

STORMWATER MANAGEMENT ORDINANCE

ORDINANCE NO. 2022-15

AN ORDINANCE OF RADNOR TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA, ESTABLISHING THE RADNOR TOWNSHIP STORMWATER MANAGEMENT ORDINANCE IN ACCORDANCE WITH ACT 167, THE PENNSYLVANIA STORMWATER MANAGEMENT ACT

The Radnor Township Board of Commissioners, upon recommendation of the Township Engineer, Delaware County and the Pennsylvania Department of Environmental Protection, does hereby enact a new Chapter 245, Stormwater Management to read as follows:

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ARTICLE I – GENERAL PROVISIONS

Section 101. Short Title

This Ordinance shall be known as the “Radnor Township Stormwater Management Ordinance.”

Section 102. Statement of Findings

The governing body of the Municipality finds that:

- A. Inadequate management of accelerated stormwater runoff resulting from development throughout a watershed increases flood flows and velocities, contributes to erosion and sedimentation, overtaxes the carrying capacity of existing streams and storm sewers, greatly increases the cost of public facilities to convey and manage stormwater, undermines floodplain management and flood reduction efforts in upstream and downstream communities, reduces infiltration, and threatens public health and safety.
- B. Inadequate planning and management of stormwater runoff resulting from land development throughout a watershed can also harm surface water resources by changing the natural hydrologic patterns, accelerating stream flows (which increase scour and erosion of stream beds and stream banks, thereby elevating sedimentation), destroying aquatic habitat, and elevating aquatic pollutant concentrations and loadings such as sediments, nutrients, heavy metals, and pathogens. Groundwater resources are also impacted through loss of recharge.
- C. A comprehensive program of stormwater management, including minimization of impacts of development, redevelopment, and activities causing accelerated erosion and loss of natural infiltration, is fundamental to the public health, safety, welfare, and the protection of the people of the Municipality and all of the people of the Commonwealth, their resources, and the environment.
- D. Stormwater can be an important water resource by providing infiltration for water supplies and baseflow of streams, which also protects and maintains surface water quality.
- E. Impacts from stormwater runoff can be minimized by using project designs that maintain the natural hydrologic regime and sustain high water quality, infiltration, stream baseflow, and aquatic ecosystems. The most cost-effective and environmentally advantageous way to manage stormwater runoff is through nonstructural project design that minimizes impervious surfaces and sprawl, avoids sensitive areas (i.e., stream buffers, floodplains, steep slopes), and considers topography and soils to maintain the natural hydrologic regime.
- F. Public education on the control of pollution from stormwater is an essential component in successfully addressing stormwater.

- G. Federal and state regulations require certain municipalities to implement a program of stormwater controls. These municipalities are required to obtain a permit for stormwater discharges from their separate storm sewer systems under the National Pollutant Discharge Elimination System (NPDES).
- H. Non stormwater discharges to municipal separate storm sewer systems can contribute to pollution of waters of the Commonwealth by the Municipality.
- I. The use of green infrastructure and low impact development (LID) are intended to address the root cause of water quality impairment by using systems and practices which use or mimic natural processes to 1) infiltration and recharge, 2) evapotranspiration, and/or 3) harvest and use precipitation near where it falls to earth. Green infrastructure practices, LID, and CD contribute to the restoration or maintenance of pre-development hydrology.

Section 103. Purpose

The purpose of this Ordinance is to promote the public health, safety, and general welfare, property, and water quality implementing drainage and stormwater management practices, criteria, and provisions included herein for land development, construction, and Earth Disturbance Activities, to achieve the following throughout the Township:

- A. Promote alternative project designs and layouts that minimize the impacts on surface and groundwater.
- B. Promote nonstructural best management practices (BMPs).
- C. Minimize increases in runoff stormwater volume.
- D. Minimize impervious surfaces.
- E. Manage accelerated stormwater runoff and erosion and sedimentation problems and stormwater runoff impacts at their source by regulating activities that cause these problems.
- F. Provide review procedures and performance standards for stormwater planning and management.
- G. Utilize and preserve existing natural drainage systems as much as possible.
- H. Manage stormwater impacts close to the runoff source, requiring a minimum of structures and relying on natural processes.
- I. Focus on infiltration of stormwater to maintain base flow, to prevent degradation of surface and groundwater quality, and to otherwise protect water resources.
- J. Protect base flows and quality of streams and watercourses, where possible.

- K. Meet legal water quality requirements under state law, including regulations at 25 Pennsylvania Code Chapter 93 to protect, maintain, reclaim, and restore the existing and designated uses of the Waters of the Commonwealth.
- L. Address the quality and quantity of stormwater discharges from the development site.
- M. Provide standards to meet certain NPDES MS4 permit requirements.
- N. Implement an illicit discharge detection and elimination program that addresses non-stormwater discharges into the Township’s separate storm sewer system (MS4).
- O. Preserve the flood-carrying capacity of streams.
- P. Prevent accelerated scour, erosion and sedimentation of stream channels.
- Q. Provide performance standards and design criteria based on watershed-wide stormwater management planning.
- R. Provide proper operation and maintenance of all permanent stormwater management facilities and BMPs that are implemented within the Municipality.
- S. Implement the requirements of Total Maximum Daily Loads (TMDLs) where applicable to waters within or impacted by the Township.

Section 104. Statutory Authority

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

- A. Act of October 4, 1978, 32 P.S., P.L. 864 (Act 167) Section 680.1 et seq., as amended, the “Storm Water Management Act” (hereinafter referred to as “the Act”);
- B. Act of July 31, 1968, P.L. 805, No. 247, Pennsylvania Municipalities Planning Code, Act 247, as amended; and
- C. Radnor Township Home Rule Charter

Section 105. Applicability/Regulated Activities

All regulated activities and all activities that may affect stormwater runoff, including but not limited to land development, redevelopment, and earth disturbance activity located within the municipality, are subject to regulation by this Ordinance.

This Ordinance contains the stormwater management performance standards and design criteria that are necessary from a watershed-wide perspective. Local stormwater management design criteria (e.g., inlet spacing, inlet type, collection system design and details, outlet structure

design, etc.) shall continue to be regulated by the applicable municipal ordinances and applicable state regulations.

Section 106. Exemptions

An exemption shall not relieve the Applicant from implementing the requirements of the municipal Ordinance or from implementing such measures as are necessary to protect public health, safety, and property. An exemption shall not relieve the Applicant from complying with the special requirements for watersheds draining to identified high quality (HQ) or exceptional value (EV) waters or any other current or future state or municipal water quality protection requirements. If a drainage problem is documented or known to exist downstream of, or is expected from the proposed activity, then the Municipality may withdraw exemptions listed in Table 106 and require the Applicant to comply with all requirements of this Ordinance. Even though the Applicant is exempt, he is not relieved from complying with other municipal ordinances or regulations.

General Exemptions

Table 106.1 summarizes the exemptions from certain provisions of this Ordinance. Exemptions are for the items noted in Table 106.1 only and shall not relieve the Applicant from other applicable sections of this Ordinance.

Any regulated activity that is exempt from some provisions of the Ordinance is exempt only from those provisions. If development is to take place in phases, the developer is responsible for implementing the requirements of the Ordinance as the impervious cover/earth disturbance threshold is met. The date of the municipal Ordinance adoption shall be the starting point from which to consider tracts as “parent tracts” in which future subdivisions and respective impervious area and earth disturbance computations shall be cumulatively considered. Exemption shall not relieve the applicant from implementing such measures as are necessary to protect health, safety, and property. For example:

If a property owner proposes a 150 square foot shed after adoption of the municipal stormwater management Ordinance, that property owner would be exempted from water quality and quantity requirements of the Ordinance as noted in Table 106.1 of the Ordinance. If, within three years the property owner proposes to construct a 499 square foot room addition, the applicant would be required to comply with the requirements for the Simplified Method for the full 649 square feet of impervious cover created since adoption of the municipal Ordinance. If an additional 700 square foot swimming pool/patio is proposed later, the property owner would be required to implement the full stormwater quantity and quality control submission requirements of this Ordinance for the total 1,349 square feet of additional impervious surface added to the original property since adoption of the Municipal Ordinance.

**TABLE 106.1
Ordinance Exemptions**

Ordinance Article or Section	Type of Project	Regulated Impervious Surface			Earth Disturbance		
		0-499 sq. ft.	500-999 sq. ft.	1,000+ sq. ft.	0-4,999 sq. ft. disturbance	5,000 sq. ft. - < 1 acre	≥ 1 acre
Article IV SWM Site Plan Requirements	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Exempt	Modified ¹	Not Exempt
Section 304 Nonstructural Project Design	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Exempt	Not Exempt	Not Exempt
Section 305 Infiltration Volume Requirements	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Exempt	Exempt	Not Exempt
Section 306 Water Quality Requirements	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Modified ²	Modified ²	Not Exempt
Section 307 Stream Bank Erosion Requirements	Development Redevelopment	Exempt	Not Exempt Simplified Approach	Not Exempt	Exempt	Exempt	Not Exempt
Section 308 Stormwater Peak Rate Control and Management Districts	Development Redevelopment	Exempt	Exempt	Not Exempt	Exempt	Not Exempt	Not Exempt
Erosion and Sediment Pollution Control Requirements	Must comply with Title 25, Chapter 102 of the PA Code and other applicable state and municipal codes, including the Clean Streams Law.						Not Exempt

Legend:

- “Regulated Impervious Surface” in Table 106.1 includes new, additional, impervious surface/cover as part of development or redevelopment.
- Exempt - Exempt from required section provision only – SWM site plan submission may still be required if other section provisions are applicable.
- Modified¹ - Modified SWM site plan need only consist of items in Sections 402.A.2 and 4; 402B.7, 8, 11, and 22; and 402.D.1 and 3 and related supportive material needed to determine compliance with Sections 304 and 308. Modified SWM site plan is required that includes all elements of Section 304, as applicable.
- Modified² - Modified SWM site plan need only consist of items and related material needed to determine compliance with Section 311.
- Simplified Approach – Must comply with provisions of Appendix B of the Ordinance.
- Redevelopment – See Section 308.I for alternate stormwater peak rate control criteria.

A. Exemptions for Specific Activities

1. Use of land for gardening or home consumption.
2. Agriculture when operated in accordance with a conservation plan, nutrient management plan, or erosion and sedimentation control plan approved by the County Conservation District, including activities such as growing crops, rotating crops, tilling soil, and grazing animals. For agriculture with an approved conservation plan, installation of new or expansion of existing farmsteads, animal housing, waste

storage, and production areas having impervious surfaces that result in a net increase in impervious surface of between 500-999 square feet shall apply the simplified approach, and net increases in impervious surface of greater than or equal to 1,000 square feet shall be subject to the provisions of this Ordinance.

3. High Tunnel if:

- a. The High Tunnel or its flooring does not result in an impervious surface exceeding 25% of all structures located on the Landowner's total contiguous land area; and
- b. The High Tunnel meets one of the following:
 - i. The High Tunnel is located at least 100 feet from any perennial stream or watercourse, public road, or neighboring property line.
 - ii. The High Tunnel is located at least 35 feet from any perennial stream or watercourse, public road or neighboring property line and located on land with a slope not greater than 7%.
 - iii. The High Tunnel is supported with a buffer or diversion system that does not directly drain into a stream or other watercourse by managing stormwater runoff in a manner consistent with the requirements of Pennsylvania Act 167.

4. Forest management operations which are following the Department of Environmental Protection's (PADEP) management practices contained in its publication "Soil Erosion and Sedimentation Control Guidelines for Forestry," are operating under an approved erosion and sedimentation plan and must comply with the stream buffer requirements in Section 311.

5. Repaving without reconstruction.

6. Emergency Exemption - Emergency maintenance work performed for the protection of public health, safety, and welfare. A written description of the scope and extent of any emergency work performed shall be submitted to Radnor Township within two (2) calendar days of the commencement of the activity. If Radnor Township finds that the work is not an emergency, then the work shall cease immediately, until a stormwater site-plan in accordance with this ordinance is submitted and approved by the municipality.

7. Maintenance Exemption - Any maintenance to an existing stormwater management system made in accordance with plans and specifications approved by the Township Engineer or Radnor Township.

Section 107. Repealer

Any ordinance or ordinance provision of the Township inconsistent with any of the provisions of this and other federal and state regulations are hereby repealed to the extent of the inconsistency

only. Existing Chapter 245 of the Radnor Township Code of Ordinances is specifically repealed and replaced by this Ordinance.

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 Ordinances or Legal Requirements

- A. 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.
- B. To the extent that this Ordinance imposes more rigorous or stringent requirements for stormwater management, the specific requirements contained in this Ordinance shall be followed.
- C. Nothing in this Ordinance shall be construed to affect any of the Township's requirements regarding stormwater matters that do not conflict with the provisions of this Ordinance, such as local stormwater management design criteria (e.g., inlet spacing, inlet type, collection system design and details, outlet structure design, etc.). Conflicting provisions in other municipal ordinances or regulations shall be construed to remain. The requirements of this Ordinance shall supersede any conflicting requirements in other municipal ordinance or regulations.

Section 110. Erroneous Permit

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

Section 111. Waivers

- A. If the Township determines that any requirement under this Ordinance cannot be achieved for a particular regulated activity, the Township Engineer may, after an evaluation of alternatives, approve measures other than those in this Ordinance, subject to Sections 111.B and 111.C.
- B. Waivers or modifications of the requirements of this Ordinance may be approved by the Township Engineer if enforcement will exact undue hardship because of peculiar conditions pertaining to the land in question, provided that the modifications will not be contrary to the public interest and that the purpose of the Ordinance is preserved. Cost or financial burden shall not be considered a hardship. Modification may be considered if an alternative standard or approach will provide equal or better achievement of the purpose of

the Ordinance. A request for modifications shall be in writing and accompany the Stormwater Management Site Plan submission. The request shall provide the facts on which the request is based, the provision(s) of the Ordinance involved and the proposed modification.

- C. No waiver or modification of any regulated stormwater activity involving Earth Disturbance greater than or equal to one (1) acre may be granted by the Municipality unless that action is approved in advance by PADEP or the Delaware County Conservation District.

ARTICLE II – DEFINITIONS

Section 201. Interpretation

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

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

Section 202. Definitions

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

Agricultural Activities – The work of producing crops and raising livestock including tillage, plowing, disking, harrowing, pasturing, nursery and sod operations, excluding greenhouse structures, and installation of conservation measures. Construction of new buildings or impervious area is not considered an agricultural activity.

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

Applicant – A landowner or other person who has filed an application to the Municipality for approval to engage in any regulated activity defined in Section 105 of this Ordinance.

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

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

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

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

BMP (Best Management Practice) – Activities, facilities, designs, measures, or procedures used to manage stormwater impacts from regulated activities, to meet state water quality requirements, to promote infiltration, and to otherwise meet the purposes of this Ordinance. Stormwater BMPs are commonly grouped into one of two broad categories or measures: “structural” or “nonstructural.” In this Ordinance, nonstructural BMPs or measures include certain low impact development practices used to minimize the contact of pollutants with stormwater runoff. These practices aim to limit the total volume of stormwater runoff and manage stormwater at its source by techniques such as protecting natural systems and incorporating existing landscape features. Nonstructural BMPs include, but are not limited to, low impact development practices such as the protection of sensitive and special value features such as wetlands and riparian areas, the preservation of open space while clustering and concentrating development, the reduction of impervious cover, and the disconnection of rooftops from storm sewers. Structural BMPs are those that consist of a physical to capture and treat stormwater runoff. Structural BMPs include, but are not limited to, a wide variety of practices and devices, from large-scale retention ponds and constructed wetlands to small-scale underground treatment systems, infiltration facilities, filter strips, bioretention, wet ponds, permeable paving, grassed swales, riparian buffers, sand filters, detention basins, and manufactured devices. Structural and nonstructural stormwater BMPs are permanent appurtenances to the project Site.

Buffer – See Riparian Buffer.

Channel – An open drainage feature through which stormwater flows. Channels include, but shall not be limited to, natural and man-made drainageways, swales, streams, ditches, canals, and pipes flowing partly full.

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

Cistern – An underground reservoir or tank for storing rainwater.

Conservation District – The Delaware County Conservation District.

Conveyance – A natural or manmade, existing, or proposed Stormwater Management Facility, feature or channel used for the transportation or transmission of stormwater from one place to another. For the purposes of this Ordinance, Conveyance shall include pipes, drainage ditches,

channels, and swales (vegetated and other), gutters, stream channels, and like facilities or features.

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

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

Department – The Pennsylvania Department of Environmental Protection. Also referred to as “DEP”, “PA DEP”, or “PADEP.”

Designee – The agent of the Delaware County Planning Department, Delaware County Conservation District, and/or agent of the Governing Body involved with the administration, review, or enforcement of any provisions of this Ordinance by contract or memorandum of understanding.

Design Professional (Qualified) – A Pennsylvania Registered Professional Engineer, Registered Professional Land Surveyor trained to develop SWM site plan, or any person licensed by the Pennsylvania Department of State or qualified by law to perform the work required by the Ordinance.

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

Detention or To Detain – The prevention of, or to prevent, the discharge, directly or indirectly, of a given volume of stormwater runoff into surface waters by temporary storage.

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

Developer – A person, or company, or organization who seeks to undertake any regulated earth disturbance activities at a project site in the Municipality.

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

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

Diameter at Breast Height (DBH) – The outside bark diameter at breast height which is defined as four and one half (4.5) feet (1.37m) above the forest floor on the uphill side of the tree.

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

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

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

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

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

Downslope Property Line – That portion of the property line of the lot, tract, or parcels of land being developed, located such that overland or pipe flow from the project site would be directed towards it by gravity.

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

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

Drainage Permit – A permit issued by the Municipality after the stormwater management site plan has been approved.

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; road maintenance; building construction; the moving, depositing, stockpiling, or storing of soil, rock, or earth materials.

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

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

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

Erosion and Sediment (E&S) Control Plan – A plan that is designed to minimize accelerated erosion and sedimentation. Said plan must be submitted to and approved by the Delaware County Conservation District before construction can begin.

Evapotranspiration (ET) – The combined processes of evaporation from the water or soil surface and transpiration of water by plants.

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

Existing Conditions – The initial condition of a project site prior to the proposed alteration. If the initial condition of the site is undeveloped land, the land use shall be considered as “meadow” unless the natural land cover is proven to generate a lower curve number or Rational “c” value, such as forested lands.

FEMA – Federal Emergency Management Agency.

Financial Hardship – A situation where the greatest possible profit cannot be fully realized from development/redevelopment on a given parcel of land due to added costs or burdens associated with the design, construction, and/or maintenance of stormwater structures, facilities, buffers and/or setbacks.

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

Floodplain – Any land area susceptible to inundation by water from any natural source or as delineated by the applicable Department of Housing and Urban Development, Federal Emergency Management Agency (FEMA) maps and studies as being a Special Flood Hazard Area.

Floodway – The channel of a watercourse and those portions of the adjoining floodplains which are reasonably required to carry and discharge the 100-year frequency flood (also called the base flood or one percent (1%) annual chance flood). Unless otherwise specified, the boundary of the floodway is as indicated on maps and flood insurance studies provided by FEMA. In an area where no FEMA maps or studies have defined the boundary of the 100-year frequency floodway, it is assumed, absent evidence to the contrary, that the floodway extends from the stream to fifty (50) feet from the top-of-bank.

Fluvial Geomorphology – The study of landforms associated with river channels and the processes that form them.

Forest Management/Timber Operations – Planning and associated activities necessary for the management of forest lands. These include timber inventory and preparation of forest

management plans, silvicultural treatment, cutting budgets, logging road design and construction, timber harvesting, and reforestation.

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

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

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

Green Infrastructure – Systems and practices that use or mimic natural processes to infiltrate, evapotranspire, or reuse stormwater on the site where it is generated. Also referred to as Green Stormwater Infrastructure (GSI).

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

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

HEC-HMS – The U.S. Army Corps of Engineers, Hydrologic Engineering Center (HEC) - Hydrologic Modeling System (HMS). This model was used to model the Darby-Cobbs and Crum Creek watersheds during the Act 167 plan development and was the basis for the standards and criteria of this Ordinance.

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

High Tunnel – A structure which meets the following:

1. Is used for the production, processing, keeping, storing, sale or shelter of an agricultural commodity as defined in section 2 of the Act of December 19, 1974 (P.L. 973, No. 319), known as the “Pennsylvania Farmland and Forest Land Assessment Act of 1974,” or the storage of agricultural equipment or supplies; and
2. Is constructed with all the following:
 - a. has a metal, wood, or plastic frame;
 - b. when covered, has a plastic, woven textile, or other flexible covering; and
 - c. has a floor made of soil, crushed stone, matting, pavers, or a floating concrete slab.

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

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

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

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

Impervious Surface – A surface that prevents the infiltration of water into the ground. Impervious surfaces shall include, but are not limited to, streets, sidewalks, pavements, additional indoor living spaces, patios, *swimming pools [coping and decking only]*, garages, storage sheds, and similar structures, driveway areas, roofs, tennis or other paved courts. For the purposes of determining compliance with this Ordinance, compacted soils or stone surfaces used for vehicle parking and movement shall be considered impervious. Uncompacted gravel areas with no vehicular traffic shall be considered pervious per review by the Municipal Engineer. Surfaces that were designed to allow infiltration (i.e. pavers and areas of porous pavement) are not to be considered impervious surface if designed to function as a BMP per review by the Municipal Engineer. Additionally, for the purposes of determining compliance with this Ordinance, the total horizontal projection area of all ground-mounted and free-standing solar collectors, including solar photovoltaic cells, panels, and arrays, shall be considered pervious so long as the Municipal Engineer determines that the area underneath the solar photovoltaic cells, panels, and arrays is maintained as a vegetated pervious surface.

Credit will be provided for the removal of impervious surface up to 999 square feet. The existing impervious must be removed, along with any stone bedding beneath the impervious surface. This shall be tilled to a depth of 6", with equipment not compacting the soil. A minimum 6" of topsoil is required above the tilled surface. The credit will be square foot for square foot.

