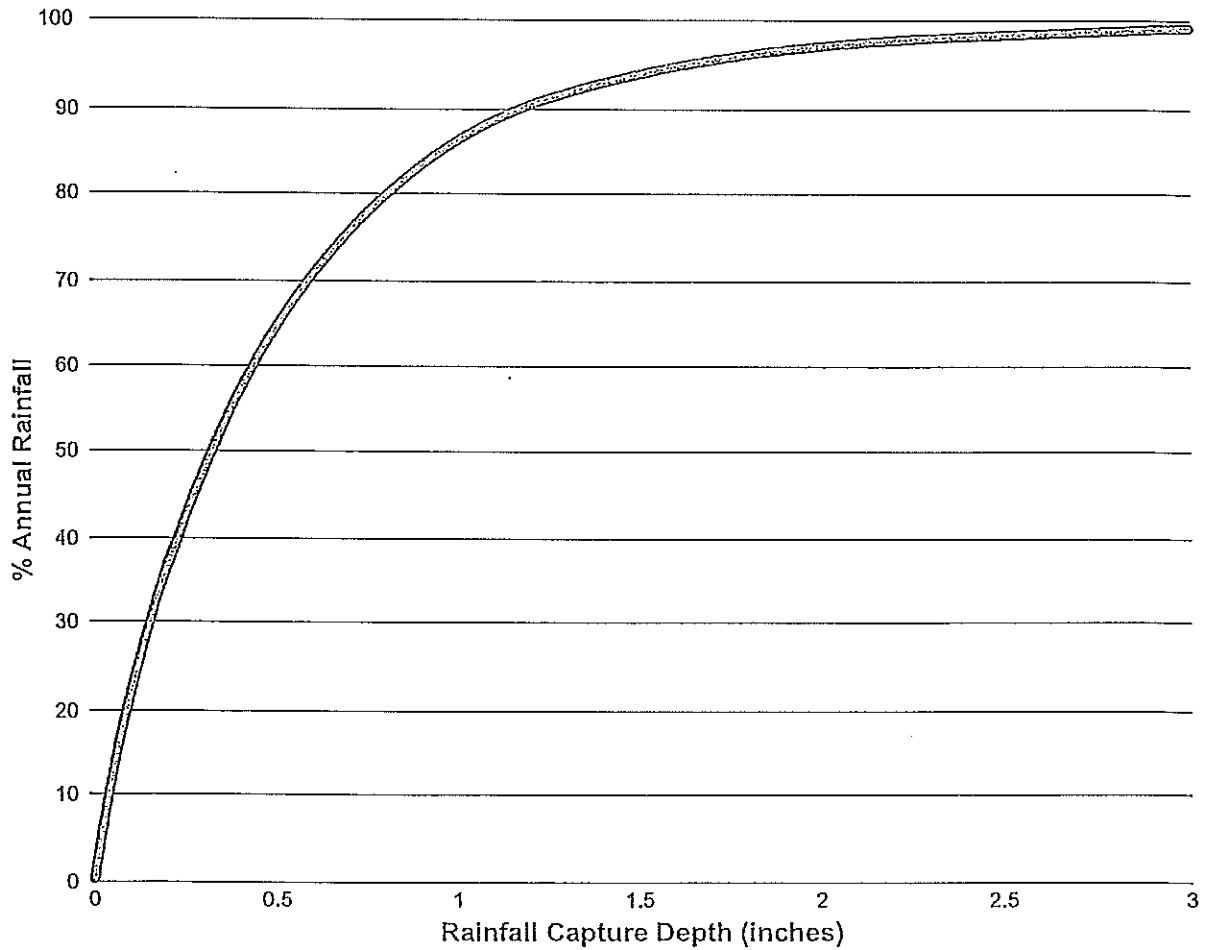
- A. If used for whole site designs, the "fraction I" used is the proposed impervious as a fraction of the entire site. As an example, for a 60% impervious site with all impervious directed to a first stage Direct Recharge/Subsurface BMP, use 30% Direct Recharge with 0.60 fraction I to yield 50% Direct Recharge/fraction I and translate into 0.42 inches of storage over impervious areas. The total first stage Direct Recharge maximum BMP storage is 0.42 inches of depth times the surface area of the impervious cover. Similarly, if a first stage Vegetated/Surface BMP followed by a second stage Direct Recharge/Subsurface BMP was used, the minimum Vegetated/Surface storage is 0.15 inches over the impervious cover.
- B. If used for pieces of the site smaller than the whole site, the fraction I used is the impervious cover of the part of the site in question as a fraction of the area of the same piece. Each piece may be designed for 30% Direct Recharge if desired, but individual pieces may exceed 30% Direct Recharge provided all BMPs on site are providing less than 30% Direct Recharge in aggregate. In this case, the BMP storage for each piece is used in the chart with the fraction I using the whole site area to determine the contribution of each piece to the 30% Direct Recharge allowable. As an example, still using the 60% impervious site, a piece of the site uses a Direct Recharge/Subsurface BMP first. The piece is half of the total area of the site and is 80% impervious. The BMP is designed for 0.6 inches of runoff from the impervious surfaces. Using 0.6 inches of storage and a fraction I of 0.80, the piece is designed for (%Direct Recharge/fraction I = 60) 48% Direct Recharge. The impervious cover in this piece has fraction I of 0.4 of the overall site acreage and, therefore, using 