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

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

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

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

Inflow – The flow entering the stormwater management facility and/or BMP.

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

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

Invert – The lowest surface, the floor or bottom of a culvert, drain, sewer, channel, basin, BMP, or orifice.

Land Development – Any of the following activities:

- (i) The improvement of one (1) lot or two (2) or more contiguous lots, tracts, or parcels of land for any purpose involving:
 - a. A group of two (2) or more residential or nonresidential buildings, whether proposed initially or cumulatively, or a single nonresidential building on a lot or lots regardless of the number of occupants or tenure, or
 - b. The division or allocation of land or space, whether initially or cumulatively, between or among two (2) or more existing or prospective occupants by means of, or for the purpose of, streets, common areas, leaseholds, condominiums, building groups, or other features.
- (ii) A subdivision of land.
- (iii) Development in accordance with Section 503(1.1) of the Pennsylvania Municipalities Planning Code.

Limiting Zone – A soil horizon or condition in the soil profile or underlying strata that includes one of the following:

- (i) A seasonal high-water table, whether perched or regional, determined by direct observation of the water table or indicated by soil mottling.
- (ii) A rock with open joints, fracture or solution channels, or masses of loose rock fragments, including gravel, with insufficient fine soil to fill the voids between the fragments.
- (iii) A rock formation, other stratum, or soil condition that is so slowly permeable that it effectively limits downward passage of water.

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

Low Impact Development (LID) - Site design approaches and small-scale stormwater management practices that promote the use of natural systems for infiltration, evapotranspiration, and reuse of rainwater. LID can be applied to new development, urban retrofits, and revitalization projects. LID utilizes design techniques that infiltrate, filter, evaporate, and store runoff close to its source. Rather than rely on costly large-scale conveyance and treatment systems, LID addresses stormwater through a variety of small, cost-effective landscape features located on-site.

Main Stem (Main Channel) – Any stream segment or other runoff conveyance used as a reach in watershed-specific hydrologic models.

Managed Release Concept (MRC) - A post-construction stormwater management (PCSM) strategy that comprises the collection, management, and filtration of captured runoff from the contributing drainage area through a best management practice (BMP) that is preferably vegetated and includes release of a portion of the captured runoff through an underdrain within the BMP. If the MRC BMP is not vegetated, then pretreatment is required to meet water quality requirements. MRC is intended to be used for project areas or subareas where infiltration is considered infeasible to meet regulatory requirements. Refer to the “Managed Release Concept” Version 1.2 (August 25, 2020) guidance document or latest guidance from PA DEP.

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.

Maximum Design Storm – The maximum (largest) design storm that is controlled by the stormwater facility.

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

Municipality – Radnor Township Delaware County, Pennsylvania.

Natural Condition – Pre-development condition.

Natural Hydrologic Regime – See Hydrologic Regime.

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

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

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

Nonstructural Best Management Practice (BMPs) – Methods of controlling stormwater runoff quantity and quality, such as innovative site planning, impervious area and grading reduction, protection of natural depression areas, temporary ponding on site, and other techniques.

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

NRCS – Natural Resource Conservation Service (previously SCS).

Open Channel – A conveyance channel that is not enclosed.

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

Outflow – The flow exiting the stormwater management facility and/or BMP.

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

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

Parking Lot Storage – Involves the use of parking areas as temporary impoundments with controlled release rates during rainstorms.

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

Pennsylvania Stormwater Best Management Practices Manual (Document Number 363-0300-002) (December 2006, and as subsequently amended) - The Best Management Practices Manual published by the Pennsylvania Department of Environmental Protection. The manual is to supplement federal and state regulations and the Department of Environmental Protection’s Comprehensive Stormwater Management Policy that emphasizes effective site planning as the preferred method of managing runoff while also providing numerous examples of BMPs that can be employed in Pennsylvania to further avoid and minimize flooding and water resource problems.

Pervious Area – Any area not defined as impervious.

Pet – A domesticated animal (other than a disability assistance animal) kept for amusement or companionship.

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

Planning Commission – The Planning Commission of Radnor Township.

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 Pennsylvania Code § 92.1.

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

Pre-construction – Prior to commencing construction activities.

Pre-development Condition – Undeveloped/natural condition.

Pretreatment – Techniques employed in stormwater BMPs to provide storage or filtering to trap coarse materials and other pollutants before they enter the system, but not necessarily designed to meet the water quality volume requirements of Section 306.

Project Site – The specific area of land where any regulated activities in the Municipality are planned, conducted, or maintained.

Qualified Professional – See Design Professional (Qualified).

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

Reach – Any stream segment or other runoff conveyance used in the watershed-specific hydrologic models.

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

Reconstruction – Demolition and subsequent rebuilding of impervious surface.

Record Drawings – Original documents revised to suit the as-built conditions and subsequently provided by the Engineer to the client. The Engineer reviews the contractor's as-builts against his/her own records for completeness, then either turns these over to the client or transfers the information to a set of reproducible, in both cases for the client's permanent records.

Redevelopment – Any development that requires demolition or removal of existing structures or impervious surfaces at a site and replacement with new impervious surfaces. Maintenance activities such as top layer grinding and re-paving are not considered to be redevelopment. Interior remodeling projects and tenant improvements are also not considered to be redevelopment.

Regulated Activities – Any earth disturbances activities or any activities that involve the alteration or development of land in a manner that may affect stormwater runoff, including redevelopment.

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

Regulated Impervious Surface – Proposed impervious surface as part of a current proposed activity and all existing impervious surfaces installed after Radnor Township 2022 Stormwater Ordinance was adopted that first regulated impervious surface as part of a previous activity.

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

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

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

Retention or To Retain – The prevention of direct discharge of stormwater runoff into receiving waters or water bodies by temporary or permanent containment in a pond or depression; examples include systems which discharge by percolation to groundwater, and/or evaporation processes and which generally have residence times of less than three (3) days.

Retention Basin – A structure in which stormwater is stored and not released during the storm event. Retention basins are designed for infiltration purposes and do not have an outlet.

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

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

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

Riser – A vertical pipe extending from the bottom of a pond that is used to control the discharge rate from the pond for a specified design storm.

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

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

Rooftop Detention – The temporary ponding and gradual release of stormwater falling directly onto flat roof surfaces using controlled-flow roof drains in building designs.

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

SALDO – Subdivision and Land Development Ordinance.

Sediment – Soil or other materials transported by surface water as a product of erosion.

Sediment Basin – A barrier, dam, or retention or detention basin located and designed in such a way as to retain rock, sand, gravel, silt, or other material transported by water during construction.

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

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

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

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

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

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

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

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

Special Protection Sub watersheds – Watersheds that have been designated by PADEP as EV or HQ waters.

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

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

Storage Indication Method – A reservoir routing procedure based on solution of the continuity equation (inflow minus outflow equals the change in storage) with outflow defined as a function of storage volume and depth.

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

Storm Sewer – A system of pipes and/or open channels that conveys intercepted runoff and stormwater from other sources but excludes domestic sewage and industrial wastes.

Stormwater – Drainage runoff from the surface of the land resulting from precipitation, snow, or ice melt.

Stormwater Control Measure – Physical features used to effectively control, minimize, and treat stormwater runoff which also may be referred to as Stormwater Management Practice (SMP). [See Best Management Practice (BMP)].

Stormwater Management District – Those subareas of a watershed in which some type of detention is required to meet the plan requirements and the goals of Act 167.

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

Stormwater Management Plan – The watershed plan for managing stormwater runoff for a watershed, adopted by Delaware and/or Chester Counties as required by the Act of October 4, 1978, P.L. 864 (Act 167), as amended, and known as the “Storm Water Management Act.” See also Watershed Stormwater Management Plan.

Stormwater Management (SWM) Site Plan – The plan prepared by the Applicant or his representative indicating how stormwater runoff will be managed at the particular site of interest according to this Ordinance, and including all necessary design drawings, calculations, supporting text, and documentation to demonstrate that Ordinance requirements have been met, hereafter referred to as “SWM site plan.”

Stream – A natural watercourse.

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

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

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

Subdivision – The division or redivision of a lot, tract, or parcel of land by any means into two (2) 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 (10) acres not involving any new street or easement of access or any residential dwelling shall be exempted.

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

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

SWM Site Plan – See Stormwater Management Site Plan.

Timber Operations – See Forest Management.

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

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

USDA – United States Department of Agriculture.

Undeveloped Condition – Natural condition (see also Pre-development Condition).

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

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

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

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

Watershed Stormwater Management Plan – A watershed plan for managing stormwater runoff for a watershed, adopted by Delaware and/or Chester Counties as required by the Act of October 4, 1978, P.L. 864 (Act 167), as amended, and known as the “Storm Water Management Act” (e.g., Chester Creek, Ridley Creek, Crum Creek, Darby-Cobbs Creeks). See also Stormwater Management Plan.

Wellhead – 1. A structure built over a well, 2. The source of water for a well.

Wellhead Protection Area – The surface and subsurface area surrounding a water supply well, well field, or spring supplying a public water system through which contaminants are reasonably likely to move toward and reach the water source.

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

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

Woods – A natural groundcover with more than one (1) viable tree of a DBH of six (6) inches or greater per fifteen hundred (1,500) square feet which existed within three (3) years of application; a cover condition for which SCS curve numbers have been assigned or to which equivalent Rational Method runoff coefficients have been assigned.

ARTICLE III – STORMWATER MANAGEMENT

Section 301. General Requirements

- A. Applicants proposing regulated activities in the Township which do not fall under the exemption criteria shown in Section 106 shall submit a stormwater management site plan consistent with this Ordinance and the applicable watershed stormwater management plan to the Municipality for review. The stormwater management criteria of this Ordinance shall apply to the total proposed development even if development is to take place in stages.
- B. No regulated activity within the Township shall commence until the Township issues approval [in the form of a permit] of a SWM plan, which demonstrates compliance with the requirements of this ordinance.
- C. The Applicant is required to design the site to minimize surface discharge of stormwater and the creation of impervious surfaces in order to maintain, as much as possible, the natural hydrologic regime.
- D. The SWM site plan must be designed consistent with the sequencing provisions of Section 304 to ensure maintenance of the natural hydrologic regime, to promote infiltration, and to protect groundwater and surface water quality and quantity. The SWM site plan designer must proceed sequentially in accordance with Article III of this Ordinance.
- E. Stormwater drainage systems shall be designed in order to preserve natural flow conditions to the maximum extent practicable.
- F. Alteration of existing drainage discharge onto adjacent property shall only be proposed in accordance with PADEP guidance document “Chapter 102 Off-Site Discharges of Stormwater to Non-Surface Waters – Frequently Asked Questions (FAQ)” dated January 2, 2019, or latest guidance document from PADEP. Such discharge shall be subject to any applicable discharge criteria specified in this Ordinance and **still must meet the requirements of Act 167.**
- G. Areas of existing diffused drainage discharge, whether proposed to be concentrated or maintained as diffused drainage areas, shall be subject to any applicable discharge criteria in the general direction of existing discharge, except as otherwise provided by this Ordinance. If diffused drainage discharge is proposed to be concentrated and discharged onto adjacent property, the Applicant must document that adequate downstream conveyance facilities exist to safely transport the concentrated discharge or otherwise prove that no erosion, sedimentation, flooding, or other impacts will result from the concentrated discharge.
- H. Where a development site is traversed by a stream, drainage easements consisting of the one hundred year flood plain limits shall be provided on either side of, and conform to the line of such streams.
- I. Minimization of impervious surfaces and infiltration of runoff through seepage beds, infiltration trenches, etc., is encouraged where soil conditions permit in order to reduce the size or eliminate the need for detention facilities or other structural BMPs.

- J. All stormwater runoff from new development or redevelopment shall be pretreated for water quality prior to discharge to surface or groundwater. Rooftop runoff may go directly to an infiltration BMP or be evapotranspired.
- K. All regulated activities within the Township shall be designed, implemented, operated, and maintained to meet the purposes of this Ordinance, through these two elements:
1. Erosion and sediment control during earth disturbance activities (e.g., during construction), and
 2. Water quality protection measures after completion of earth disturbance activities (i.e., after construction), including operations and maintenance.
- L. The BMPs shall be designed, implemented, and maintained to meet state water quality requirements and any other more stringent requirements as determined by the Municipality. Applicants shall utilize the *Pennsylvania Stormwater Best Management Practices Manual* (PA BMP Manual), as amended, or other sources acceptable to the Municipal Engineer, for testing and design standards for BMPs, and where there is a conflict with the provisions of this Ordinance, the most restrictive applies.
- M. Post-construction water quality protection shall be addressed as required by Section 306.
- N. Operations and maintenance of permanent stormwater BMPs shall be addressed as required by Article VII.
- O. All BMPs used to meet the requirements of this Ordinance shall conform to the state water quality requirements and any more stringent requirements as set forth by the Municipality.
- P. Techniques described in Appendix E (Low Impact Development) of this Ordinance shall be considered because they reduce the costs of complying with the requirements of this Ordinance and the state water quality requirements.
- Q. In selecting the appropriate BMPs or combinations thereof, the Applicant shall consider the following:
1. Total contributing drainage area.
 2. Permeability and infiltration rate of the site's soils.
 3. Slope and depth to bedrock.
 4. Seasonal high-water table.
 5. Proximity to building foundations and wellheads.
 6. Erodibility of soils.
 7. Land availability and configuration of the topography.
 8. Peak discharge and required volume control.
 9. Stream bank erosion.
 10. Efficiency of the BMPs to mitigate potential water quality problems.
 11. The volume of runoff that will be effectively treated.
 12. The nature of the pollutant being removed.

13. Maintenance requirements.
14. Creation/protection of aquatic and wildlife habitat.
15. Recreational value.
16. Enhancement of aesthetic and property values.

- R. The design of all stormwater management facilities shall incorporate sound engineering principles and practices in a manner that does not aggravate existing stormwater problems. The Municipality reserves the right to disapprove any design that would result in construction in or continuation of a stormwater problem area.
- S. The applicant may meet the stormwater management criteria through off-site stormwater management measures as long as the proposed measures are in the same subwatershed as shown in Ordinance Appendix A.
- T. Stormwater Hotspots – Stormwater runoff from hotspots shall be pretreated prior to surface or groundwater infiltration to prevent pollutant runoff. Industrial sites referenced in 40 CFR 125 are examples of hotspots.

Below is a list of examples of hotspots:

- Vehicle salvage yards and recycling facilities
- Vehicle fueling stations
- Vehicle service and maintenance facilities
- Vehicle and equipment cleaning facilities
- Fleet storage areas (bus, truck, etc.)
- Industrial sites based on Standard Industrial Classification Codes
- Marinas (service and maintenance areas)
- Outdoor liquid container storage
- Outdoor loading/unloading facilities
- Public works storage areas
- Facilities that generate or store hazardous materials
- Commercial container nursery
- Contaminated sites/brownfields
- Other land uses and activities as designated by an appropriate review authority

The following land uses and activities are not normally considered hotspots:

- Residential streets and rural highways
- Residential development
- Institutional development
- Office developments
- Nonindustrial rooftops
- Pervious areas, except golf courses and nurseries (which may need an integrated pest management (IPM) plan)

While streets and highways (average daily traffic volume (ADT) greater than thirty thousand (30,000)) are not considered stormwater hotspots, it is important to ensure that highway

stormwater management facilities are designed to adequately protect receiving streams and/or groundwater.

The Environmental Protection Agency's (EPA) NPDES stormwater program requires some industrial sites to prepare and implement a stormwater pollution prevention plan.

- U. The following standards for protection of adjacent and downgradient properties from off-site conveyance must be accomplished:

For any location where a new concentrated discharge of stormwater from any frequency rainfall event, up to and including the 100-year storm and the volume of runoff up to and including the 2-year storm onto or through adjacent property(ies) or downgradient property(ies), the following are required:

1. A drainage easement (or other legal agreement/approval) must be obtained for conveyance of discharges onto or through adjacent properties per the PADEP guidance document "Chapter 102 Off-Site Discharges of Stormwater to Non-Surface Wasters – Frequently Asked Questions (FAQ)" dated January 2, 2019, or latest guidance document from PADEP.
2. The conveyance must be designed to avoid erosion, flooding, or other damage to the properties through which it is being conveyed.

Section 302. Permit Requirements by Other Governmental Entities

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

- A. All regulated earth disturbance activities subject to permit requirements by PADEP under regulations at Title 25 Pennsylvania Code Chapter 102.
- B. Work within natural drainageways subject to permit by PADEP under Title 25 Pennsylvania Code Chapter 105.
- C. Any stormwater management facility that would be located in or adjacent to surface waters of the Commonwealth, including wetlands, subject to permit by PADEP under Title 25 Pennsylvania Code Chapter 105.
- D. Any stormwater management facility that would be located on or discharging to a state highway right-of-way or require access to or from a state highway shall be subject to approval by PennDOT.
- E. 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 PADEP under Title 25 Pennsylvania Code Chapter 105.

Section 303. Erosion and Sediment Control During Regulated Earth Disturbance Activities

- A. No regulated earth disturbance activities within the Municipality shall commence until the Municipality receives an approval from the PADEP in compliance with Title 25 Chapter 102 of the Pennsylvania Code of an erosion and sediment control plan for construction activities if applicable.
- B. PADEP has regulations regarding an erosion and sediment control under Title 25 Pennsylvania Code Chapter 102.
- C. In addition, under Title 25 Pennsylvania Code Chapter 92, a PADEP “NPDES Construction Activities” Permit is required for regulated earth disturbance activities.
- D. Evidence of any necessary permit(s) for regulated earth disturbance activities from the appropriate PADEP regional office or County Conservation District must be provided to the Municipality. The issuance of an NPDES Construction Permit (or permit coverage under the statewide General Permit (PAG-2)) satisfies the requirements of subsection 403.A.
- E. A copy of the erosion and sediment control plan and any required permit, as required by PADEP regulations, shall be available on the project site at all times.
- F. Additional erosion and sediment control design standards and criteria are recommended to be applied where infiltration BMPs are proposed. At a minimum, they shall include the following:

1. Areas proposed for infiltration BMPs shall be protected from sedimentation and compaction during the construction phase to maintain maximum infiltration capacity.
2. Infiltration BMPs shall not be constructed nor receive runoff until the entire drainage area contributory to the infiltration BMP has achieved final stabilization.

Section 304. Nonstructural Project Design Process (Sequencing to Minimize Stormwater Impacts)

The design of all regulated activities shall include the following to minimize stormwater impacts to reduce the surface discharge of stormwater, reduce the creation of unnecessary impervious surfaces, prevent the degradation of waters of the Commonwealth, and maintain as much as possible the natural hydrologic regime of the site.

- A. The Applicant shall apply Low Impact Development (LID) methods such as those listed in Appendix E, provided that use of this method does not conflict with other local codes.
- B. The Applicant shall demonstrate that the design process follows the sequence noted below. The goal of the sequence is to minimize the increases in stormwater runoff and impacts to water quality resulting from the proposed regulated activity:
 1. The following items in this subsection shall be addressed prior to development of other stormwater management site plan design elements:
 - a. Prepare an Existing Resource and Site Analysis Map (ERSAM) showing environmentally sensitive areas including, but not limited to, steep slopes, ponds, lakes, streams, wetlands, hydric soils, vernal pools, stream buffers, and hydrologic soil groups. Land development, any existing recharge areas, and other requirements outlined in the municipal SALDO shall also be included.
 - b. Establish a stream buffer according to Section 311.
 - c. Prepare a draft project layout avoiding sensitive areas identified in Section 304.B.1.a.
 - d. Identify site-specific existing conditions drainage areas, discharge points, recharge areas, and hydrologic soil groups A and B (areas conducive to infiltration).
 - e. Evaluate nonstructural stormwater management alternatives:
 - i. Minimize earth disturbance.
 - ii. Minimize impervious surfaces.
 - iii. Break up large impervious surfaces.
 - f. Determine into what management district the site falls (Ordinance Appendix A), and conduct an existing conditions runoff analysis.
 2. The following items in this subsection may be addressed in any order provided that all items in Section 304.B.1 have been completed.
 - a. Satisfy the infiltration objective (Section 305) and provide for stormwater pretreatment prior to infiltration.
 - b. Provide for water quality protection in accordance with Section 306 water quality requirements.

- c. Provide stream bank erosion protection in accordance with Section 307 stream bank erosion requirements.
- d. Prepare final project design to maintain existing conditions drainage areas and discharge points, to minimize earth disturbance and impervious surfaces, and, to the maximum extent possible, to ensure that the remaining site development has no surface or point discharge.
- e. Conduct a proposed conditions runoff analysis based on the final design that meets the management district requirements (Section 308).
- f. Manage any remaining runoff prior to discharge through detention, bioretention, direct discharge, or other structural control.

Section 305. Infiltration Volume Requirements

Providing for infiltration consistent with the natural hydrologic regime is required. Design of the infiltration facilities shall consider infiltration to compensate for the reduction in the recharge that occurs when the ground surface is disturbed, or impervious surface is created.

If it cannot be physically accomplished, then the design professional shall be responsible for demonstrating to the satisfaction of the Township Engineer that this cannot be physically accomplished on the site (e.g., shallow depth to bedrock or limiting zone, open voids, steep slopes, etc. per the PA BMP). A financial hardship as defined in Section 202 is not acceptable to avoid implementing infiltration facilities. If infiltration can be physically accomplished, the volume of runoff to be infiltrated shall be determined from Section 305.A.2 depending on demonstrated site conditions and shall be the greatest volume that can be physically infiltrated or alternative methods consistent with the PA BMP Manual (as amended) or other PADEP guidance, such as the Managed Release Concept, may be used to manage this volume with approval from the Municipal Engineer. For example:

- Any applicant (developer or redeveloper) shall first attempt to infiltrate the volume required in Section 305.A.2.a.
- If the Section 305.A.2.a requirement cannot be physically accomplished, then the applicant is required to attempt to infiltrate the volume required in Section 305.A.2.b.
- Finally, if the 305.A.2.b infiltration volume cannot be physically accomplished, the applicant must, at a minimum, infiltrate the volume required in 305.A.2.c

A. Infiltration BMPs shall meet the following minimum requirements:

1. Infiltration BMPs intended to receive runoff from developed or redeveloped areas shall be selected based on suitability of soils and site conditions and shall be constructed on soils that have the following characteristics:
 - a. A minimum depth of twenty-four (24) inches between the bottom of the BMP and the top of the limiting zone.
 - b. An infiltration rate sufficient to accept the additional stormwater volume and dewater completely as determined by field tests conducted by the Applicant's design professional.