0.6 inches of storage and a fraction I of 0.4 yields a Direct Recharge/fraction I of 60% using the graph which solves to a Direct Recharge of 24%. This means that this piece uses 24% of the allowable 30% Direct Recharge. The remaining piece(s) will need to be designed for 6% or less Direct Recharge. The remaining piece in this example has a fraction I of the overall site of 0.2. Using 6% Direct Recharge and a fraction I of 0.2 yields a Direct Recharge/fraction I of 30%. Entering the graph at that value, the maximum storage for the piece in a first stage Direct Recharge/Subsurface BMP is 0.2 inches over the impervious portion of its tributary area.
- C. If more than two stages of Vegetated/Surface and Direct Recharge/Subsurface BMPs are used to control the WQv, the design considerations are as follows:
 1. If the design has a first stage Vegetated/Surface BMP draining to additional stage Vegetated/Surface BMPs and subsequent Direct Recharge/Subsurface BMP, add the storage volumes of the Vegetated/Surface BMPs and use this volume as the first stage Vegetated/Surface storage volume.
 2. Similarly, if two or more Direct Recharge/Subsurface BMPs are used first followed by a Vegetated/Surface BMP, add the storage volumes of the Direct Recharge/Subsurface BMPs and use this volume as the first stage Direct Recharge BMP storage volume.
 3. In designs with more than two Vegetated/Surface or Direct Recharge/Subsurface BMPs used in series to control the WQv and rules C.1 and C.2 don't apply, the chart shall be applied conservatively to assure the Direct Recharge standard is not violated. For example, with proposed use of a first stage Direct Recharge/Subsurface BMP, second stage Vegetated/Surface BMP, and third stage Direct Recharge/Subsurface BMP, all storage provided shall be assumed to be Direct Recharge for use in the chart.