- c. The infiltration facility shall be capable of completely draining the retention (infiltration) volume (Re_v) within three (3) days (72 hours) from the end of the design storm.
2. The size of the infiltration facility and Re_v shall be based upon the following volume criteria:
- a. Modified Control Guideline One (MCG-1) of the PA BMP Manual – The retention (infiltration) volume (Re_v) to be captured and infiltrated shall be the net 2-year 24-hour volume. The net volume is the difference between the post-development runoff volume and the pre-development runoff volume. The post-development total runoff volume for all storms equal to or less than the 2-year 24-hour duration precipitation shall not be increased. For modeling purposes, existing (pre-development) non-forested pervious areas must be considered meadow in good condition or its equivalent, and twenty (20) percent of existing impervious area, when present, shall be considered meadow in good condition.
 - b. Infiltrating the entire Re_v volume in Section 305.A.2.a (above) may not be feasible on every site due to site-specific limitations such as shallow depth to bedrock or the water table. If it cannot be physically accomplished, then the following criteria from Modified Control Guideline Two (MCG-2) of the PA BMP Manual must be satisfied:

At least the first one-inch (**1.0"**) of runoff from new or replacement impervious surfaces shall be infiltrated.

$$Re_v = 1 \text{ (inch)} * \text{impervious area (square feet)} \div 12 \text{ (inches)} = \text{cubic feet (cf)}$$

An asterisk (*) in equations denotes multiplication.

- c. Only if infiltrating the entire Re_v volume in Section 305.A.2.b (above) cannot be physically accomplished, then the following minimum criteria from Modified Control Guideline Two (MCG-2) of the PA BMP Manual must be satisfied:

Wherever possible, infiltration facilities should be designed to accommodate infiltration of the entire water quality volume (WQv) (Section 306.A); however, in all cases at least the first one-half inch (0.5") of the WQv shall be infiltrated. The minimum infiltration volume (Re_v) required would, therefore, be computed as:

$$Re_v = I * \text{impervious area (square feet)} \div 12 \text{ (inches)} = \text{cubic feet (cf)}$$

An asterisk (*) in equations denotes multiplication.

Where:

I = The maximum equivalent infiltration amount (inches) that the site can physically accept or 0.50 inch, whichever is greater.

The retention volume values derived from the methods in Section 305.A.2.a, 305.A.2.b, or 305.A.2.c is the minimum volume the Applicant must control through an infiltration BMP facility. If site conditions preclude capture of runoff from portions of the impervious area, the infiltration volume for the remaining area should be increased an equivalent amount to offset the loss.

Only if the minimum of 0.50 inch of infiltration requirement **cannot be physically accomplished**, a waiver from Section 305, Infiltration Volume Requirements is required from the Municipality.

- B. Soils - A detailed soils evaluation of the project site shall be required to determine the suitability of infiltration facilities. The evaluation shall be performed by a qualified design professional and at minimum address soil permeability, depth to bedrock, and subgrade stability. The general process for designing the infiltration BMP shall be:
 - 1. Analyze hydrologic soil groups as well as natural and man-made features within the site to determine general areas of suitability for infiltration practices. In areas where development on fill material is under consideration, conduct geotechnical investigations of sub-grade stability; infiltration may not be ruled out without conducting these tests.
 - 2. Provide field tests as required in the PA BMP Manual.
 - 3. Design the infiltration structure for the required retention (Re_v) volume based on field determined capacity at the level of the proposed infiltration surface.
 - 4. If on-lot infiltration structures are proposed by the Applicant's design professional, it must be demonstrated to the Municipality that the soils are conducive to infiltrate on the lots identified.
- C. Infiltration facilities should, to the greatest extent practicable, be located to avoid introducing contaminants via groundwater, and be in conformance with an approved source water protection assessment or source water protection plan.
- D. Roadway drainage systems should provide an opportunity to capture accidental spills. Road de-icing material storage facilities shall be designed to avoid salt and chloride runoff from entering waterways and infiltration facilities. The qualified design professional shall evaluate the possibility of groundwater contamination from the proposed infiltration facility and perform a hydrogeologic justification study if necessary.
- E. The antidegradation analysis found in Chapter 93 shall be applied in HQ or EV streams.
- F. An impermeable liner will be required in detention basins where the possibility of groundwater contamination exists. The Municipality may require a detailed hydrogeologic investigation.
- G. The applicant should provide safeguards against groundwater contamination for land uses that may cause groundwater contamination should there be a mishap or spill.

Section 306. Water Quality Requirements

The Applicant shall comply with the following water quality requirements of this Article.

To control post-construction stormwater impacts from regulated activities and conform to state water quality requirements, BMPs which replicate pre-development stormwater infiltration and runoff conditions must be provided in the site design such that post-construction stormwater discharges do not degrade the physical, chemical, or biological characteristics of the receiving waters. The green infrastructure and Low Impact Development (LID) practices provided in the PA BMP Manual, as well as the guidance on green infrastructure and LID provided in Appendix E shall be utilized for all regulated activities wherever possible. This may be achieved by the following:

1. Infiltration: replication of pre-construction stormwater infiltration conditions,
 2. Treatment: use of water quality treatment BMPs to provide filtering of chemical and physical pollutants from the stormwater runoff, and
 3. Stream bank and stream bed protection: management of volume and rate of post- construction stormwater discharges to prevent physical degradation of receiving waters (e.g., from scouring).
- A. Developed areas shall provide adequate storage and treatment facilities necessary to capture and treat stormwater runoff. The infiltration volume computed under Section 305 may be a component of the water quality volume if the Applicant chooses to manage both components in a single facility. If the calculated water quality volume (WQv) is greater than the volume required to be infiltrated as described in Section 305.A.2, then the difference between the two volumes shall be treated for water quality by an acceptable stormwater management practice(s). The required water quality volume (WQv) is the storage capacity needed to capture and treat a portion of stormwater runoff from the developed areas of the site.

To achieve this requirement, the following criterion is established:

The Post-construction total runoff volume shall not exceed the Predevelopment total runoff volume for all storms equal to or less than the two-year, 24-hour duration precipitation (design storm). If the Municipal Engineer concurs that this criterion cannot be met, a minimum of one half (0.5)-inches of runoff from all Regulated Impervious Surfaces shall be managed. For modeling purposes, existing (pre-development) non-forested pervious areas must be considered meadow in good condition or its equivalent, and twenty (20) percent of existing impervious area, when present, shall be considered meadow in good condition.

This volume requirement can be managed by the permanent volume of a wet basin or the detained volume from other BMPs. Where appropriate, wet basins shall be utilized for water quality control and shall follow the guidelines of the PA BMP Manual referenced in Ordinance Appendix G.

Release of water can begin at the start of the storm (i.e., the invert of the water quality orifice is at the invert of the facility). The design of the facility shall provide for protection from clogging and unwanted sedimentation.

- B. The temperature of receiving waters shall be protected through the use of BMPs that moderate temperature.
- C. Evapotranspiration may be quantified and credited towards meeting volume requirements according to the PADEP Post Construction Stormwater Management (PCSM) Spreadsheet and Instructions (December 2020) or the most recent guidance from PADEP.

Section 307. Stream Bank Erosion Requirements

- A. In addition to controlling the water quality volume (in order to minimize the impact of stormwater runoff on downstream stream bank erosion), the primary requirement to control stream bank erosion is to design a BMP to detain the proposed conditions 2-year, 24-hour design storm to the existing conditions 1-year flow using the SCS Type II distribution. Additionally, provisions shall be made (such as adding a small orifice at the bottom of the outlet structure) to release the proposed conditions 1-year storm for a minimum of twenty-four (24) hours from a point in time when the maximum volume of water from the 1-year storm is stored in a proposed BMP (i.e., the maximum water surface elevation is achieved in the facility). Release of water can begin at the start of the storm (i.e., the invert of the water quality orifice is at the invert of the facility).
- B. The minimum orifice size in the outlet structure to the BMP shall be three (3) inches in diameter where possible, and a trash rack shall be installed to prevent clogging. On sites with small drainage areas contributing to this BMP that do not provide enough runoff volume to allow a 24-hour attenuation with the 3-inch orifice, the calculations shall be submitted showing this condition. When the calculated orifice size is below three (3) inches, gravel filters (or other methods) are recommended to discharge low-flow rates subject to the municipal engineer's satisfaction. When filters are utilized, maintenance provisions shall be provided to ensure filters meet the design function. All facilities shall make use of measures to extend the flow path and increase the travel time of flows in the facility.

Section 308. Stormwater Peak Rate Control

- A. Each watershed has been divided into either stormwater management districts or release rate districts as shown on the respective Management District or Release Rate Maps in Appendix A.
 - 1. In addition to the watershed-specific requirements specified in Tables 308.1, [308.2, 308.3, etc. for each of the watersheds] below, the erosion and sedimentation control (Section 303), the nonstructural project design (Section 304), the infiltration (Section 305), the water quality (Section 306), and the stream bank erosion (Section 307) requirements shall be implemented.
 - 2. Standards for managing runoff from each subarea in a watershed for the 2-, 5-, 10-, 25-, 50-, and 100-year design storms are shown in Tables 308.1, [308.2, 308.3, etc.]. Development sites located in each of the management/release rate districts must control proposed conditions runoff rates to existing conditions runoff rates for the design storms in accordance with the Table/s.

- B. General - Proposed conditions rates of runoff from any regulated activity shall not exceed the peak release rates of runoff from existing conditions for the design storms specified on the Stormwater Management District Watershed Map (Ordinance Appendix A) and this section of the Ordinance.
- C. District Boundaries - The boundaries of the stormwater management districts are shown on an official map that is available for inspection at the municipal and County Planning offices. A copy of the official map at a reduced scale is included in Ordinance Appendix A. 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 2-foot topographic contours (or most accurate data required) provided as part of the SWM site plan.
- D. Sites Located in More than One (1) District or Watershed - For a proposed development site located within two (2) or more stormwater management district subareas, the peak discharge rate from any subarea shall meet the management district criteria for which the discharge is located. The natural hydrology of each respective subarea shall be maintained, and drainage shall not be redirected from one subarea to another. Under circumstances where the Applicant shows this cannot be accomplished, a waiver is required by the Municipality.

TABLE 308.1

PEAK RATE CONTROL STANDARDS IN WATERSHEDS OTHER THAN DARBY-COBBS CREEK

District	Proposed Condition Design Storm	(reduce to)	Existing Condition Design Storm
A	2-year		1-year
	5-year		5-year
	10-year		10-year
	25-year		25-year
	50-year		50-year
	100-year		100-year
B	2-year		1-year
	5-year		2-year
	10-year		5-year
	25-year		10-year
	50-year		25-year
	100-year		100-year

TABLE 308.2

PEAK RATE CONTROL STANDARDS BY STORMWATER MANAGEMENT DISTRICT IN THE DARBY-COBBS CREEK WATERSHED

District	Proposed Condition Design Storm	Existing Condition Design Storm
A	2 - year 5 - year 10 - year 25 - year 100-year	1 - year 5 - year 10 - year 25 - year 100-year
B-1	2 - year 10 - year 25 - year 50- year 100-year	1- year 5 - year 10 - year 25- year 100-year
B-2	2 - year 5 - year 25 - year 50- year 100 - year	1- year 2 - year 5 - year 10- year 100 - year
C	Conditional Direct Discharge District	

E. Off-site Areas - Off-site areas that drain through a proposed development site are not subject to release rate criteria when determining allowable peak runoff rates. On-site drainage facilities shall be designed to safely convey off-site flows through the development site.

F. Site Areas - Where the site area to be impacted by a proposed development activity differs significantly from the total site area, only the proposed impact area utilizing stormwater management measures shall be subject to the peak rate control standards noted above. Unimpacted areas for which the discharge point has not changed are not subject to the peak rate control standards.

G. Alternate Criteria for Redevelopment Sites - For redevelopment sites, one of the following minimum design parameters shall be accomplished, whichever is most appropriate for the given site conditions as determined by Radnor Township;

1. Meet the full requirements specified by Table[s] 308.1 [308.2...] and Sections 308.A through 308.H, or
2. Reduce the total pre-development impervious surface on the site by at least twenty percent (20%); based upon a comparison of existing impervious surface to regulated impervious surface. In this case, calculations must be provided that show the peak rate has not increased.

Section 309. Calculation Methodology

A. Stormwater runoff from all development sites with a drainage area of greater than five (5) acres shall be calculated using a generally accepted calculation technique that is based on the NRCS Soil Cover Complex Method. Table 309.1 summarizes acceptable computation methods. The method selected by the design professional shall be based on the individual limitations and suitability of each method for a particular site. The use of the Rational Method to estimate peak discharges for drainage areas greater than five (5) acres shall be permitted only upon approval of the Municipal Engineer.

TABLE 309.1

**ACCEPTABLE COMPUTATION METHODOLOGIES FOR
SWM SITE PLAN**

METHOD	DEVELOPED BY	APPLICABILITY
TR-20 (or commercial computer package based on TR-20)	USDA NRCS	Applicable where use of full hydrology computer model is desirable or necessary.
TR-55 (or commercial computer package based on TR-55)	USDA NRCS	Applicable for land development plans where limitations described in TR-55.
HEC-1/ HEC-HMS	US Army Corps of Engineers	Applicable where use of a full hydrologic computer model is desirable or necessary.
Rational Method (or commercial computer package based on Rational Method)	Emil Kuichling (1889)	For sites up to five (5) acres, or as approved by the Municipality and/or municipal Engineer.
Other Methods	Varies	Other computation methodologies approved by the Municipality and/or municipal Engineer.

B. All calculations consistent with this Ordinance using the Soil Cover Complex Method shall use the appropriate design rainfall depths for the various return period storms. Rainfall depths shall be according to NOAA Atlas 14 values consistent with a partial duration series. When stormwater calculations are performed for routing procedures or water quality functions, the duration of rainfall shall be twenty-four (24) hours. See Appendix F in this Ordinance for specific DDF and IDF curves for this area.

C. The following criteria shall be used for peak rate runoff calculations:

1. For development sites not considered redevelopment, the ground cover used in determining the existing conditions flow rates shall be as follows:

- a. Wooded sites shall use a ground cover of “woods in good condition.” Portions of a site having more than one viable tree measuring a diameter at breast height (DBH) of six (6) inches or greater per fifteen hundred (1,500) square feet shall be considered wooded where such trees existed within three (3) years of application. -
 - b. The undeveloped portion of the site including agriculture, bare earth, and fallow ground shall be considered as “meadow in good condition,” unless the natural ground cover generates a lower curve (CN) number or Rational “c” value (i.e., woods) as listed in Tables F-1 or F-2 in Appendix F of this Ordinance.
2. For redevelopment sites, the ground cover used in determining the existing conditions flow rates for the developed portion of the site shall be based upon meadow in good condition.
- D. All calculations using the Rational Method shall use rainfall intensities consistent with appropriate times-of-concentration (duration) and storm events with rainfall intensities obtained from NOAA Atlas 14 partial duration series estimates, or the latest version of the PennDOT Drainage Manual (PDM Publication 584). See Appendix F in this Ordinance for specific DDF and IDF curves for this area. Times-of-concentration shall be calculated based on the methodology recommended in the respective model used. Times of concentration for channel and pipe flow shall be computed using a minimum of 5 minutes.
 - E. Runoff curve numbers (CN) for both existing and proposed conditions to be used in the Soil Cover Complex Method shall be obtained from Table F-1 in Appendix F of this Ordinance.
 - F. Runoff coefficients (c) for both existing and proposed conditions for use in the Rational Method shall be obtained from Table F-2 in Appendix F of this Ordinance.
 - G. Hydraulic computations to determine the capacity of pipes, culverts, and storm sewers shall be consistent with methods and computations contained in the Federal Highway Administration Hydraulic Design Series Number 5 (Publication No. FHWA-NHI-01-020 HDS No. 5). Hydraulic computations to determine the capacity of open channels shall be consistent with methods and computations contained in the Federal Highway Administration Hydraulic Engineering Circular Number 15 (Publication No. FHWA-NHI-05-114 HEC 15). Values for Manning’s roughness coefficient (n) shall be consistent with Table F-3 in Appendix F of the Ordinance.
 - H. Outlet structures for stormwater management facilities shall be designed to meet the performance standards of this Ordinance using any generally accepted hydraulic analysis technique or method.
 - I. The design of any stormwater detention facilities intended to meet the performance standards of this Ordinance shall be verified by routing the design storm hydrograph through these facilities using an acceptable method. The design storm hydrograph shall be computed using a calculation method that produces a full hydrograph. The Municipality may approve the use of any generally accepted full hydrograph approximation technique that shall use a total runoff volume that is consistent with the volume from a method that produces a full hydrograph.

Section 310. Other Requirements

- A. All wet basin designs shall incorporate biologic controls consistent with the West Nile Guidance found in Appendix H, PADEP document 363-0300-001 “Design Criteria – Wetlands Replacement/Monitoring,” or contact the Pennsylvania State Cooperative Wetland Center (www.wetlands.psu.edu/) or the Penn State Cooperative Extension Office (www.extension.psu.edu/extmap.html).
- B. Any stormwater basin required or regulated by this Ordinance designed to store runoff and requiring a berm or earthen embankment shall be designed to provide an emergency spillway to handle flow up to and including the 100-year proposed conditions. The height of embankment must provide a minimum of 1.0 foot or more of freeboard above the maximum pool elevation computed when the facility functions for the 100-year proposed conditions inflow. Should any stormwater management facility require a dam safety permit under PADEP Chapter 105, the facility shall be designed in accordance with Chapter 105 and meet the regulations of Chapter 105 concerning dam safety. Chapter 105 may require the passing of storms larger than 100-year event.
- C. Any drainage conveyance facility and/or channel not governed by Chapter 105 regulations must be able to convey, without damage to the drainage structure or roadway, runoff from the 25-year storm event. The larger the events (50-year and 100-year) must also be safely conveyed in the direction of natural flow without creating additional damage to any drainage structures, nearby structures, or roadways.
- D. Conveyance facilities transporting flow to or exiting from stormwater management facilities (i.e., detention basins) shall be designed to convey the 100-year frequency storm.
- E. Roadway crossings or structures located within designated floodplain areas must be able to convey runoff from a 100-year design storm consistent with Federal Emergency Management Agency National Flood Insurance Program – Floodplain Management Requirements.
- F. Any facility located within a PennDOT right-of-way must meet PennDOT minimum design standards and permit submission requirements.
- G. Adequate erosion protection and energy dissipation shall be provided along all open channels and at all points of discharge. Design methods shall be consistent with the Federal Highway Administration Hydraulic Engineering Circular Number 11 (Publication No. FHWA-IP-89-016) and the PADEP Erosion and Sediment Pollution Control Program Manual (Publication No. 363-2134-008).

Section 311. Riparian Buffers

- A. Except as required by Chapter 102, if a perennial or intermittent stream passes through, or a waterbody (i.e., lake, pond, wetland) is present on the site, the Applicant shall create a Riparian Buffer extending a minimum of [Municipality to select riparian buffer requirement: 50 to 150 feet], to either side of the top-of-bank of the channel, lake, or wetland

- B. The Riparian Buffer shall be planted with native vegetation and maintained in a vegetated state (Refer to Appendix B, Pennsylvania Native Plant List, contained in the PA BMP Manual or latest guidance document from PADEP).
1. The following provisions also apply to Riparian Buffers on lots in existence at the time of adoption of this Ordinance:
 - a. If the applicable rear or side yard setback is less, the buffer width may be reduced to twenty-five (25) percent of the setback or twenty-five (25) feet, whichever is greater.
 - b. If a stream traverses a site in a manner that significantly reduces the use of the site, the buffer may be either:
 - i. Reduced to twenty-five (25) feet on either side, with municipal approval, or
 - ii. Reduced to ten (10) feet with municipal waiver.
 2. Permitted uses within the Riparian Buffer include the following, subject to municipal approval and provided that they comply with all federal, state, and local regulations:
 - a. Recreational trails. See Ordinance Appendix J Riparian Buffer Trail Guidelines.
 - b. Utility rights-of-way
 - c. Bridges
 - d. Other uses subject to municipal approval
 3. If an existing buffer is legally prescribed (i.e., deed, covenant, easement, etc.) and it exceeds the requirements of this Ordinance, the existing buffer shall be maintained.

ARTICLE IV – STORMWATER MANAGEMENT (SWM) SITE PLAN REQUIREMENTS

Section 401. General Requirements

For any of the activities regulated by this Ordinance, the preliminary or final approval of subdivision and/or land development plans, the issuance of any building or occupancy permit, or the commencement of any earth disturbance activity may not proceed until the property owner, Applicant, or his/her agent has received written approval of a SWM site plan from the Municipality and an adequate erosion and sediment control plan review by the Conservation District unless the project qualifies for an exemption in Section 106.

Section 402. SWM Site Plan Contents

The SWM site plan shall consist of a general description of the project including sequencing items described in Section 304, calculations, maps, and plans. A note on the maps shall refer to the associated computations and erosion and sediment control plan by title and date. The cover sheet of the computations and erosion and sediment control plan shall refer to the associated maps by title and date. All SWM site plan materials shall be submitted to the Municipality in a format that is clear, concise, legible, neat, and well organized; otherwise, the SWM site plan shall not be accepted for review and shall be returned to the Applicant.