Essentially, any Vegetated/Surface BMP applied beyond the first stage will be ignored for purposes of determining compliance with the Direct Recharge standard.



PERCENT ANNUAL RAINFALL VERSUS VEGETATED/SURFACE BMP DESIGN RUNOFF CHART

To use this chart, for a given fraction of site impervious directed to a Vegetated/Surface BMP, calculate the runoff capture depth over the impervious in inches, use the curve to find % annual rainfall. The weighted average of % annual rainfall considering all impervious cover to all BMPs must be a minimum of 56%.



APPENDIX D

Recommendation Chart for Infiltration Stormwater Management BMPs in Carbonate Bedrock*

		CARBONATE BEDROCK															
		2 to 4 Feet				Over 4 Feet to 8 Feet				Over 8 Feet							
SITE RISK FACTORS	Geology Type	Less than 2 Feet				High Buffer				Medium Buffer				Low Buffer			
	Effective Soil Thickness	Low to High Buffer				High Buffer				Medium Buffer				Low Buffer			
Special Geologic Features**		(Unacceptable)				Preliminary				Preliminary				Preliminary			
DESIGN FACTORS	SITE INVESTIGATION RECOMMENDED	Preliminary				Preliminary				Preliminary				Preliminary			
	Infiltration Leading Rates (% Increase) ***	0-100%	100-300%	300-500%	0-100%	100-300%	300-500%	0-100%	100-300%	300-500%	0-100%	100-300%	300-500%	0-100%	100-300%	300-500%	
PROGRAM SUMMARY GUIDANCE ****		RECOMMENDED				RECOMMENDED				RECOMMENDED				NOT RECOMMENDED			



RECOMMENDED



NOT RECOMMENDED

* Source: Developed by Cahill Associates based on information in "Technical Best Management Practice Manual & Infiltration Feasibility Report", November 2002 and input from the LVP, 2003.

** Special Geologic Feature Buffer widths are as follows:

- Low Buffer is less than 50 feet
- Medium Buffer is 50 feet to 100 feet
- High Buffer is greater than 100 feet

*** Rates greater than 500% not recommended.

**** Assumes adequately permeable soils and lack of natural constraints as required for all infiltration systems.

- 1 Infiltration systems may be allowed at the determination of the Engineer and/or Geologist, provided that a Detailed Site Investigation is undertaken which confirms nature of rock, location of Special Geologic Features, and adequacy of the buffer between the SGF and the proposed stormwater system(s).
- 2 In these Special Geologic Features: Low Buffer situations, infiltration systems may be allowed at the determination of the Engineer and/or Geologist, provided that a Detailed Site Investigation is undertaken and a 25 foot buffer from SGFs is maintained.

APPENDIX E

STORMWATER BEST MANAGEMENT PRACTICES
OPERATIONS AND MAINTENANCE AGREEMENT

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

WITNESSETH

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

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

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

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

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

- BMP – "Best Management Practice;" activities, facilities, designs, measures or procedures used to manage stormwater impacts from land development, to protect and maintain water quality and groundwater recharge and to otherwise meet the purposes of the Municipal Stormwater Management Ordinance, including but not limited to infiltration trenches, seepage pits, filter strips, bioretention, wet ponds, permeable paving, rain gardens, grassed swales, forested buffers, sand filters and detention basins.
- Infiltration Trench – A BMP surface structure designed, constructed, and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or groundwater aquifer,
- Seepage Pit – An underground BMP structure designed, constructed, and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or groundwater aquifer,
- Rain Garden – A BMP overlain with appropriate mulch and suitable vegetation designed, constructed, and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or underground aquifer; and

WHEREAS, the municipality requires, through the implementation of the Plan, that stormwater management 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 *and if not timely paid, a municipal lien shall be placed upon the premises for 110% of the invoice amount, plus statutorily allowed fees, expenses and costs.*
6. The intent and purpose of this Agreement is to ensure the proper maintenance of the on-site BMP(s) by the Landowner; provided, however, that this Agreement shall not be deemed to create or 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, *hereby release and hold harmless* 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) *as necessary* 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 _____, 20__.

NOTARY PUBLIC

(SEAL)

APPENDIX F

LOW IMPACT DEVELOPMENT PRACTICES

ALTERNATIVE APPROACH FOR
MANAGING STORMWATER RUNOFF

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

The recommended alternative approach is to promote practices that will minimize post-development runoff rates and volumes, which will minimize needs for artificial conveyance and storage facilities. To simulate pre-development hydrologic conditions, forced infiltration is often necessary to offset the loss of infiltration by creation of impervious surfaces. The ability of the ground to infiltrate depends upon the soil types and its conditions.