The following items shall be included in the SWM site plan, when applicable:

A. General

1. General description of the project, including those areas described in Section 304.B.
2. General description of proposed permanent stormwater management techniques, including construction specifications of the materials to be used for stormwater management facilities.
3. Complete hydrologic, hydraulic, and structural computations for all stormwater management facilities.
4. An erosion and sediment control plan, including all reviews and letters of adequacy from the Conservation District.
5. A general description of proposed nonpoint source pollution controls.
6. A justification must be included in the SWM Site Plan if BMPs other than green infrastructure methods and LID practices are proposed to achieve the volume, rate, and water quality controls under this Ordinance.
7. The SWM Site Plan Application and completed fee schedule form and associated fee (Ordinance Appendix C-1).
8. The SWM Site Plan Checklist (Appendix C-2).

B. Maps or Plan Sheets

Map(s) or plan sheets of the project area shall be submitted on 24-inch x 36-inch sheets and/or shall be prepared in a form that meets the requirements for recording at the offices of the Recorder of Deeds of Delaware County. If the SALDO has more stringent criteria than this Ordinance, then the more stringent criteria shall apply. The contents of the map(s) shall include, but not be limited to:

1. The location of the project relative to highways, municipal boundaries, or other identifiable landmarks.
2. Existing contours at intervals of two (2) feet.
3. Existing streams, lakes, ponds, or other waters of the Commonwealth within the project area.
4. Other physical features including flood hazard boundaries, stream buffers, existing drainage courses, areas of natural vegetation to be preserved, and the total extent of the upstream area draining through the site.
5. The locations of all existing and proposed utilities, sanitary sewers, and water lines within fifty (50) feet of property lines.
6. An overlay showing soil names and boundaries.
7. Limits of earth disturbance, including the type and amount of impervious area that would be added.
8. Proposed structures, roads, paved areas, and buildings.
9. Final contours at intervals of two (2) feet.
10. The name of the development, the name and address of the owner of the property, and the name of the individual or firm preparing the plan.
11. The date of submission.
12. A graphic and written scale of one (1) inch equals no more than fifty (50) feet; for tracts of twenty (20) acres or more, the scale shall be one (1) inch equals no more than one hundred (100) feet.
13. A north arrow.
14. The total tract boundary and size with distances marked to the nearest foot and bearings to the nearest degree.
15. Existing and proposed land use(s).

16. A key map showing all existing man-made features beyond the property boundary that would be affected by the project.
17. Location of all open channels.
18. Overland drainage patterns and swales.
19. A 15-foot wide access easement around all stormwater management facilities that would provide ingress to and egress from a public right-of-way.
20. A 20-foot wide [10' either side of the pipe] for all sanitary sewer mains.
21. The location of all erosion and sediment control facilities.
22. A note on the plan indicating the location and responsibility for maintenance of stormwater management facilities that would be located off site. All off-site facilities shall meet the performance standards and design criteria specified in this Ordinance.
23. A statement, signed by the Applicant, acknowledging that any revision to the approved SWM site plan must be approved by the Municipality, and that a revised erosion and sediment control plan must be submitted to the Conservation District for a determination of adequacy.
24. The following signature block signed and sealed by the qualified Licensed Professional Engineer responsible for the preparation of the SWM Site Plan:

“I, (Licensed Professional Engineer), on this date (date of signature), hereby certify that the SWM site plan meets all design standards and criteria of the Radnor Township Stormwater Management Ordinance.”

25. The following signature block for the Municipality:

“On behalf of Radnor Township (Municipal official or designee), on this date (date of signature), has reviewed and hereby certifies to the best of my knowledge that the SWM Site Plan meets all design standards and criteria of the Radnor Township Stormwater Management Ordinance.”

C. Supplemental information to be submitted to the Municipality:

1. A written description of the following information shall be submitted by the Applicant and shall include:
 - a. The overall stormwater management concept for the project designed in accordance with Section 304.
 - b. Stormwater runoff computations as specified in this Ordinance.
 - c. Stormwater management techniques to be applied both during and after development.

- d. Expected project time schedule.
 - e. Development stages or project phases, if so proposed.
 - f. An operations and maintenance plan in accordance with Section 702 of this Ordinance.
2. An erosion and sediment control plan.
 3. A description of the effect of the project (in terms of runoff volumes and peak flows) on adjacent properties and on any existing municipal stormwater collection system that may receive runoff from the project site.
 4. A Declaration of Adequacy and Highway Occupancy Permit from the Pennsylvania Department of Transportation (PennDOT) District office when utilization of a PennDOT storm drainage system is proposed.

D. Stormwater Management Facilities

1. All stormwater management facilities must be located on a plan and described in detail.
2. The locations of existing and proposed septic tank infiltration areas and wells must be shown.
3. All calculations, assumptions, loading ratios (guidelines presented in the PA BMP Manual), and criteria used in the design of the stormwater management facilities must be shown.

Section 403. Plan Submission

The Municipality shall require receipt of a complete SWM site plan, as specified in this Ordinance.

- A. Proof of application or documentation of required permit(s) or approvals for the programs listed below shall be part of the plan, if applicable:
1. NPDES Permit for Stormwater Discharges from Construction Activities
 2. PADEP permits as needed
 - a. PADEP Joint Permit Application
 - b. Chapter 105 (Dam Safety and Waterway Management)
 - c. Chapter 106 (Floodplain Management)
 3. PennDOT Highway Occupancy Permit
 4. Any other permit under applicable state or federal regulations

- B. The plan shall be coordinated with the state and federal permit process and the municipal SALDO review process. The process implementing the provisions in this Ordinance is illustrated in Appendices D-1 and D-2.
- C. For projects that require SALDO approval, the SWM site plan shall be submitted by the Applicant as part of the preliminary plan submission where applicable for the regulated activity.
- D. For regulated activities that do not require SALDO approval, see Section 301, General Requirements.
- E. Five (5) copies of the SWM site plan shall be submitted by the applicant for review in accordance with established criteria and procedures:
 - 1. Two (2) copies to the Municipality accompanied by the requisite municipal review fee, as specified in this Ordinance.
 - 2. Two (2) copies to the County Conservation District.
 - 3. One (1) copy to the municipal Engineer.
- F. Any submissions to the agencies listed above that are found to be incomplete shall not be accepted for review and shall be returned to the Applicant with a notification in writing of the specific manner in which the submission is incomplete.

Section 404. Stormwater Management (SWM) Site Plan Review

- A. SWM plans shall be submitted to the municipality for review by the municipal engineer for consistency with this Ordinance and the respective Act 167 Stormwater Management Plan. Any plan found incomplete may not be accepted for review and may be returned to the Applicant. The municipal Engineer will review the SWM site plan for any subdivision or land development against the municipal SALDO provisions not otherwise superseded by this Ordinance.
- B. The applicant shall respond to the Conservation District comments on the SWM site plan prior to being considered for final approval by the Municipality.
- C. For activities regulated by this Ordinance (Section 105), the municipal Engineer will notify the Applicant and the Municipality in writing, with a copy to the Building Permit Officer, within 30 calendar days, whether the SWM site plan is consistent with the stormwater management plan.
 - 1. If the municipal Engineer determines that the SWM site plan is consistent with the stormwater management ordinance, the municipal Engineer will forward a letter of consistency to the municipality, who will then forward a copy to the Applicant.
 - 2. If the municipal Engineer determines that the SWM site plan is inconsistent or noncompliant with the stormwater management ordinance, the municipal Engineer will forward a letter to the municipality, with a copy to the Applicant citing the reason(s) and specific Ordinance sections for the inconsistency or noncompliance. Inconsistency or noncompliance may be due to inadequate information to make a reasonable judgment as to compliance with the

stormwater management plan. Any SWM site plans that are inconsistent or noncompliant may be revised by the Applicant and resubmitted when consistent with this Ordinance.

- D. For regulated activities under this Ordinance that require an NPDES Permit Application, the Applicant shall forward a copy of the municipal Engineer's letter stating that the SWM site plan is consistent with the stormwater management ordinance to the Conservation District. PADEP and the Conservation District may consider the municipal Engineer's review comments in determining whether to issue a permit.
- E. The Municipality will not grant preliminary or final approval to any subdivision or land development for regulated activities specified in this Ordinance if the SWM site plan has been found by the municipal Engineer to be inconsistent with the stormwater management ordinance. All required permits from PADEP must be obtained prior to approval of any subdivision or land development.
- F. No building permits for any regulated activity specified in this Ordinance will be approved by the Municipality if the SWM site plan has been found to be inconsistent with the stormwater management ordinance, as determined by the municipal Engineer and Conservation District, or without considering the comments of the municipal Engineer and Conservation District. All required permits from PADEP must be obtained prior to issuance of a building permit.
- G. The Applicant shall be responsible for completing record drawings of all stormwater management facilities included in the approved SWM site plan. The record drawings and an explanation of any discrepancies with the design plans shall be submitted to the municipal Engineer for final approval. In no case will the Municipality approve the record drawings until the Municipality receives a copy of an approved Declaration of Adequacy and/or Highway Occupancy Permit from the PennDOT District office, NPDES Permit, and any other applicable permits or approvals from PADEP or the Conservation District. The above permits and approvals must be based on the record drawings.
- H. The Municipality's approval of a SWM site plan shall be valid for a period not to exceed 3 (three) years commencing on the date that the Municipality signs the approved SWM site plan. If stormwater management facilities included in the approved SWM site plan have not been constructed, or if constructed, record drawings of these facilities have not been approved within this five-year time period, then the Municipality may consider the SWM site plan inconsistent or noncompliant and may revoke any and all permits. SWM site plans that are determined to be inconsistent or noncompliant by the Municipality shall be resubmitted in accordance with Section 406 of this Ordinance.
- I. For any SWM Site Plan that proposes to use any BMPs other than green infrastructure and LID practices to achieve the volume and rate controls required under this Ordinance, the Municipality will not approve the SWM Site Plan unless it determines that green infrastructure and LID practices are not practicable.

Section 405. Revision of Plans

- A. A revision to a submitted SWM site plan under review by the Municipality for a development site that involves the following shall require a resubmission to the Municipality of a revised SWM site plan consistent with Section 403 of this Ordinance and be subject to review as specified in Section 404 of this Ordinance:
1. Change in stormwater management facilities or techniques,
 2. Relocation or redesign of stormwater management facilities, or
 3. Is necessary because soil or other conditions are not as stated on the SWM site plan as determined by the municipal Engineer.
- B. A revision to an already approved or inconsistent or noncompliant SWM site plan shall be submitted to the Municipality, accompanied by the applicable municipal review and inspection fee. A revision to a SWM site plan for which a formal action has not been taken by the Municipality shall be submitted to the Municipality accompanied by the applicable municipal review and inspection fee.

Section 406. Resubmission of Inconsistent or Noncompliant SWM Site Plans

An inconsistent or noncompliant SWM site plan may be resubmitted with the revisions addressing the municipal Engineer's concerns documented in writing. It must be addressed to the municipality in accordance with Section 403 of this Ordinance, distributed accordingly, and be subject to review as specified in Section 404 of this Ordinance. The applicable municipal review and inspection fee must accompany a resubmission of an inconsistent or noncompliant SWM site plan.

ARTICLE V – INSPECTIONS

Section 501. Inspections

- A. The municipal Engineer or his municipal designee shall inspect all phases of the installation of the permanent BMPs and/or stormwater management facilities as deemed appropriate by the municipal Engineer.
- B. During any stage of the work, if the municipal Engineer or his municipal designee determines that the permanent BMPs and/or stormwater management facilities are not being installed in accordance with the approved stormwater management plan, the Municipality may revoke any existing permits or other approvals and issue a cease and desist order until a revised SWM site plan is submitted and approved, as specified in this Ordinance, and until the deficiencies are corrected.

A final inspection of all BMPs and/or stormwater management facilities shall be conducted by the municipal Engineer or his municipal designee to confirm compliance with the approved SWM site plan prior to the issuance of any occupancy permit.

After final inspection, inspections shall be conducted at the frequencies specified in Appendix I of this Ordinance.

Section 502. As-built Plans, Completion Certificate, and Final Inspections

- A. The developer shall be responsible for providing as-built plans of all SWM BMPs included in the approved SWM site plan for activities involving regulated impervious surfaces 1,000 sq. ft. or greater and for earth disturbances 5,000 sq. ft. or greater. The as-built plans and all explanation of any discrepancies with the construction plans shall be submitted to the Municipality within three (3) months of the completion of construction of the SWM BMPs.
- B. As-built plans shall show the location (including latitude and longitude coordinates) and as-built conditions of all SWM BMPs and include the following information: impervious surfaces included in the approved SWM site plan; topographic contours; and existing, proposed, and built impervious surfaces shown in the as-built drawings.
- C. The as-built submission shall include a certification of completion signed by a Design Professional verifying that all permanent SWM BMPs have been constructed according to the approved plans and specifications.
- D. The municipality will review the as-built submission for consistency with the approved SWM site plan as well as actual conditions at the project site. After receipt of the completion certification by the Municipality, the Municipality may conduct a final inspection.
- E. If an NPDES Permit for Stormwater Discharges Associated with Construction Activities was required for the Regulated Activity, a Notice of Termination (NOT) approval must be obtained upon completion of construction prior to final approval of the project by the Municipality.

ARTICLE VI – FEES AND EXPENSES

Section 601. Municipality SWM Site Plan Review and Inspection Fee

Fees have been established by the Township to defray plan review and construction inspection costs incurred by the Township. All fees shall be paid by the Applicant at the time of SWM site plan submission in accordance with the Township's current fee resolution. The Township shall periodically update the review and inspection fee schedule to ensure that review costs are adequately reimbursed.

Section 602. Expenses Covered by Fees

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

- A. Administrative costs.
- B. The review of the SWM site plan by the Township and the municipal Engineer.
- C. The site inspections.
- D. The inspection of stormwater management facilities and drainage improvements during construction.
- E. Attendance at meeting.
- F. The final inspection upon completion of the stormwater management facilities and drainage improvements presented in the SWM site plan.
- G. Any additional work required to enforce any permit provisions regulated by this Ordinance, correct violations, and assure proper completion of stipulated remedial actions.

ARTICLE VII – OPERATION AND MAINTENANCE (O&M) RESPONSIBILITIES AND EASEMENTS

Section 701. Performance Guarantee

- A. For all activities requiring submittal of a SWM site plan, the Applicant shall provide a financial guarantee to the Township for the timely installation and proper construction of all stormwater management facilities as:
 - 1. Required by the approved SWM site plan equal to or greater than the full construction cost of the required facilities, or
 - 2. The amount and method of payment provided for in the SALDO.
- B. For other regulated activities, the Township may require a financial guarantee from the Applicant.

Section 702. Responsibilities for Operations and Maintenance (O&M) of Stormwater Controls and BMPs

- A. The SWM site plan shall include a BMP operations and maintenance plan that describes how the permanent (e.g., post-construction) stormwater controls and BMPs will be properly operated, inspected, and maintained.
- B. Establish access easements that include all significant stormwater controls, conveyances, and BMPs, and indicate a 15-foot perimeter area surrounding these features that will provide the municipality sufficient ingress to and egress from a public right-of-way.
- C. The following items shall be included in the stormwater control and BMP operations and maintenance plan, as applicable:
 - 1. Map(s) of the project area, in a form that meets the requirements for recording at the offices of the Recorder of Deeds of Delaware County, shall be submitted on 11 x 17 sheets. The contents of the maps(s) shall include, but not be limited to:
 - a. Clear identification of the location and nature of permanent stormwater controls and BMPs,
 - b. The location of the project site relative to highways, municipal boundaries, or other identifiable landmarks,
 - c. Existing and final contours at intervals of two (2) feet, or others as appropriate,

- d. Existing streams, lakes, ponds, or other bodies of water within the project site area,
 - e. Other physical features including flood hazard boundaries, sinkholes, streams, existing drainage courses, and areas of natural vegetation to be preserved,
 - f. The locations of all existing and proposed utilities, sanitary sewers, and water lines within fifty (50) feet of property lines of the project site,
 - g. Proposed final changes to the land surface and vegetative cover, including the type and amount of impervious area that would be added,
 - h. Proposed final structures, roads, paved areas, and buildings, and
 - i. Access easement boundaries
2. A description of how each permanent stormwater control and BMP will be operated and maintained,
 3. The identity and contact information associated with the person(s) responsible for operations and maintenance,
 4. The name of the project site, the name and address of the owner of the property, and the name of the individual or firm preparing the plan, and
 5. A statement, signed by the landowner, acknowledging that the stormwater controls and BMPs are fixtures that can be altered or removed only after approval by the Municipality.
- D. The stormwater control and BMP operations and maintenance plan for the project site shall establish responsibilities for the continuing operation and maintenance of all permanent stormwater controls and BMPs, as follows:
1. If a plan includes structures or lots that are to be separately owned and in which streets, sewers, and other public improvements are to be dedicated to the Township, stormwater controls and BMPs may, at the Township's discretion, also be dedicated to and maintained by the Township.
 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, the operations and maintenance of stormwater controls and BMPs shall be the responsibility of the landowner.

- E. The Township will make the final determination on the continuing operations and maintenance responsibilities. The Township reserves the right to accept or reject the operations and maintenance responsibility for any or all of the stormwater controls and BMPs.

Section 703. Municipal Review of a Stormwater Control and BMP Operations and Maintenance Plan

- A. The Township will review the stormwater control and BMP operations and maintenance plan for consistency with this Ordinance and any permits issued by PADEP.
- B. The Township will notify the Applicant in writing whether or not the stormwater control and BMP operations and maintenance plan is approved.
- C. The Township will require an as-built plan per Section 502 showing all constructed stormwater controls and BMPs and an explanation of any discrepancies with the approved operations and maintenance plan.

Section 704. Adherence to an Approved Stormwater Control and BMP Operations and Maintenance Plan

It shall be unlawful to alter or remove any permanent stormwater control and BMP required by an approved stormwater control and BMP operations and maintenance plan or to allow the property to remain in a condition which does not conform to an approved stormwater control and BMP operations and maintenance plan.

Section 705. Operations and Maintenance Agreement for Privately Owned Stormwater Controls and BMPs

- A. Prior to final approval of the site's SWM site plan (including plans for private facilities constructed under the simplified method), the Applicant shall sign and record an operations and maintenance agreement with the Municipality covering all stormwater controls and BMPs that are to be privately owned (refer to Appendix I). The maintenance agreement shall be transferred with transfer of ownership in perpetuity. The agreement shall be substantially the same as the agreement in Appendix I of this Ordinance.
- B. Other items may be included in the agreement where determined necessary to guarantee the satisfactory operation and maintenance of all permanent stormwater controls and BMPs. The agreement shall be subject to the review and approval of the Township.

Section 706. Stormwater Management Easements

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

- B. Stormwater management easements shall be provided to the municipality by the Applicant or property owner for access for inspections and maintenance, the preservation of stormwater runoff conveyance, infiltration, and detention areas, and for other stormwater controls. The purpose of the easement shall be specified in any agreement under Section 705.

Section 707. Recording of an Approved Stormwater Control and BMP Operations and Maintenance Plan and Related Agreements

- A. The owner of any land upon which permanent stormwater controls and BMPs will be placed, constructed, implemented, or permanently maintained, as described in the stormwater control and BMP operations and maintenance plan, shall record the following documents in the Office of the Recorder of Deeds for Delaware County, within fifteen (15) days of approval of the stormwater control and BMP operations and maintenance plan by the Township:
 - 1. The operations and maintenance plan, or a summary thereof,
 - 2. Operations and maintenance agreements under Section 705, and
 - 3. Easements under Section 706.
- B. The Township may suspend or revoke any approvals granted for the project site upon discovery of failure on the part of the owner to comply with this section.

ARTICLE VIII – PROHIBITIONS

Section 801. Prohibited Discharges

- A. Any drain or conveyance, whether on the surface or subsurface, that allows any non-stormwater discharge including sewage, process wastewater, and wash water to enter the Township's separate storm sewer system, riparian buffers, wetlands, or other Waters of the Commonwealth is prohibited.
- B. No person shall allow, or cause to allow, stormwater discharges into the Township's separate storm sewer system that are not composed entirely of stormwater, except as provided in subsection C below, and discharges allowed under a state or federal permit.
- C. The following discharges are authorized unless they are determined to be significant contributors to pollution to the waters of the Commonwealth:
 - 1. Discharges from fire fighting activities.
 - 2. Potable water sources including water line and fire hydrant flushings if such discharges do not contain detectable concentrations of Total Residual Chlorine (TRC).
 - 3. Non-contaminated irrigation drainage water.
 - 4. Routine external building washdown (which does not use detergents or other compounds).
 - 5. Non-contaminated HVAC condensation and water from geothermal systems.
 - 6. Residential (i.e., not commercial) vehicle wash water where agents are not utilized.
 - 7. Springs and water from crawl space pumps.
 - 8. Uncontaminated water from foundation or from footing drains.
 - 9. Flows from riparian habitats and wetlands.
 - 10. Lawn watering.
 - 11. Pavement washwaters where spills or leaks of toxic or hazardous materials have not occurred (unless all spill material has been removed) and where detergents are not used.

12. Uncontaminated groundwater.
 13. Non-contaminated hydrostatic test water discharges, if such discharges do not contain detectable concentrations of TRC.
 14. Diverted stream flows.
- D. In the event that the Township determines that any of the discharges identified in Section 801.C significantly contribute to pollution of waters of the Commonwealth, or is so notified by PADEP, the Township will notify the responsible person to cease the discharge.
 - E. Upon notice provided by the Township under Section 801.D, the discharger will have a reasonable time, as determined by the Township, to cease the discharge consistent with the degree of pollution caused by the discharge.
 - F. Nothing in this section shall affect a discharger's responsibilities under state law.

Section 802. Prohibited Connections

The following connections are prohibited, except as provided in Section 801.C above:

- A. Any drain or conveyance, whether on the surface or subsurface, that allows any non-stormwater discharge, including sewage, process wastewater, wash water entering the separate storm sewer system, and any connections to the storm drain system from indoor drains and sinks. Any drain or Conveyance that delivers non-stormwater discharges directly into wetlands, Riparian Buffers, or other Waters of the Commonwealth is prohibited.

Section 804. Roof Drains and Sump Pumps

- A. Roof drains and sump pumps shall not be connected to sanitary sewers.
- B. Roof drains and sump pumps shall not be connected to streets, storm sewers, or roadside ditches except on a case-by-case basis as determined by the Township.
- C. Roof drains and sump pumps shall discharge to infiltration areas or vegetative BMPs to the maximum extent practicable where advantageous to do so.

Section 805. Alteration of BMPs

- A. No person shall modify, remove, fill, landscape, or alter any existing stormwater control or BMP unless it is part of an approved maintenance program without the written approval of the Township.

- B. No person shall place any structure, fill, landscaping, or vegetation into a stormwater control or BMP or within a drainage easement that would limit or alter the functioning of the stormwater control or BMP without the written approval of the Township.

ARTICLE IX – ENFORCEMENT AND PENALTIES

Section 901. Right-of-Entry

- A. Upon presentation of proper credentials, duly authorized representatives of the Township may enter at reasonable times upon any property within the Township to inspect the implementation, condition, or operation and maintenance of all erosion and sediment controls and permanent stormwater BMPs, Conveyances, or other stormwater management facilities both during and after completion of a Regulated Activity, or for compliance with any requirement of this Ordinance.
- B. Persons working on behalf of the Township shall have the right to temporarily locate on or in any stormwater control or BMP in the Township such devices as are necessary to conduct monitoring and/or sampling of the discharges from such stormwater control or BMP.
- C. If the property owner or representative does not grant access to the Township within 24 hours of notification, it will be a violation of this Ordinance.

Section 902. Public Nuisance

- A. The violation of any provision of this Ordinance is hereby deemed a public nuisance.
- B. Each day that a violation continues shall constitute a separate violation.

Section 903. Enforcement Generally

- A. Whenever the Township finds that a person has violated a prohibition or failed to meet a requirement of this Ordinance, the Township may order compliance by written notice to the responsible person. Such notice may, without limitation, require the following remedies:
 - 1. Performance of monitoring, analyses, and reporting.
 - 2. Elimination of prohibited connections or discharges.
 - 3. Cessation of any violating discharges, practices, or operations.
 - 4. Abatement or remediation of stormwater pollution or contamination hazards and the restoration of any affected property.
 - 5. Payment of a fine to cover administrative and remediation costs.
 - 6. Implementation of stormwater controls and BMPs, and
 - 7. Operation and maintenance of stormwater controls and BMPs.

- B. Such notification shall set forth the nature of the violation(s) and establish a time limit for correction of these violations(s). Said notice may further advise that, if applicable, should the violator fail to take the required action within the established deadline, the work will be done by the Township or designee, and the expense thereof 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 Township from pursuing any and all other remedies available in law or equity.

Section 904. Suspension and Revocation of Permits and Approvals

- A. Any building, land development, or other permit or approval issued by the Township may be suspended or revoked by the Township for:
 - 1. Noncompliance with or failure to implement any provision of the permit.
 - 2. A violation of any provision of this Ordinance or any other law or regulation applicable to the regulated activity.
 - 3. The creation of any condition or the commission of any act during construction or development that constitutes or creates a hazard or nuisance, pollution, or endangers the life, health, or property of others.
- B. Prior to revocation or suspension of a permit and at the request of the Applicant, the Board of Commissioner's designated hearing officer shall schedule a hearing to discuss the noncompliance if there is no immediate danger to life, public health, or property. The expense of a hearing shall be the Applicant's responsibility.
- C. A suspended permit or approval may be reinstated by the Township when:
 - 1. The Township Engineer or designee has inspected and approved the corrections to the stormwater controls and BMPs or the elimination of the hazard or nuisance, and/or
 - 2. The Township is satisfied that the violation has been corrected.
- D. A permit or approval that has been revoked by the Township cannot be reinstated. The Applicant may apply for a new permit in accordance with this Ordinance.

Section 905. Penalties

- A. Any person violating the provisions of this Ordinance shall be subject to a fine of no less than \$250.00 up to a maximum of \$1,000.00 for each violation, recoverable with costs. Each day that the violation continues shall constitute a separate offense and the applicable fines are cumulative.
- B. In addition, the Municipality may institute injunctive, mandamus, or any other appropriate action or proceeding at law or in equity for the enforcement of this Ordinance. Any court of competent jurisdiction shall have the right to issue restraining orders, temporary or permanent injunctions, mandamus, or other appropriate forms of remedy or relief.

Section 906. Notification

In the event that a person fails to comply with the requirements of this Ordinance or fails to conform to the requirements of any permit issued hereunder, and the Township chooses to pursue enforcement action, the Township will provide written notification of the violation. Such notification will state the nature of the violation(s) and establish a time limit for correction of these violation(s). Failure to comply within the time specified will subject such person to the penalty provisions of this Ordinance. All such penalties will be deemed cumulative and shall not prevent the Township from pursuing any and all remedies. It shall be the responsibility of the owner of the real property on which any regulated activity is proposed to occur, is occurring, or has occurred to comply with the terms and conditions of this Ordinance.

Section 907. Enforcement

The Township Board of Commissioners and its designee are hereby authorized and directed to enforce all the provisions of this Ordinance. All inspections regarding compliance with the SWM site plan shall be the responsibility of the municipality or its designee.

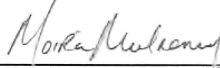
- A. A set of design plans approved by the Township shall be on file and available for viewing at the site throughout the duration of the construction activity. Periodic inspections may be made by the Township or its designee during construction.
- B. It shall be unlawful for any person, firm, or corporation to undertake any regulated activity under Section 105 on any property except as provided for in the approved SWM site plan and pursuant to the requirements of this Ordinance. It shall be unlawful to alter or remove any control structure required by the SWM site plan pursuant to this Ordinance or to allow the property to remain in a condition that does not conform to the approved SWM site plan.

- C. At the completion of the project and as a prerequisite for the release of the performance guarantee, the owner or his representatives shall:
 - 1. Provide a certification of completion from an engineer, architect, surveyor, or other qualified person verifying that all stormwater facilities have been constructed according to the plans and specifications and approved revisions thereto.
 - 2. Provide a set of as-built (record) drawings per Section 502.
- D. After receipt of the certification by the Township, a final inspection shall be conducted by the municipality or its designee to certify compliance with this Ordinance.
- E. An occupancy permit will not be issued unless the certification of completion pursuant to Section 907.C.1 has been secured. The occupancy permit shall be required for each lot owner and/or Applicant for all subdivisions and land developments in the Township.

Section 908. Appeals

- A. Any person aggrieved by any action of Radnor Township or its designee relevant to the provision of this Ordinance may appeal to the Radnor Township Board of Commissioners or a hearing officer appointed by the Board of Commissioners, within thirty (30) days of that action.
- B. Any person aggrieved by any decision of the Radnor Township's Governing Body relevant to the provision of this Ordinance may appeal to the Delaware County Court of Common Pleas in the County within thirty (30) days of the Township's decision.

ENACTED and ORDAINED at an advertised meeting of the Radnor Township Board of Commissioners on the 12th day of September 2022. This Ordinance shall take effect in accordance with the Radnor Township Home Rule Charter.



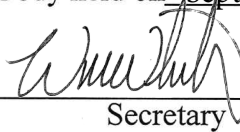
Moira Mulrone, President
Radnor Township Board of Commissioners

ATTEST:

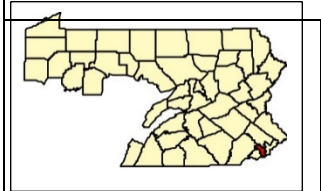
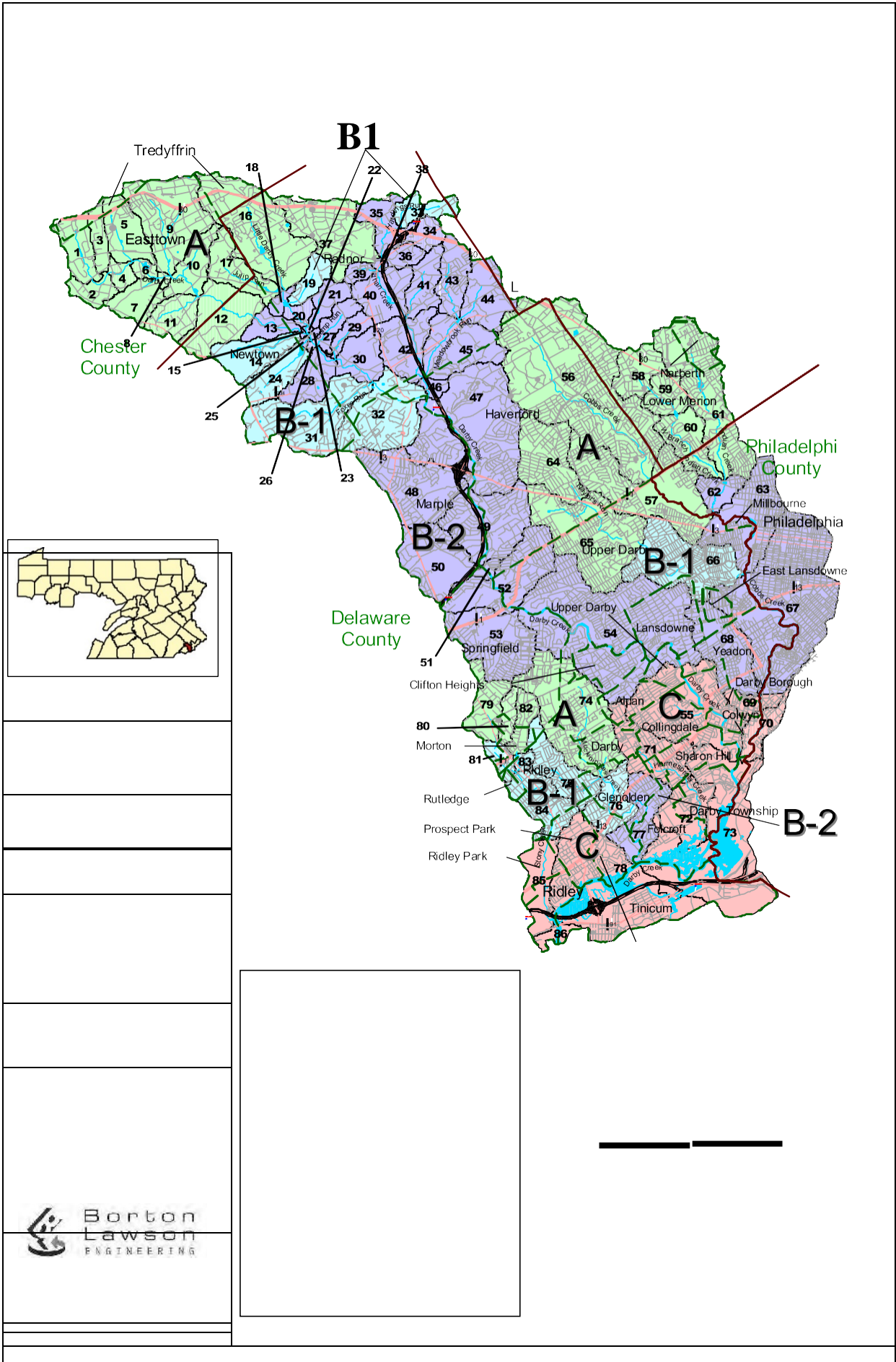


Secretary

I hereby certify that the foregoing Ordinance was advertised in the Delco Times on August 24, 2022 a newspaper of general circulation in the Municipality and was duly enacted and approved as set forth at a regular meeting of the Municipality's Governing Body held on September 12, 2022



Secretary



**Borton
Lawson
ENGINEERING**

SIMPLIFIED APPROACH TO STORMWATER MANAGEMENT FOR SMALL PROJECTS

Introduction

The following procedures have been developed to allow homeowners to comply with stormwater management criteria for new projects to meet the requirements of the Act 167 Stormwater Management Ordinance of the Municipality including sizing, designing, locating, and installing on-lot measures, referred to herein as “Best Management Practices” (BMPs). Pennsylvania Act 167 was authorized on October 4, 1978 (32 P.S., P.L. 864) and gave Pennsylvania municipalities the power to regulate activities that affect stormwater runoff and surface and groundwater quantity and quality.

Individual home construction projects on single-family lots which result in between 500 square feet and 999 square feet of regulated impervious surface (including the building footprint, driveway, sidewalks, and parking areas) are not required to submit formal drainage plans to the Municipality or County; however, they are still required to address water quality and infiltration goals as outlined in this Simplified Approach document. If the guidelines presented in this brochure are followed, the individual homeowner will not require professional services to comply with these water quality and infiltration goals.

Section B.1 describes requirements and a simplified method for designing a suitable BMP, and a description of what needs to be included on the simple sketch plan. Section B.2 presents definitions of key terms. Section B.3 presents options of BMPs that can be considered for on-lot stormwater management. An example of how to obtain the size and dimensions of a BMP is explained in Section B.4. Section B.5 describes the requirements to be met for the modified Operation, Maintenance, and Inspection Plan.

The Simplified Approach requires:

- The first 1” of rainfall runoff from regulated impervious surfaces to be captured (see definition in Section B.2).

The purpose of this is to help reduce stormwater runoff in the community, to maintain groundwater recharge, to prevent degradation of surface and groundwater quality, and to otherwise protect water resources and public safety.

What needs to be sent to the Municipality?

Even though a formal drainage plan is not required for individual lot owners, the Simplified Method worksheet found in Table B-4 and a simple sketch plan containing the features described in Step 5 of Section B.1 needs to be submitted to the Municipality, and if applicable, the contractor prior to construction. The Operation and Maintenance Agreement found in Section B.5 needs to be signed and submitted with the simple sketch plan to the Municipality for approval.

B.1 Determination of Simplified Approach Volume Requirements

All proposed impervious areas must be included in the determination of the amount of regulated impervious areas and the size of proposed BMPs needed to control stormwater. Proposed and regulated impervious areas on an individual residential lot include: roof area, pavement, sidewalks, driveways, patios, porches, permanent pools, or parking areas. Sidewalks, driveways, or patios that are constructed with gravel or pervious pavers that will not be converted to an impervious surface in the future need not be included in this calculation. Therefore, the amount of proposed and regulated impervious area can be reduced for proposed driveways, patios, and sidewalks through the use of gravel, pervious pavement, and turf pavers. All regulated impervious areas must be constructed so that runoff is conveyed to a BMP; no runoff can be directed to storm sewers, inlets, or other impervious areas (i.e., street).

In addition, the use of low impact development is recommended to further minimize the effect of the new construction on water, land, and air. Low impact development is a method of development that incorporates design techniques that include: minimizing the amount of land disturbance, reducing impervious cover, disconnecting gutters and directing runoff to vegetated areas to infiltrate, and redirecting the flow of runoff from impervious driveways to vegetated areas instead of to the street or gutter.

Below are the steps that must be undertaken to meet the Ordinance requirements. The results obtained for each step must be included in the Simplified Method Worksheet found in Table B-4:

STEP 1 – Determine the total area of all-regulated impervious surfaces that will need to drain to one or more BMPs. Determine locations where BMPs need to be placed so that runoff from all of the regulated impervious surfaces can be captured. Select the BMPs to be used and determine the requirements of each from Section B.3. For instance, the back half of a garage may drain 200 square feet of roof to a rain barrel, and the front half of a garage may drain 200 square feet of roof and 540 square feet of driveway to a bioretention area. Then, obtain the required storage volume and surface area needed for each of the proposed BMPs from the appropriate heading below.

For Rain Barrels/Cisterns

STEP 2 –Select the regulated impervious area value in Column 1 of Table B-1 that is closest to, but not less than, the determined value.

STEP 3 – Determine the volume that needs to be provided in cubic feet and gallons to satisfy the volume requirements using Columns 2 and 3 in Table B-1.

Table B-1: Simplified Method - Calculating Rain Barrel/Cistern Storage Volume for 1" Rainfall¹

Column 1	Column 2	Column 3	
Regulated Impervious Area (square feet)	Volume of Rain Barrel/Cistern ² (cubic feet)	Volume of Rain Barrel/Cistern (gallons)	
<i>I</i>	V_{RBcf}	V_{RBgal}	
Sum of all Regulated Impervious Areas	$(1*(1/12)*I)/0.75=V_{RBcf}$	$VRBcf * 7.48=VRBgal$	
50	6	42	↑
100	11	83	
150	17	125	Rain Barrel
200	22	166	↓
250	28	208	
300	33	249	↓
350	39	291	
400	44	332	↓
450	50	374	
500	56	416	↓
550	61	457	
600	67	499	Cistern
650	72	540	↓
700	78	582	
750	83	623	↓
800	89	665	
850	94	706	↓
900	100	748	
950	106	790	↓
999	111	830	

¹The typical volume of a rain barrel is between 50-200 gallons, so more than 1 rain barrel may be needed. Larger volumes may require a cistern.

²Assume that the rain barrel/cistern is 25% full

For Rain Gardens/Bioretenion or Dry Well #1:

STEP 2 – Select the regulated impervious area value in Column 1 of Table B-2 that is closest to, but not less than, the determined value.

STEP 3 - Determine the volume that needs to be provided in cubic feet to satisfy the volume requirements using Column 2 in Table B-2.

STEP 4 – Using the value from Column 2 determined above, select the depth (D) of the proposed BMP, and then simply determine the surface area needed for that depth from Column 3 of Table B-2.

Note: The arrows under Column 3 in Table B-2 indicate which range of depths is appropriate for each BMP. To determine the depth based on the area, select an area that corresponds to the required volume that is closest to, but not more than the area to be used. To determine the area based on the depth, select a depth that is closest to, but not less than, the depth that is to be used.

Table B-2: Simplified Method - Calculating Rain Garden/Bioretenion and Dry Well #1 Storage Volume and Surface Area for 1” Rainfall

Column 1	Column 2	Column 3								
Proposed Impervious Area (square feet)	Volume of Rain Garden/Bioretenion or Dry Well #1 ¹ (cubic feet)	Surface Area of Rain Garden/Bioretenion or Dry Well #1 Acceptable Depths for Each BMP are indicated by the arrows below (square feet)								
		<i>Area Required for a BMP with a Depth(D) of 0.5'</i>	<i>Area Required for a BMP with a Depth(D) of 1.0'</i>	<i>Area Required for a BMP with a Depth(D) of 1.5'</i>	<i>Area Required for a BMP with a Depth(D) of 2.0'</i>	<i>Area Required for a BMP with a Depth(D) of 2.5'</i>	<i>Area Required for a BMP with a Depth(D) of 3.0'</i>	<i>Area Required for a BMP with a Depth(D) of 3.5'</i>	<i>Area Required for a BMP with a Depth(D) of 4.0'</i>	
		Rain Garden /Bioretenion (0.5'-1.0')		Dry Well #1 (1.5'-4.0')						
<i>I</i>	<i>V</i>	<i>A(sf)</i>								
Sum of all Proposed Impervious Areas	$1*(1/12)*I= V$	$V/D=A$								
50	4	8	4	3	2	2	1	1	1	
100	8	17	8	6	4	3	3	2	2	
150	13	25	13	8	6	5	4	4	3	
200	17	33	17	11	8	7	6	5	4	
250	21	42	21	14	10	8	7	6	5	
300	25	50	25	17	13	10	8	7	6	
350	29	58	29	19	15	12	10	8	7	
400	33	67	33	22	17	13	11	10	8	
450	38	75	38	25	19	15	13	11	9	
500	42	83	42	28	21	17	14	12	10	
550	46	92	46	31	23	18	15	13	11	
600	50	100	50	33	25	20	17	14	13	
650	54	108	54	36	27	22	18	15	14	

700	58	117	58	39	29	23	19	17	15
750	63	125	63	42	31	25	21	18	16
800	67	133	67	44	33	27	22	19	17
850	71	142	71	47	35	28	24	20	18
900	75	150	75	50	38	30	25	21	19
950	79	158	79	53	40	32	26	23	20
999	83	167	83	56	42	33	28	24	21

¹Assume that the rain garden/bioretenention or the dry well #1 are 0% full

For Infiltration Trench or Dry Well #2:

STEP 2 – Select the regulated impervious area value in Column 1 of Table B-3 that is closest to, but not less than, the determined value.

STEP 3 - Determine the volume that needs to be provided in cubic feet to satisfy the volume requirements using Column 2 in Table B-3.

STEP 4 – Using the value from Column 2 determined above, select the depth (D) of the proposed BMP, and then simply determine the surface area needed from Column 3 of Table B-3.

Note: The arrows under Column 3 in Table B-3 indicate which range of depths is appropriate for each BMP. To determine the depth based on the area, select an area that corresponds to the required volume that is closest to, but not less than, the area to be used. To determine the area based on the depth, select a depth that is closest to, but not less than, the depth that is to be used.

STEP 5 - Sketch a simple site plan as shown in Figure B-1 that includes:

- Name and address of the owner of the property, and or name and address of the individual preparing the plan, along with the date of submission.
- Location of proposed structures, driveways, or other paved areas with approximate size in square feet.
- Location, orientation, and dimensions of all proposed BMPs. For all rain gardens/bioretention, infiltration trenches, and dry wells, the length, width, and depth must be included on the plan. For rain barrels or cisterns the volume must be included.
- Location of any existing or proposed on-site septic system and/or potable water wells showing rough proximity to infiltration facilities.
- Location of any existing waterbodies such as; streams, lakes, ponds, wetlands, or other waters of the Commonwealth within fifty (50) feet of the project site, and the distance to the project site and/or BMPs. The project or BMPs cannot be located less than fifty (50) feet away from a perennial or intermittent stream. If an existing buffer is legally prescribed (i.e., deed, covenant, easement, etc.) and it exceeds the requirements of this Ordinance, the existing buffer shall be maintained.
- Location of all existing structures including buildings, driveways, and roads within fifty (50) feet of the project site.