Preserving natural hydrologic conditions requires careful alternative site design considerations. Site design practices include preserving natural drainage features, minimizing impervious surface area, reducing the hydraulic connectivity of impervious surfaces, and protecting natural depression storage. A well-designed site will contain a mix of all those features. The following describes various techniques to achieve the alternative approach:

- **Preserving Natural Drainage Features.** Protecting natural drainage features, particularly vegetated drainage swales and channels, is desirable because of their ability to infiltrate and attenuate flows and to filter pollutants. However, this objective is often not accomplished in land development. In fact, commonly held drainage philosophy encourages just the opposite pattern—streets and adjacent storm sewers typically are located in the natural headwater valleys and swales, thereby replacing natural drainage functions with a completely impervious system. As a result, runoff and pollutants generated from impervious surfaces flow directly into storm sewers with no opportunity for attenuation, infiltration, or filtration. Developments designed to fit site topography also minimize the amount of grading on site.
- **Protecting Natural Depression Storage Areas.** Depression storage areas have no surface outlet, or drain very slowly following a storm event. They can be commonly seen as ponded areas in farm fields during the wet season or after large runoff events. Traditional development practices eliminate these depressions by filling or draining, thereby obliterating their ability to reduce surface runoff volumes and trap pollutants. The volume and release rate characteristics of depressions should be protected in the design of the development site. The depressions can be protected by simply avoiding the depression or by incorporating its storage as additional capacity in required detention facilities.
- **Avoiding Introduction of Impervious Areas.** Careful site planning should consider reducing impervious coverage to the maximum extent possible. Building footprints, sidewalks, driveways and other features producing impervious surfaces should be evaluated to minimize impacts on runoff.
- **Reducing the Hydraulic Connectivity of Impervious Surfaces.** Impervious surfaces are significantly less of a problem if they are not directly connected to an impervious conveyance system (such as storm sewer). Two basic ways to reduce hydraulic connectivity are routing of roof runoff over lawns and reducing the use of storm sewers. Site grading should promote

increasing travel time of stormwater runoff, and should help reduce concentration of runoff to a single point in the development.

- **Routing Roof Runoff over Lawns.** Roof runoff can be easily routed over lawns in most site designs. The practice discourages direct connections of downspouts to storm sewers or parking lots. The practice also discourages sloping driveways and parking lots to the street. By routing roof drains and crowning the driveway to run off to the lawn, the lawn is essentially used as a filter strip.
- **Reducing the Use of Storm Sewers.** By reducing use of storm sewers for draining streets, parking lots, and back yards, the potential for accelerating runoff from the development can be greatly reduced. The practice requires greater use of swales and may not be practical for some development sites, especially if there are concerns for areas that do not drain in a "reasonable" time. The practice requires educating local citizens and public works officials, who expect runoff to disappear shortly after a rainfall event.
- **Reducing Street Widths.** Street widths can be reduced by either eliminating on-street parking or by reducing roadway widths. Municipal planners and traffic designers should encourage narrower neighborhood streets which ultimately could lower maintenance.
- **Limiting Sidewalks to One Side of the Street.** A sidewalk on one side of the street may suffice in low-traffic neighborhoods. The lost sidewalk could be replaced with bicycle/recreational trails that follow back-of-lot lines. Where appropriate, backyard trails should be constructed using pervious materials.
- **Using Permeable Paving Materials.** These materials include permeable interlocking concrete paving blocks or porous bituminous concrete. Such materials should be considered as alternatives to conventional pavement surfaces, especially for low use surfaces such as driveways, overflow parking lots, and emergency access roads.
- **Reducing Building Setbacks.** Reducing building setbacks reduces driveway and entry walks and is most readily accomplished along low-traffic streets where traffic noise is not a problem.
- **Constructing Cluster Developments.** Cluster developments can also reduce the amount of impervious area for a given number of lots. The biggest savings is in street length, which also will reduce costs of the development. Cluster development clusters the construction activity onto less-sensitive areas without substantially affecting the gross density of development.