Fill in the simplified method worksheet found in Table B-4, then submit the worksheet and the simple site sketch to the Municipality. Additionally, the operation and maintenance agreement found in Section B.5 must be signed and submitted to the Municipality.

Table B-3: Simplified Method - Calculating Infiltration Trench and Dry Well #2 Storage Volume and Surface Area for 1" Rainfall

Column 1	Column 2	Column 3							
Total Proposed Impervious Area (square feet)	Volume of Infiltration Trench or Dry Well #2 ¹ (cubic feet)	Surface Area of Infiltration Trench or Dry Well #2 Acceptable Depths for Each BMP are indicated by the arrows below (square feet)							
		Area Required for a BMP with a Depth(D) of 1.5'	Area Required for a BMP with a Depth(D) of 2.0'	Area Required for a BMP with a Depth(D) of 2.5'	Area Required for a BMP with a Depth(D) of 3.0'	Area Required for a BMP with a Depth(D) of 3.5'	Area Required for a BMP with a Depth(D) of 4.0'	Area Required for a BMP with a Depth(D) of 4.5'	Area Required for a BMP with a Depth(D) of 5.0'
<i>I</i>	<i>V</i>	<i>A(sf)</i>							
Sum of all Proposed Impervious Areas	$(1*(1/12)*I)/\text{Void Ratio}$ $(0.4)*=V$	$V/D=A$							
50	10	7	5	4	3	3	3	2	2
100	21	14	10	8	7	6	5	5	4
150	31	21	16	13	10	9	8	7	6
200	42	28	21	17	14	12	10	9	8
250	52	35	26	21	17	15	13	12	10
300	63	42	31	25	21	18	16	14	13
350	73	49	36	29	24	21	18	16	15
400	83	56	42	33	28	24	21	19	17
450	94	63	47	38	31	27	23	21	19
500	104	69	52	42	35	30	26	23	21
550	115	76	57	46	38	33	29	25	23
600	125	83	63	50	42	36	31	28	25
650	135	90	68	54	45	39	34	30	27

700	146	97	73	58	49	42	36	32	29
750	156	104	78	63	52	45	39	35	31
800	167	111	83	67	56	48	42	37	33
850	177	118	89	71	59	51	44	39	35
900	188	125	94	75	63	54	47	42	38
950	198	132	99	79	66	57	49	44	40
999	208	139	104	83	69	59	52	46	42

¹Assume a void ratio of 40%

Figure B-1: Typical Dry Well Configuration filled with Stone Fill (Left) and Structural Prefabricated Chamber (Right)

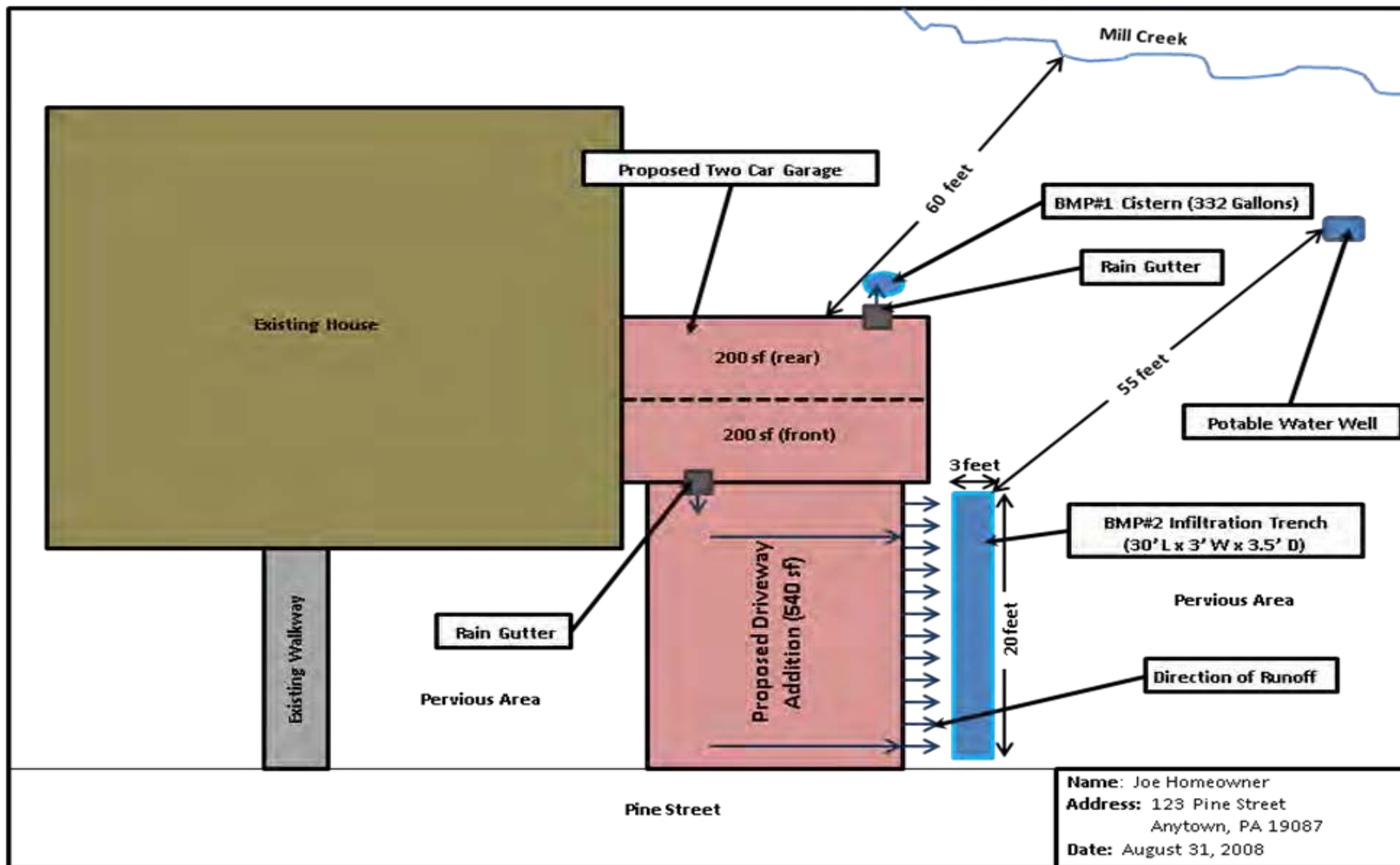


Table B-4: Simplified Method Worksheet

Simplified Method Worksheet				
STEP 1				
Proposed Impervious Surface for BMP #1	Proposed Impervious Surface for BMP #2	Proposed Impervious Surface for BMP #3		
STEPS 2&3				
Rain Barrel or Cistern				
Proposed Impervious Surface from Column 1 in Table B-1	Volume from Column 2 or 3 in Table B-1			
Rain Garden/Bioretenention or Dry Well #1				
Proposed Impervious Surface from Column 2 in Table B-2	Volume of BMP from Column 2 in Table B-2	Area of BMP from Column 3 in Table B-2	Depth of BMP from Column 3 in Table B-2	Types of Material to Be Used
Infiltration Trench or Dry Well #2				
Proposed Impervious Surface from Column 2 in Table B-3	Volume of BMP from Column 2 in Table B-3	Area of BMP from Column 3 in Table B-3	Depth of BMP from Column 3 in Table B-3	Types of Material to Be Used
Note: For additional BMPs, use additional sheets				

B.2 Definitions

Best Management Practice (BMP) - 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, dry wells, bioretention, rain gardens, permeable paving, rain barrels, and cisterns.

Capture - Collecting runoff to be stored for reuse or allowed to slowly infiltrate into the ground.

Geotextile - A fabric manufactured from synthetic fiber that is used to achieve specific objectives, including infiltration, separation between different types of media (i.e., between soil and stone), or filtration.

Hotspot - Areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants that are higher than those that are typically found in stormwater (e.g., vehicle salvage yards and recycling facilities, vehicle fueling stations, fleet storage areas, vehicle equipment and cleaning facilities, and vehicle service and maintenance facilities).

Impervious Surface - A surface that prevents the infiltration of water into the ground. Impervious surfaces include, but are not limited to, streets, sidewalks, pavements, swimming pools, driveway areas or roofs.

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

Low Impact Development - A land development and construction approach that uses various land planning, design practices, and technologies to simultaneously conserve and protect natural resource systems, and reduce infrastructure costs.

Pervious Surface - Any surface that is not impervious.

Proposed Impervious Surface – The total impervious surface proposed as part of the current Stormwater Management Permit application only. This does not include impervious surface added after the adoption date of the municipality’s Stormwater Management Ordinance.

Regulated Impervious Surface – The total of all impervious coverage added after the adoption date of the municipality’s Stormwater Management Ordinance, including the impervious coverage proposed as part of the current Stormwater Management Ordinance.

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

Stormwater - Drainage runoff from the surface of the land resulting from precipitation or snow or ice melt.

Void Ratio - The ratio of the volume of void space to the volume of solid substance in any material.

B.3 Description of BMPs

The following is a description of several types of BMPs that could be implemented. The requirements of each BMP as described below are taken directly from the PA BMP Manual. Refer to the PA BMP Manual which can be found on the PA Department of Environmental Protection's website.

Rain Barrels/Cisterns

Rain barrels are large containers that collect drainage from roof leaders and temporarily store water to be released to lawns, gardens, and other landscaped areas after the rainfall has ended. Rain barrels are typically between 50 and 200 gallons in size. The stored water can also be used as a non-potable water supply. Cisterns are larger than rain barrels having volumes of 200 gallons or more, and can be placed on the surface or underground. Figures B-2 and B-3 show examples of rain barrels and cisterns, respectively, that could be used. Rain barrels and cisterns are manufactured in a variety of shapes and sizes. All of these facilities must make provisions for the following items:

- There must be a means to release the water stored between storm events in order for the necessary storage volume to be available for the next storm.
- Stormwater must be kept from entering other potable systems, and pipes and storage units must be clearly marked "Do Not Drink."
- An overflow outlet should be placed a few inches below the top with an overflow pipe to divert flow away from structures.
- Use screens to filter debris, and covers (lids) to prevent mosquitoes.
- Make sure cisterns are watertight and do not leak.
- Rain barrels are typically assumed to be 25% full to calculate volume since they are not always emptied before each storm.*

Figure B-2: Rain Barrels



Source (pic on left): <http://www.rfcity.org/Eng/Stormwater/YourProperty/YourProperty.htm>
Source (pic on right): <http://www.floridata.com/tracks/transplantedgardener/Rainbarrels.cfm>

*This 25% has already been taken into account in Table 3.

Figure B-3: Cisterns



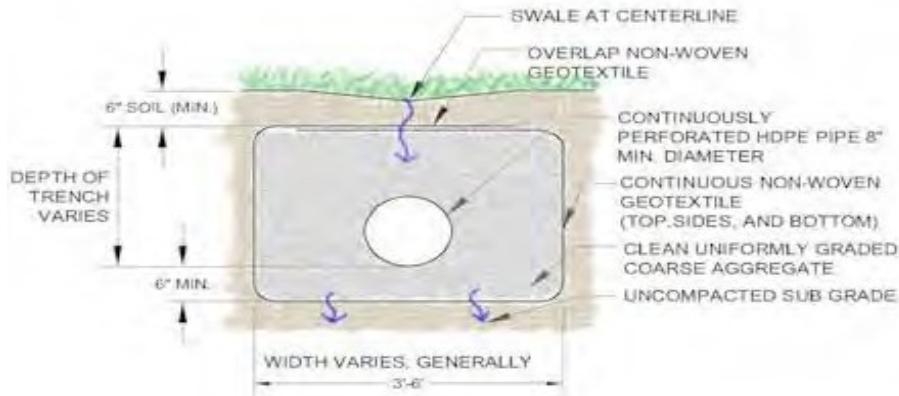
Source (for both pics): Pennsylvania Stormwater BMP Manual (2006)

Infiltration Trench

An infiltration trench is a long, narrow, rock-filled trench with or without a perforated pipe that receives stormwater runoff and has no outlet. Runoff is stored in the void space between the stones and in the pipe and infiltrates through the bottom and into the underlying soil matrix. Infiltration trenches perform well for removal of fine sediment and associated pollutants. Figure B-4 shows a typical infiltration trench configuration. Infiltration trenches shall incorporate or make provisions for the following elements:

- Perforated pipe is to be set level.
- The width is limited to between **3 and 8 feet**, and the depth ranges from **2 to 6 feet**.
- Trench should be wrapped in nonwoven geotextile (see definition in Section B.2) on the top, sides, and bottom.
- There should be a positive overflow that allows stormwater that cannot be stored or infiltrated to be discharged into a nearby vegetated area.
- Roof downspouts may be connected to infiltration trenches, but should contain a cleanout to collect sediment and debris before entering the infiltration area.
- Infiltration testing is recommended to ensure that the soil is capable of infiltrating stormwater. A description of how an infiltration test is performed is found in Appendix C of the PA BMP Manual.
- It is recommended that there be a 2-foot clearance above the regularly occurring seasonal high water table and a minimum depth to bedrock of 2 feet.
- The infiltration trench should be at least 50 feet from individual water supply wells, 100 feet from community or municipal water supply wells, and 50 feet from any septic system component. It should not be located near hotspots (see definition in Section B.2).
- The infiltration trench should be located so that it presents no threat to sub-surface structures such as building foundations and basements.
- Protect infiltration areas from compaction.
- The ratio of the collected area to the footprint of the facility should be as small as possible with a ratio of less than 5:1 preferred.

Figure B-4: Typical Infiltration Trench



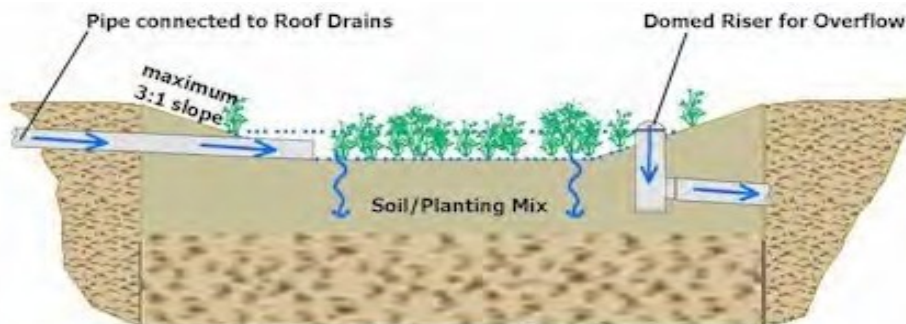
Source: Pennsylvania Stormwater BMP Manual (2006)

Rain Garden/Bioretention Area

A rain garden (bioretention area) is an excavated depression area on the surface of the land in which native vegetation is planted to filter and use stormwater runoff. Runoff ponds on top of the surface of the rain garden and then infiltrates into an enhanced soil below the surface where plants can use the water to grow. Bioretention also improves water quality, vegetation filters the water, and the root systems encourage or promote infiltration. Figure B-5 shows a typical rain garden. Key elements of a rain garden include:

- Ponding depths of **1 foot** or less (recommended).
- Native vegetation that can tolerate dry and wet weather.
- An overflow area where, if the bioretention area were to overflow, the water would flow over pervious area (i.e., grass, meadow), and would not cause harm to property, or;
- An overflow such as a domed riser to allow excess flow from large storms to travel to other substantial infiltration areas or pervious areas.
- Typical side slopes of 3:1 are recommended, with 2:1 being the maximum.
- The soil/planting mix depth should be between 1.5 feet and 6 feet deep.

Figure B-5: Typical Rain Garden/Bioretention Area



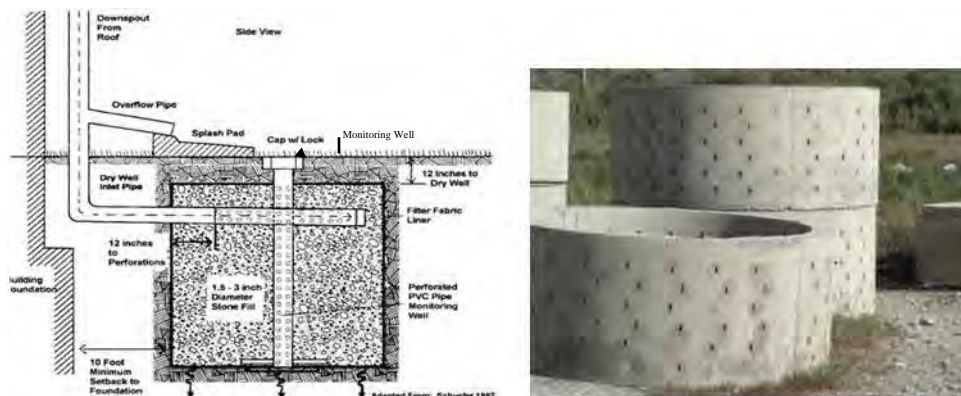
Source: Pennsylvania Stormwater BMP Manual (2006)

Dry Wells

A dry well, also referred to as a seepage pit is a subsurface storage facility that temporarily stores and infiltrates runoff from the roofs of buildings or other impervious surfaces. A dry well can be either a structural prefabricated chamber (Dry Well #1) or an excavated pit filled with stone fill (Dry Well #2). Dry wells discharge the stored runoff via infiltration into the surrounding or underlying soils. Figure B-6 shows a typical prefabricated dry well and a typical dry well configuration with stone fill. The following elements shall be incorporated into all dry well designs:

- These facilities should be located a minimum of ten (10) feet from the building foundation to avoid foundation seepage problems and are not recommended if their installation would create a risk for basement flooding.
- Construction of a dry well should be performed after surface soils in all other areas of the site are stabilized to avoid clogging.
- During construction, compaction of the subgrade soil in the bottom of the dry well should be avoided, and construction should be performed only with light machinery.
- Depth of a dry well should be between **1.5 feet and 4 feet**. Gravel fill should consist of stone of an average of one and one half to three (1.5 – 3.0) inches in diameter with the gravel fill wrapped in a nonwoven geotextile that separates the stone fill from the surrounding soil.
- At least 1 foot of soil needs to be placed over the top of the dry well.
- Dry wells should be inspected at least four (4) times annually as well as after large storm events.
- Dry wells should have overflow pipes to allow high volumes of runoff to connect to other on-site substantial infiltration areas or pervious areas.
- Every dry well needs to have at least one monitoring well.
- Infiltration testing is recommended to ensure that the underlying soil is capable of infiltrating the needed volume of stormwater.

Figure B-6: Typical Dry Well Configuration filled with Stone Fill (DRY WELL #2) (Left) and Structural Prefabricated Chamber (DRY WELL #1) (Right)



Source (for pic on left): <http://www.seagrant.sunysb.edu/pages/BMPsForMarinas.htm>

Source (for pic on right): <http://www.copelandconcreteinc.net/1800652.html>

B.4 Example

Simplified Approach Volume Determination:

Joe Homeowner wants to build a 400 square foot two car garage, and a 540 square foot (30' L x 18' W) impervious driveway that is graded so that the stormwater runoff drains to the grassy area along one edge of the driveway. (A duplicate of Table B-1 is provided below in Table B-5, a duplicate of Table B-3 is provided below in Table B-6 and outlines the steps of this example) a duplicate of Figure B-1 (Figure B-7) and a duplicate of Table B-4 are provided in Table B-7.

STEP 1 - Determine the total area of all regulated impervious surfaces to drain to each BMP:

Garage Roof (Front)	10 ft. x 20 ft.	=	200 sq. ft
Garage Roof (Rear)	10 ft. x 20 ft.	=	200 sq. ft.
Driveway (Front)	30 ft. x 18 ft.	=	540 sq. ft.

Total Proposed Impervious Surface			940 sq. ft.

Note: If the driveway used pervious pavement (i.e., paving blocks), then the total impervious area would only be 400 square feet, and no stormwater management practices would need to control runoff from the driveway.

Select a BMP or combination of BMPs from Section B.3 to be used to satisfy the volume requirement. Determine the length, width, depth and other requirements for the BMPs in Section B.3. A BMP needs to be placed to catch runoff from the back of the garage, and a BMP needs to be placed to capture runoff from the front of the garage and the driveway. Figure B-7 shows the direction the runoff flows and the locations where the BMPs are to be placed.

Joe Homeowner would like to use a rain barrel (BMP #1) to capture the runoff from the rear of the garage and an infiltration trench (BMP #2) to capture runoff from the front of the garage and the driveway.

STEP 2 and 3 for BMP #1 (Rain Barrel/Cistern)

STEP 2 - Select the regulated impervious area value for BMP #1, the rain barrel or cistern, in Column 1 that is closest to, but not less than 200 in Table B-5:

The value in Column 1 that is closest to but is not less than 200 is 200.

STEP 3 - Determine the volume that BMP #1 must be to satisfy the volume requirements using Columns 2 and 3 in Table B-5:

The volume in gallons of the rain barrel/cistern to be used as BMP #1, assuming the rain barrel/cistern is 25% full, is determined by finding the row in Column 3 that corresponds to the impervious area value determined in Step 1. Therefore, the volume of BMP #1, the rain barrel/cistern must be ≥ 166 gallons. A combination of rain barrels could be used in succession as shown in Figure B-2, or a cistern could be used.

Table B-5: Example – Calculating Storage Volume for Rain Barrel/Cistern

Column 1	Column 2	Column 3	
Regulated Impervious Area (square feet)	Volume of Rain Barrel/Cistern ¹ (cubic feet)	Volume of Rain Barrel/Cistern (gallons)	
<i>I</i>	V_{RBcf}	V_{RBgal}	
Sum of all Regulated Impervious Areas	$(1*(1/12)*I)/0.75=V_{RBcf}$	$V_{RBcf} * 7.48=V_{RBgal}$	
50	6	42	↑ Rain Barrel
100	11	83	
150	17	125	
200	22	166	
250	28	208	
300	33	249	
350	39	291	
400	44	332	
450	50	374	
500	56	416	
550	61	457	↓ Cistern
600	67	499	
650	72	540	
700	78	582	
750	83	623	
800	89	665	
850	94	706	
900	100	748	
950	106	790	
999	111	830	

¹Assume that the rain barrel/cistern is 25% full

STEPS 2 through 4 for BMP #2 (Infiltration Trench)

STEP 2 - Select the impervious area value for BMP #2, the infiltration trench, using Column 1 in Table B-6:

Find the row in Column 1 that is closest to but not less than 740 (200 from the front of the garage + 540 from the driveway). Therefore, the value selected is 750.

STEP 3 - Determine the volume that BMP #2, the infiltration trench must be to satisfy the volume requirements using Column 2 in Table B-6:

The volume of the infiltration trench to be used as BMP #2, assuming a void ratio of 40%, is determined by finding the row in Column 2 that is in the same row as 750 square feet from Step 2. Therefore, the volume of BMP #2 must be 156 cubic feet.

STEP 4 - Utilizing the value from Column 2 determined above, and the surface area that the proposed BMP will occupy, identify the proposed depth and corresponding surface area needed using Column 3 in Table B-6:

Joe Homeowner would like to place the infiltration trench along the edge of the driveway that the runoff drains to, so it would have a length of 20 feet. The smallest width that can be used, as stated in the infiltration trench requirements in Section B.3, is 3 feet. Therefore, the area of the infiltration trench is:

$$20 * 3 = 60 \text{ square feet}$$

To find the minimum depth of the trench, move toward the right side of the table from 156 cubic feet in Column 2 to Column 3, and find the column with a value of as close to but not more than 60 square feet, which is 52 square feet. Then obtain the minimum depth of the facility by reading the depth from the column heading at the top of the table. Therefore, the depth of the trench would need to be 3 feet.

Selected BMPs: Rain barrel(s) \geq 166 gallons and a 20' L x 3' W x 3' D infiltration trench

STEP 5 – Make a sketch of the site plan as shown in Figure B-7, and fill in the simplified method worksheet found as shown in Table B-7.

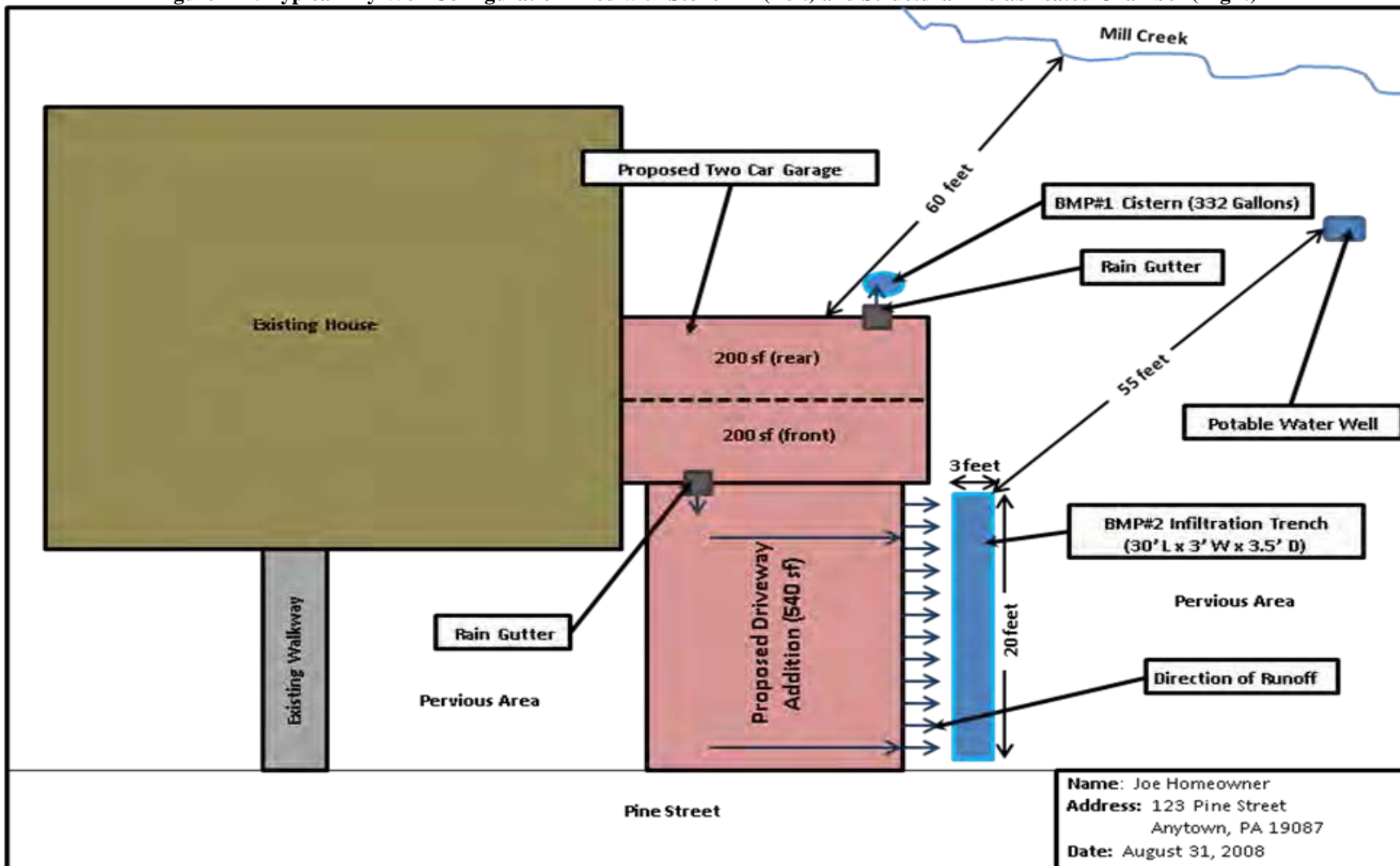
Table B-6: Example – Calculating Storage Volume Surface Area and Depth for Infiltration Trench

Column 1	Column 2	Column 3							
Total Proposed Impervious Area (square feet)	Volume of Infiltration Trench or Dry Well #2* (cubic feet)	Surface Area of Infiltration Trench or Dry Well #2 Acceptable Depths for Each BMP are indicated by the arrows below (square feet)							
		Area Required for a BMP with a Depth(D) of 1.5'	Area Required for a BMP with a Depth(D) of 2.0'	Area Required for a BMP with a Depth(D) of 2.5'	Area Required for a BMP with a Depth(D) of 3.0'	Area Required for a BMP with a Depth(D) of 3.5'	Area Required for a BMP with a Depth(D) of 4.0'	Area Required for a BMP with a Depth(D) of 4.5'	Area Required for a BMP with a Depth(D) of 5.0'
<i>I</i>	<i>V</i>	<i>A(sf)</i>							
Sum of all Proposed Impervious Areas	$(1*(1/12)*I)/\text{Void Ratio } (0.4)*=V$	$V/D=A$							
50	10	7	5	4	3	3	3	2	2
100	21	14	10	8	7	6	5	5	4
150	31	21	16	13	10	9	8	7	6
200	42	28	21	17	14	12	10	9	8
250	52	35	26	21	17	15	13	12	10
300	63	42	31	25	21	18	16	14	13
350	73	49	36	29	24	21	18	16	15
400	83	56	42	33	28	24	21	19	17
450	94	63	47	38	31	27	23	21	19
500	104	69	52	42	35	30	26	23	21
550	115	76	57	46	38	33	29	25	23
600	125	83	63	50	42	36	31	28	25

650	135	90	68	54	45	39	34	30	27
700	146	97	73	58	49	42	36	32	29
750	3 156	104	78	63	4 52	45	39	35	31
800	167	111	83	67	56	48	42	37	33
850	177	118	89	71	59	51	44	39	35
900	188	125	94	75	63	54	47	42	38
950	198	132	99	79	66	57	49	44	40
999	208	139	104	83	69	59	52	46	42

*Assume a void ratio of 40%

Figure B-7: Typical Dry Well Configuration filled with Stone Fill (Left) and Structural Prefabricated Chamber (Right)



B-23

Table B-7: Example – Simplified Method Worksheet with Results

Simplified Method Worksheet				
STEP 1				
Proposed Impervious Surface for BMP #1	Proposed Impervious Surface for BMP #2	Proposed Impervious Surface for BMP #3		
200	740			
STEPS 2&3				
Rain Barrel or Cistern				
Proposed Impervious Surface from Column 1 in Table B-5	Volume from Column 2 or 3 in Table B-5			
200	166 gallons			
Rain Garden/Bioretenention or Dry Well #1				
Proposed Impervious Surface from Column 2 in Table B-2	Volume of BMP from Column 2 in Table B-2	Area of BMP from Column 3 in Table B-2	Depth of BMP from Column 3 in Table B-2	Types of Material to Be Used
Infiltration Trench or Dry Well #2				
Proposed Impervious Surface from Column 2 in Table B-6	Volume of BMP from Column 2 in Table B-6	Area of BMP from Column 3 in Table B-6	Depth of BMP from Column 3 in Table B-6	Types of Material to Be Used
740	156	52	3	Infiltration Trench, Uniformly Graded Aggregate, HDPE 8" pipe, geotextile material, grass planted on top

Note: For additional BMPs, use additional sheets

B.5 Simplified Operation, Inspection, and Maintenance Plan

It is the property owner's responsibility to properly maintain BMPs. It is also the property owner's responsibility to inform any future buyers of the function, operation, and maintenance needed for any BMPs on the property prior to the purchase of the property. The following maintenance agreement outlines the maintenance required for each type of BMP, the responsibilities of the property owner, and the rights of the Municipality in regards to inspection and enforcement of the maintenance requirements. The Operation and Maintenance Agreement must be signed and submitted to the Municipality.

STORMWATER CONTROLS AND BEST MANAGEMENT PRACTICES OPERATIONS AND MAINTENANCE AGREEMENT

THIS AGREEMENT, made and entered into this _____ day of _____, 20__, by and between _____, (hereinafter the "Landowner"), and Radnor Township, Delaware County, Pennsylvania, (hereinafter "Municipality")

WITNESSETH

WHEREAS, the Landowner is the lawful owner of a parcel of ground located in Radnor Township, and more particularly identified as Delaware County Folio No. _____ (hereinafter "Property"); and

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

WHEREAS, Landowner has prepared a Grading Permit Plan ('Plan'), consisting of _____ Sheets prepared by _____ dated _____, and last revised _____ describing the Stormwater Facilities as shown on Sheet _____ through and including Sheet _____, copies of which sheets are attached herein collectively as **Exhibit "A"** and made part hereof; and

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

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

BMP – “Best Management Practice”- Activities, facilities, designs, measures, or procedures used to manage stormwater impacts from regulated activities, to protect and maintain water quality and promote infiltration, and to otherwise meet the purposes of the municipal Stormwater Management Ordinance, Stormwater. BMPs are commonly grouped into one of two broad categories or measures: “structural” or “nonstructural.” In this Ordinance, nonstructural BMPs or measures include certain low impact development practices used to minimize the contact of pollutants with stormwater runoff. These practices aim to limit the total volume of stormwater runoff and manage stormwater at its source by techniques such as protecting natural systems and incorporating existing landscape features. Nonstructural BMPs include, but are not limited to, low impact development practices such as the protection of sensitive and special value features such as wetlands and riparian areas, the preservation of open space while clustering and concentrating development, the reduction of impervious cover, and the disconnection of rooftops from storm sewers. Structural BMPs are those that consist of a physical to capture and treat stormwater runoff. Structural BMPs include, but are not limited to, a wide variety of practices and devices, from large-scale retention ponds and constructed wetlands to small-scale underground treatment systems, infiltration facilities, filter strips, bioretention, wet ponds, permeable paving, grassed swales, riparian buffers, sand filters, detention basins, and manufactured devices. Structural and nonstructural stormwater BMPs are permanent appurtenances to the project Site. Also referred to as Stormwater Control Measure (SCM) and/or Stormwater Management Practice (SMP).

Conveyance – As specifically identified in the Plan, a manmade, existing or proposed facility, feature or channel used for the transportation or transmission of stormwater from one place to another, including pipes, drainage ditches, channels and swales (vegetated and other), gutters, stream channels, and like facilities or features. The Conveyances identified in the Plan are permanent appurtenances to the Property; and

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

NOW, THEREFORE, in consideration of the foregoing 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 that 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 that the Municipality, pursuant to this Agreement, performs work of any nature or expends any funds in performance of said work for inspection, labor, use of equipment, supplies, materials, and the like, the Landowner shall reimburse the Municipality for all expenses (direct and indirect) incurred within ten (10) days of receipt of an invoice from the Municipality.
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 affect any additional liability on 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 interest shall release the Municipality's employees and designated representatives from all damages, accidents, casualties, occurrences, or claims which might arise or be asserted against said employees and representatives from the construction, presence, existence, or maintenance of the BMP(s) by the Landowner or Municipality. In the event that a claim is asserted against the Municipality, its designated representatives, or employees, the Municipality shall promptly notify the Landowner, and the Landowner shall defend, at his own expense, any suit based on the claim. If any judgment or claims against the Municipality's employees or designated representatives shall be allowed, the Landowner shall pay all costs and expenses regarding said judgment or claim.
8. The Municipality shall inspect the BMP(s) and Conveyance(s) to determine if they continue to function as intended.
9. The BMP(s) and Conveyance(s) shall be inspected according to the following frequencies, at a minimum:
 - a. Annually for the first 5 years.
 - b. Once every 3 years thereafter.
 - c. Municipality to enter storm frequency inspection requirements per Section 708 of the Ordinance.

Written inspection reports shall be created to document each inspection. The inspection report shall contain the date and time of the inspection, the individual(s) who completed the inspection, the location of the BMP, facility or structure inspected, observations on performance, and recommendations for improving performance, if applicable. Inspection reports shall be submitted to the Municipality within 30 days following completion of the inspection.

Landowners must notify the Municipality of BMP(s) and Conveyance(s) that are no longer functioning as designed and must coordinate with the Municipality to determine a schedule to repair or retrofit these systems to restore designed functionality.

This Agreement shall be recorded at the Office of the Recorder of Deeds of Delaware 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 interest, in perpetuity.

IN WITNESS WHEREOF, the parties hereto, intending to be legally bound, have hereunto set their hands and seals the day and year first above written.

TOWNSHIP:

RADNOR TOWNSHIP

By: _____
Name:
Title: Township Engineer

ATTEST: _____
_____, Secretary

LANDOWNER:

By: _____
Name:

By: _____
Name:

ACKNOWLEDGMENT

COMMONWEALTH OF PENNSYLVANIA :
COUNTY OF : *SS*
:

ON THIS _____ day of _____, 20____, before me a Notary Public, personally appeared _____ Radnor Township Engineer, known to me (or satisfactorily proven) to be the person whose name is subscribed to the within instrument, and acknowledged that he subscribed the same for the purposes therein contained.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal.

Notary Public [SEAL]

My Commission Expires:

WHEREAS, the Municipality and the Landowner, its administrators, executors, successors, heirs, or 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, the Landowner is required to inform future buyers of the property about the function of, operation, and maintenance requirements of the BMP or BMPs prior to the purchase of the property by said future buyer, and upon purchase of the property the future buyer assumes all responsibilities as Landowner and must comply with all components of this agreement.

WHEREAS, for the purposes of this agreement, the following definition 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, dry wells, bioretention, rain gardens, permeable paving, rain barrels, and cisterns.

WHEREAS, it is required that the BMP or BMPs as shown on the simple sketch plan further referred to as the “Plan” and in accordance with the sizing calculations found on the simplified method worksheet further referred to as the “Calculation Worksheet” be constructed and maintained by the Landowner, its administrators, executors, successors, heirs, or assigns.

WHEREAS, the Municipality requires that stormwater management BMPs be constructed and adequately operated and maintained by the Landowner, its administrators, executors, successors, heirs, or assigns, in accordance with the following maintenance requirements.

- Vegetation along the surface of an infiltration trench should be maintained in good condition, and any bare spots should be revegetated as soon as possible.

- Vehicles shouldn't be parked or driven on an infiltration trench, and care should be taken to avoid excessive compaction by mowers.
- Any debris such as leaves blocking flow from reaching an infiltration trench or bioretention/rain garden should be routinely removed.
- While vegetation is being established, pruning and weeding may be required for a bioretention/rain garden.
- Mulch in a bioretention/rain garden needs to be re-spread when erosion is evident. Once every two to three years or after major storms the entire area may require mulch replacement.
- At least twice a year the landowner needs to inspect the bioretention/rain garden for sediment buildup and vegetative conditions.
- During periods of extended drought, the bioretention/rain garden requires watering.
- Trees and shrubs in a bioretention/rain garden need to be inspected at least twice per year by the landowner to evaluate their health. If they are in poor health, they need to be replaced.
- Dry wells need to be inspected by the landowner at least four times a year and after significant rainfalls, and debris/trash, sediment, and any other waste material need to be removed and disposed of at suitable disposal/recycling sites and in compliance with local, state, and federal waste regulations.
- For dry wells, gutters need to be regularly cleaned out, and proper connections must be maintained to facilitate the effectiveness of the dry well.
- The filter screen for the dry well that intercepts roof runoff must be replaced as necessary.
- Dry wells that are damaged need to be fixed or replaced within two weeks of being damaged.
- If an intermediate sump box exists in conjunction with a dry well, it must be cleaned out at least once per year.
- Rain barrels and cisterns need to be cleared of debris routinely at least every three months and after significant storms to allow stormwater from gutters to enter them.

- Gutters that directly convey rain water to dry wells, rain barrels, and cisterns need to be routinely cleared of trash and debris at least every three months and after significant storms.
- Rain barrels and cisterns must be kept covered.
- Rain barrels and cisterns should be routinely emptied so that they are only ¼ of the way full to allow for storage of additional rainwater.
- Overflow outlets from rain barrels and cisterns must be kept free and clear of debris.
- Rain barrels and cisterns that are damaged need to be fixed or replaced within two weeks of being damaged.

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 specifications identified in the Plan and Calculation Worksheet.
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 outlined in this agreement.
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 that 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 that the Municipality, pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner shall reimburse the Municipality for all expenses (direct and indirect) incurred within ten days of receipt of an invoice from the Municipality.
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 affect 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, heirs, and other successors in interests, shall release the Municipality's employees and designated representatives from all damages, accidents, casualties, occurrences, or claims which might arise or be asserted against said employees and representatives from the construction, presence, existence, or maintenance of the BMP(s) by the Landowner or Municipality. In the event that a claim is asserted against the Municipality, its designated representatives, or employees, the Municipality shall promptly notify the Landowner and the Landowner shall defend, at his own expense, any suit based on the claim. If any judgment or claims against the Municipality's employees or designated representatives shall be allowed, the Landowner shall pay all costs and expenses regarding said judgment or claim.

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

ATTEST:

WITNESS the following signatures and seals:

(SEAL)

For the Municipality:

(SEAL)

For the Landowner:

ATTEST:

_____ (City, Borough, Township)

County of _____, Pennsylvania

I, _____, a Notary Public in and for the County and State aforesaid, whose commission expires on the _____ day of _____,

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

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

NOTARY PUBLIC

(SEAL)

ORDINANCE APPENDIX C – 1

SAMPLE SWM SITE PLAN APPLICATION

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

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

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

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

8. Stormwater

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

b. Design storm utilized (on-site conveyance systems) (24 hr.) _____

No. of Subarea _____

Watershed Name _____

Explain: _____

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

d. Subarea number(s) from Ordinance Appendix A of the respective watershed stormwater management plan or other subareas identified in other watershed stormwater management plans _____

e. Type of proposed runoff control _____

f. Does the proposed stormwater control criteria meet the requirements/guidelines of the Stormwater Ordinance? _____

If not, what variances/waivers are requested? _____

Reasons _____

g. Does the plan meet the requirements of Article III of the Stormwater Ordinance? ___

If not, what variances/waivers are requested? _____

Reasons why _____

h. Was TR-55, June 1986, utilized in determining the time of concentration? _____

- 1. What hydrologic method was used in the stormwater computations? _____

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

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

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

- a. Have the SWM site plan and E&S plan, supporting documentation, and narrative been submitted to the Delaware County Conservation District? _____
- b. Total area of earth disturbance _____ S.F.

10. Wetlands

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

11. Filing

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

CERTIFICATE OF OWNERSHIP AND ACKNOWLEDGMENT OF APPLICATION:

COMMONWEALTH OF PENNSYLVANIA
COUNTY OF _____

On this the _____ day of _____, 20__ __, before me, the undersigned officer,
personally appeared _____ who, being duly sworn according to law, deposes
and says that _____ are owners of the property described in this
application and that the application was made with

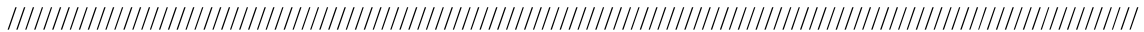
_____ knowledge and/or direction and does hereby agree with the
said application and to the submission of the same.

_____ Property
Owner

My Commission Expires _____ 20_____
Notary Public _____

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

SIGNATURE OF APPLICANT _____



(Information Below This Line To Be Completed By The Municipality)

_____ (Name of) Municipality official submission receipt:

Date complete application received _____ plan number _____

Fees _____ date fees paid _____ received by _____

Official submission receipt date _____

Received by _____

Municipality

ORDINANCE APPENDIX C – 2

SWM SITE PLAN CHECKLIST



Delaware County Conservation District
 Rose Tree Park - Hunt Club
 1521 N. Providence Rd.
 Media, PA 19063
 Phone: 610-892-9484
 Fax: 610-892-9489
 Email: info@delcocd.org

Project: _____
 Municipality: _____
 Engineer: _____
 Submittal No: _____
 Date: _____
 Project ID: _____ (for County use ONLY)

ARTICLE I: GENERAL PROVISIONS

Reference: Section 105 Applicability/Regulated Activities

- List all watersheds within which the proposed project is to take place:

- Does the Proposed Project meet the definition of a "Regulated Activity" in any of the Stormwater Management Plans? Yes No

STOP - If you have checked NO for either of the above questions, you are not required to submit a SWM plan under the watershed's respective Stormwater Management Ordinance.