APPENDIX G

PRELIMINARY SITE INVESTIGATION AND TESTING REQUIREMENTS

Required Data and Site Information: The following data shall be gathered utilizing standard testing procedures as part of a Preliminary Site Investigation:

- Bedrock composition – Any apparent boundaries between carbonate and non-carbonate bedrock must be verified by a qualified geotechnical professional.
- Bedrock structural geology – This includes the possible presence of faults and mapping of conspicuous fracture traces or lineaments.
- Overburden and soil mantle composition and thickness.
- Permeability of the soil.
- Depth to the seasonal high water table.
- Presence of special geologic features – This includes sinkholes, closed depressions, fracture traces, lineaments, joints, faults, caves, pinnacles and geologic contacts between carbonate and non-carbonate bedrock.

Preliminary Site Investigation Required for Sites Intending to Use Infiltration

Review of Available Data, Maps and Reports: Some of the required information, as listed above, can be found in existing published data. Suggested resources include the following:

- Geologic maps and references for the development area.
- The Little Lehigh Creek Basin Carbonate Prototype Area Closed Depression Map – available at the LVPC.
- USGS topographic maps.
- Lehigh and Northampton County soil survey maps.
- Aerial photographs from the LVPC or other sources.
- Relevant Pennsylvania Geologic Survey Open File Reports that provide maps of sinkholes and Karst features for Lehigh County (OF 87-01) and Northampton County (OF 87-02).
- Kochanov and Reese (2003). Density of Mapped Karst Feature in South-Central and Southeastern Pennsylvania (Map 68).
- DCNR Online Sinkhole Inventory - (<http://www.dcnr.state.pa.us/topogeo/hazards/sinkhole/default.asp>).

Field Inspections: In addition to gathering data from published sources, a field inspection of the proposed site is required. A field inspection can provide additional information relating to site features such as carbonate bedrock features, indicators of seasonal high stream-level or water table levels, streams, springs, etc.

Soil Test Pit and Percolation Test Requirements: A minimum of one test pit and a minimum of 2 percolation tests are required for every site. A test pit is a 2-3 foot wide, 8 foot deep trench excavated with a backhoe for observing subsurface conditions. The test pits will be used to describe soil depth and quality, including soil horizons, and testing of permeability or percolation rates and can be conducted by a certified Sewage Enforcement Officer.

Percolation tests are to be conducted as follows (adapted from § 73.15. "Percolation Tests" of the Pennsylvania Code):

1. The percolation tests shall be made in separate holes uniformly spaced over the possible infiltration area.
2. An "Initial Presoak" should not be performed.
3. Percolation holes located within the possible infiltration area shall be used in the calculation of the average percolation rate.
4. Holes having a uniform diameter of 6 to 10-inches shall be bored or dug as follows:



- a. To the depth of the bottom of the possible infiltration BMP.
 - b. Alternate depths if the test pits/auger holes indicate that the soils are more suitable at a different depth (i.e. if a clay horizon is identified and more suitable soils are located beneath the horizon, an infiltration test should be performed in the suitable horizon).
5. The bottom and sides of the hole shall be scarified with a knife blade or sharp-pointed instrument to completely remove any smeared soil surfaces and to provide a natural soil interface into which water may percolate. Loose material shall be removed from the hole. Two inches of coarse sand or fine gravel shall be placed in the bottom of the hole to protect the soil from scouring and clogging of the pores.
 6. Immediately before the percolation test, as a final presoak, water shall be placed in the hole to a minimum depth of 6-inches over the gravel and readjusted every 30 minutes for 1 hour.
 7. The drop in the water level during the last 30 minutes of the final presoaking period shall be applied to the following standard to determine the time interval between readings for each percolation hole:
 - a. If water remains in the hole, the interval for readings during the percolation test shall be 30 minutes.
 - b. If no water remains in the hole, the interval for readings during the percolation test may be reduced to 10 minutes.
 8. After the final presoaking period, water in the hole shall again be adjusted to approximately 6-inches over the gravel and readjusted when necessary after each reading.
 - a. Measurement to the water level in the individual percolation holes shall be made from a fixed reference point and shall continue at the interval determined from step No. 7 (above) for each individual percolation hole until a minimum of eight readings are completed or until a stabilized rate of drop is obtained, whichever occurs first. A stabilized rate of drop means a difference of ¼-inch or less of drop between the highest and lowest readings of four consecutive readings.
 - b. The drop that occurs in the final period in percolation test holes, expressed as inches per hour, shall be used to calculate the average percolation rate.
 - c. When the rate of drop in a percolation test is too slow to obtain a measurable rate, the rate of 0.25 inches per hour shall be assigned to that hole for use in calculating the average percolation rate. The infiltration area may be placed over holes with no measurable rate when the average percolation rate for the possible infiltration area is within the acceptable range.

When a percolation test hole yields a percolation rate of greater than 12-inches per hour, the proposed infiltration area may not be designed or installed within 25-feet of this hole unless the municipality determines that a testing anomaly caused the fast percolation rate and a retest of the area yields acceptable percolation rates. This percolation rate limit is established to protect groundwater quality and to minimize the risk of subsidence.

Additional Site Investigation and Testing Required if Infiltration is Proposed

Soil Test Pit Requirements: The required number of test pits varies with Effective Soil Thickness. As risk factors increase, the number of test pits increases. A minimum of 2 test pits, uniformly spaced within the proposed infiltration area (e.g., the 2 pits should be centered on each half of the proposed infiltration area), are required for any site proposing infiltration unless the applicant can demonstrate that one test pit is adequately representative of the area proposed for infiltration. For larger infiltration areas, multiple test pits shall be developed at the densities as listed below:

Effective Soil Thickness (ft.)	Test Pit Density (per acre of proposed infiltration area)*	Percolation Tests (per acre of proposed infiltration area)**	Auger Grid Spacing (Feet On-Center)***
8	4	8	50
4 to 8	6	12	35
2 to 4	8	16	25

*No. of Test Pits required = Infiltration sq. ft./43,560 sq. ft. x test pit density from chart rounded up to the nearest whole number

** No. of Percolation Tests required = Infiltration sq. ft./43,560 sq. ft. x percolation tests from chart rounded up to the nearest whole number

***Auger testing is only required on Carbonate sites.

Soil Auger Testing Requirements for Carbonate Areas: Because soil depth is not uniform in many carbonate areas, test pits will not be sufficient to accurately determine the depth to bedrock. Augering provides this essential data as inexpensively as possible. Track-rig rotary soil auger test drilling allows relatively inexpensive, qualitative determination of the presence of overburden voids and will generally penetrate to the top-of-bedrock. Augers typically extend to depths of 20 feet. Special augers extend to as much as 50 feet. Augers do not extend into the bedrock. Auger testing should be performed in a grid pattern across the proposed infiltration area, spaced as indicated in the above table.

Percolation Testing Requirements: For each proposed infiltration area, a minimum of six percolation tests shall be conducted with a vertical component permeability test unless the applicant can demonstrate that fewer tests accurately represent the percolation rate of the proposed infiltration area. Additional testing shall be required if the initial test results show significant variability in the vertical component percolation rate. For larger infiltration areas, percolation tests shall be conducted at the densities listed in the table above.

APPENDIX H

LIST OF ACCEPTABLE BMPs

Best Management Practice	Design Reference Number
Bioretention ^A	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 ^A (Sand, Peat, Compost, etc.)	4, 5, 10, 16
Vegetated Buffers/Filter Strips	2, 3, 5, 11, 16, 17
Vegetated Roofs	4, 13
Vegetated Swales ^A	2, 3, 5, 11, 16, 17
Water Quality Inlets ^C	4, 7, 15, 16, 19
Wet Detention Ponds	4, 5, 6, 8

^A This BMP could be designed with or without an infiltration component. If infiltration is proposed, the site and BMP will be subject to the testing and other infiltration requirements in this Ordinance.

^B See table below.

^C Water Quality Inlets include such BMPs as Oil/Water Separators, Sediment Traps/Catch Basin Sumps and Trash/Debris Collectors in Catch Basins.

LIST OF ACCEPTABLE BMPs

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	"Stormwater Best Management Practices Manual," Pennsylvania Department of Environmental Protection, January 2005 or current version.
5	"Evaluation and Management of Highway Runoff Water Quality," Federal Highway Administration, FHWA-PD-96-032, Washington, D.C., 1996.
6	"Evaporation Maps of the United States," U.S. Weather Bureau (now NOAA/National Weather Service) Technical Paper 37, Published by Department of Commerce, Washington D.C., 1959.
7	"Georgia Stormwater Manual," AMEC Earth and Environmental, Center for Watershed Protection, Debo and Associates, Jordan Jones and Goulding, Atlanta Regional Commission, Atlanta, Georgia, 2001.
8	"Hydraulic Design of Highway Culverts," Federal Highway Administration, FHWA HDS 5, Washington, D.C., 1985 (revised May 2005).
9	"Low Impact Development Design Strategies <i>An Integrated Design Approach</i> ," Prince Georges County, Maryland Department of Environmental Resources, June 1999.
10	"Maryland Stormwater Design Manual," Maryland Department of the Environment, Baltimore, Maryland, 2000.
11	"Pennsylvania Handbook of Best Management Practices for Developing Areas," Pennsylvania Department of Environmental Protection, 1998.
12	"Recommended Procedures for Act 167 Drainage Plan Design," LVPC, Revised 1997.
13	"Roof Gardens History, Design and Construction," Osmundson, Theodore. New York: W.W. Norton & Company, 1999.
14	"The Texas Manual on Rainwater Harvesting," Texas Water Development Board, Austin, Texas, Third Edition, 2005.
15	"VDOT Manual of Practice for Stormwater Management," Virginia Transportation Research Council, Charlottesville, Virginia, 2004.
16	"Virginia Stormwater Management Handbook," Virginia Department of Conservation and Recreation, Richmond, Virginia, 1999.
17	"Water Resources Engineering," Mays, L. W., John Wiley & Sons, Inc., 2005.
18	"Urban Hydrology for Small Watersheds," Technical Report 55, U.S. Department of Agriculture, Natural Resources Conservation Service, 1986.
19	U.S. EPA, Region 1 New England web site (as of August 2005) http://www.epa.gov/NE/assistance/ceitts/stormwater/techs/html .

LIST OF ACCEPTABLE BMPs PRE-TREATMENT METHODS FOR "HOT SPOT" LAND USES

Hot Spot Land Use	Pre-treatment Method(s)
Vehicle Maintenance and Repair Facilities including Auto Parts Stores	<ul style="list-style-type: none"> - 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	<ul style="list-style-type: none"> - Water Quality Inlets - Spill Prevention and Response Program
Storage Areas for Public Works	<ul style="list-style-type: none"> - 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	<ul style="list-style-type: none"> - Spill Prevention and Response Program
Commercial Nursery Operations	<ul style="list-style-type: none"> - 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

Design references for the pre-treatment methods, as necessary, are listed below. If the applicant can demonstrate to the satisfaction of the municipality that the proposed land use is not a Hot Spot, then the pre-treatment requirement would not apply.

Pre-treatment Method	Design Reference ^A
Constructed Wetlands	5, 6, 10, 12, 18
Diversion of Stormwater Away from Potential Contamination Areas	5, 13
Stormwater Collection and Reuse (especially for irrigation)	5, 16
Stormwater Filters (Sand, Peat, Compost, etc.)	5, 6, 12, 18
Vegetated Swales	2, 4, 6, 13, 18, 19
Water Quality Inlets	5, 9, 17, 18, 21

^A These numbers refer to the Design Reference Title Chart beginning on H2.



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