ARTICLE I: GENERAL PROVISIONS

Reference: Section 106 Exemptions

Note: Parent tract refers to the total parcel configuration on October 12, 2022, and includes any subdivision of lands which may have occurred after that date.

Parent Tract Area: _____ acres

Total Existing Impervious Area (as of (October 12, 2022) _____ acres

Total New Impervious Area (all Phases): _____ acres

Parcel IS Exempt

Parcel IS NOT Exempt

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 304 Nonstructural Project Design

- Has an Existing Resource and Site Analysis Map (ERSAM) been prepared?
 Yes No, Explain _____

ARTICLE III: STORMWATER MANAGEMENT (continued)

1. Are any of the following Environmentally Sensitive areas identified on site?

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

2. Does the site layout plan avoid Environmentally Sensitive Areas identified on site?

Yes No, Explain _____

3. Has a stream buffer been established per Section 306.C.?

Yes No, Explain _____

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 305 Infiltration

1. Is the proposed activity considered a "Stormwater Hotspot"? (Refer to Section 301.T) Yes No

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

Yes No, Explain _____

3. Total Recharge Volume Required: _____ cubic feet (using: Modified CG-1; Modified CG-2)

4. How is the Required Recharge Volume being addressed?

<input type="checkbox"/> Infiltration Trench	<input type="checkbox"/> Dry Swales
<input type="checkbox"/> Infiltration Basin	<input type="checkbox"/> Other: _____
<input type="checkbox"/> Bioretention	

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 306 Water Quality Requirements

1. Have provisions been installed to address stormwater runoff water quality on site?

Yes No, Explain _____

2. Total Water Quality Volume Required: _____ acre feet

3. Is the site in a Special Protection watershed which includes Exceptional Value (EV) or High Quality (HQ) waters? Yes No

4. How is the Required Water Quality Volume being addressed?

Wet Detention Basin Sand Filter
 Extended Dry Detention Basin Constructed Wetlands
 Bioretention Other: _____

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 307 Stream Bank Erosion Requirements

1. Has the 2- year proposed conditions flow been reduced to the 1- year existing conditions flow?

Yes No, Explain _____

2. Does the proposed conditions 1- year storm drain over a minimum 24- hour period?

Yes No, Explain _____

ARTICLE III: STORMWATER MANAGEMENT

Reference: Section 308 Stormwater Peak Rate Control and Management Districts

1. In which of the following Stormwater Management District(s) is the site located? A B

Other _____

ARTICLE III: STORMWATER MANAGEMENT (Continued)

Reference: Section 310 Other Requirements

1. Is this project subject to PENN DOT approval?

Yes No

a. If "YES," have these plans been forwarded to PENNDOT for review?

Yes No, Explain _____

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

Yes No Not Applicable

3. Are any proposed stormwater facilities subject to PADEP Chapter 105 permitting?

Yes No

a. If "YES," have these plans been forwarded to PADEP for review?

Yes No, Explain _____

ARTICLE VII: MAINTENANCE RESPONSIBILITIES

Reference: Section 702 Responsibilities for Operations and Maintenance of Stormwater Controls /BMPs

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

Yes No, Explain _____

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

Municipality

Private Owner

Homeowner Association

Other _____

ORDINANCE APPENDIX E

LOW IMPACT DEVELOPMENT (LID) PRACTICES

LOW IMPACT DEVELOPMENT (LID) PRACTICES

ALTERNATIVE APPROACH FOR MANAGING STORMWATER RUNOFF

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

The recommended alternative approach is to promote practices that will minimize proposed conditions runoff rates and volumes, which will minimize needs for artificial conveyance and storage facilities. To simulate pre-development hydrologic conditions, 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 of 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 are typically located in the natural headwater valleys and swales, thereby replacing natural drainage functions with a completely impervious system. As a result, runoff and pollutants generated from impervious surfaces flow directly into storm sewers with no opportunity for attenuation, infiltration, or filtration. Developments designed to fit site topography also minimize the amount of grading on site.
- **Protecting Natural Depression Storage Areas.** Depressional storage areas either have no surface outlet or drain very slowly following a storm event. They can be commonly seen as ponded areas in farm fields during the wet season or after large runoff events. Traditional development practices eliminate these depressions by filling or draining, thereby obliterating their ability to reduce surface runoff volumes and trap pollutants. The volume and release rate characteristics of depressions should be protected in the design of the development site. The depressions can be protected by simply avoiding the depression or by incorporating its storage as additional capacity in required detention facilities.

- **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 a 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 connection 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 impervious cover associated with 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 occurs with street length, which also will reduce costs of the development. Cluster development groups the

construction activity in less-sensitive areas without substantially affecting the gross density of development.

In summary, a careful consideration of the existing topography and implementation of a combination of the above mentioned techniques may avoid construction of costly stormwater control measures. Benefits include reduced potential for downstream flooding and water quality degradation of receiving streams/water bodies, enhancement of aesthetics, and reduction of development costs. Other benefits include more stable baseflows in receiving streams, improved infiltration, reduced flood flows, reduced pollutant loads, and reduced costs for conveyance and storage.

ORDINANCE APPENDIX F

STORMWATER MANAGEMENT DESIGN CRITERIA

TABLE F-1 RUNOFF CURVE NUMBERS

TABLE F-2 RATIONAL RUNOFF COEFFICIENTS

TABLE F-3 MANNING ROUGHNESS COEFFICIENTS

FIGURE F-1 INTENSITY-DURATION-FREQUENCY (IDF) CURVES

FIGURE F-2 DEPTH-DURATION-FREQUENCY (DDF) CURVES

FIGURE F-3 RAINFALL DISTRIBUTION – S CURVE

FIGURE F-4 RADNOR TOWNSHIP STORMWATER DISTRICTS

TABLE F-1
RUNOFF CURVE NUMBERS

LAND USE DESCRIPTION	Hydrologic Condition	HYDROLOGIC SOIL GROUP			
		A	B	C	D
Open Space					
Grass cover < 50%	Poor	68	79	86	89
Grass cover 50% to 75%	Fair	49	69	79	84
Grass cover > 75%	Good	39	61	74	80
Meadow		30	58	71	78
Agricultural					
Pasture, grassland, or range - Continuous forage for grazing	Poor	68	79	86	89
Pasture, grassland, or range - Continuous forage for grazing	Fair	49	69	79	84
Pasture, grassland, or range - Continuous forage for grazing	Good	39	61	74	80
Brush-brush-weed-grass mixture with brush the major element	Poor	48	67	77	83
Brush-brush-weed-grass mixture with brush the major element	Fair	35	56	70	77
Brush-brush-weed-grass mixture with brush the major element	Good	30	48	65	73
Fallow Bare soil	-----	77	86	91	94
Crop residue cover (CR)	Poor	76	85	90	93
	Good	74	83	88	90
Woods - grass combination (orchard or tree farm)					
	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods					
	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30	55	70	77

Commercial	(85% impervious)	89	92	94	95
Industrial	(72% impervious)	81	88	91	93
Institutional	(50% impervious)	71	82	88	90

Residential districts by average lotsize:

	% Impervious				
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 acres	12	46	65	77	82
Farmstead		59	74	82	86
Smooth surfaces (concrete, asphalt, gravel, or bare compacted soil)		98	98	98	98
Water		98	98	98	98
Mining/newly graded areas (pervious areas only)		77	86	91	94

* Includes multi-family housing unless justified lower density can be provided.

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

Source: NRCS (SCS) TR-55

TABLE F-2

RATIONAL RUNOFF COEFFICIENTS

LAND USE DESCRIPTION	HYDROLOGIC SOIL GROUP				
	A	B	C	D	
Cultivated land : without conservation treatment	.49	.67	.81	.88	
: with conservation treatment	.27	.43	.61	.67	
Pasture or range land: poor condition	.38	.63	.78	.84	
: good condition	---*	.25	.51	.65	
Meadow: good condition	---*	---*	.44	.61	
Woods: thin stand , poor cover, no mulch	---*	.34	.59	.70	
: good cover	---*	---*	.45	.59	
Open spaces, lawns, parks, golf courses, cemeteries					
Good condition: grass cover on 75% or more of the area	*	.25	.51	.65	
Fair conditi on: grass cover on 50% to 75% of the area	*	.45	.63	.74	
Commercial and business areas (85% impervious)	.84	.90	.93	.96	
Industrial districts (72% impervious)	.67	.81	.88	.92	
Residential:					
Average lot size	Average % impervious				
1/8 acre or less	65	.59	.76	.86	.90
1/4 acre	38	.25	.49	.67	.78
1/3 acre	30	*	.49	.67	.78
1/2 acre	25	*	.45	.65	.76
1 acre	20	---*	.41	.63	.74
Paved parking lots, roofs, driveways, etc.	.99	.99	.99	.99	
Streets and roads:					
Paved with curbs and storm sewers	.99	.99	.99	.99	
Gravel	.57	.76	.84	.88	
Dirt	.49	.69	.80	.84	

Notes: Values are based on SCS definitions and are average values.

Values indicated by---* should be determined by the design engineer based on site characteristics.

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

TABLE F-3

MANNING'S ROUGHNESS COEFFICIENTS

Roughness Coefficients (Manning's "n") for Overland Flow

Surface Description	n		
Dense growth	0.4	-	0.5
Pasture	0.3	-	0.4
Lawns	0.2	-	0.3
Bluegrass sod	0.2	-	0.5
Short grass prairie	0.1	-	0.2
Sparse vegetation	0.05	-	0.13
Bare clay-loam soil (eroded)	0.01	-	0.03
Concrete/asphalt - very shallow depths (less than 1/4 inch)	0.10	-	0.15
- small depths (1/4 inch to several inches)	0.05	-	0.10

Roughness Coefficients (Manning's "n") for Channel Flow

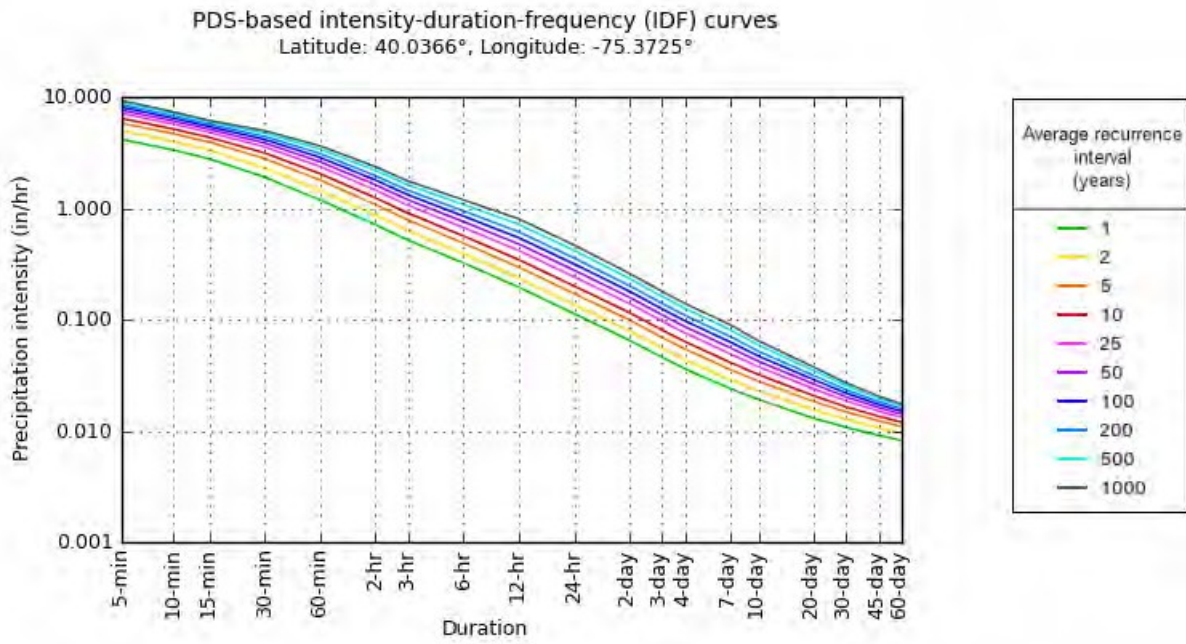
Reach Description	n
Natural stream, clean, straight, no rifts or pools	0.03
Natural stream, clean, winding, some pools or shoals	0.04
Natural stream, winding, pools, shoals, stony with some weeds	0.05
Natural stream, sluggish deep pools and weeds	0.07
Natural stream or swale, very weedy or with timber underbrush	0.10
Concrete pipe, culvert, or channel	0.012
Corrugated metal pipe	0.012-0.021 ⁽¹⁾
High density polyethylene (HDPE) pipe	
Corrugated	0.021-0.029 ⁽²⁾
Smooth lined	0.012-0.020 ⁽²⁾

(1) Depending upon type, coating, and diameter

(2) Values recommended by the American Concrete Pipe Association, check manufacturer's recommended value

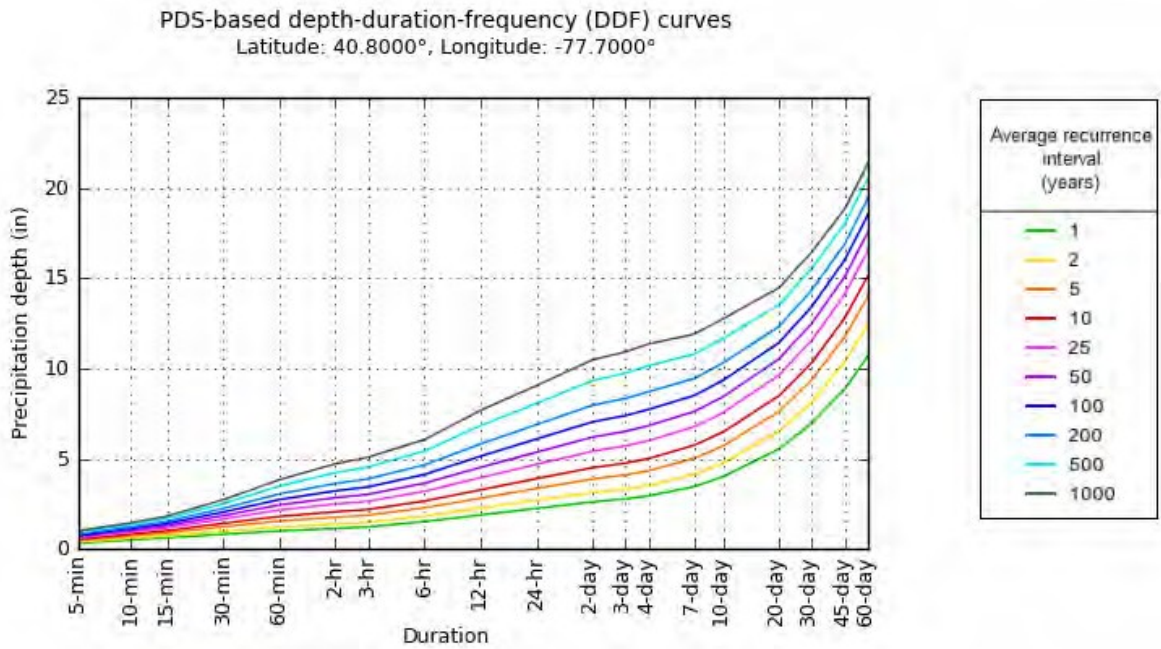
Source: U.S. Army Corps of Engineers, HEC-1 Users Manual

FIGURE F-1
INTENSITY-DURATION-FREQUENCY (DDF) CURVES



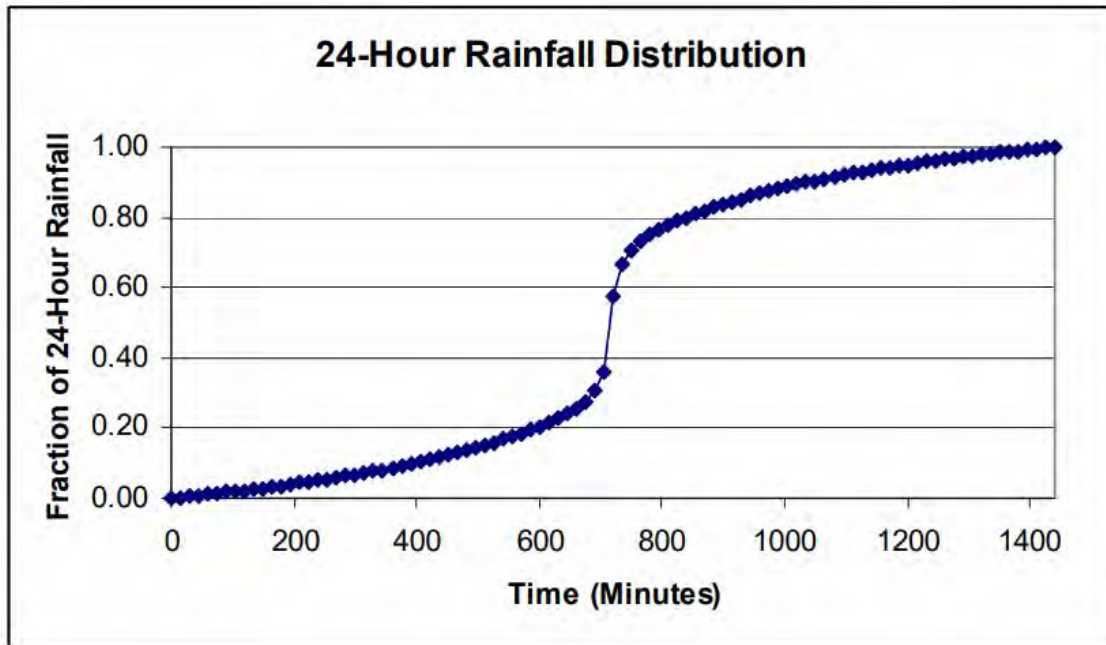
Source: NOAA ATLAS 14 https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=pa

**FIGURE F-2
DEPTH-DURATION-FREQUENCY (IDF) CURVES**



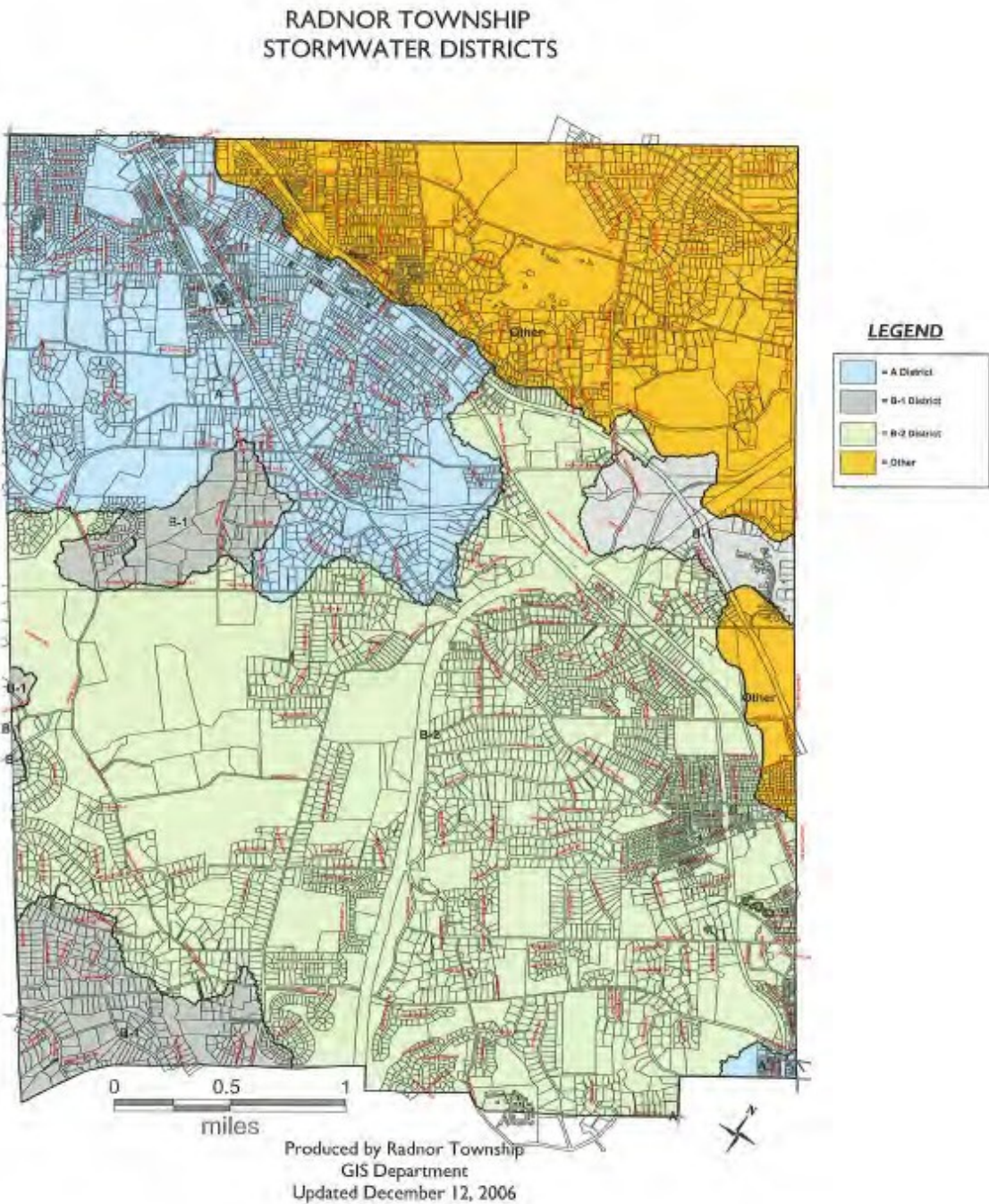
Source: NOAA ATLAS 14 https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=pa

**FIGURE F-3
RAINFALL DISTRIBUTION – S CURVE**



Source: PennDOT Publication 584

**FIGURE F-4
RADNOR TOWNSHIP STORMWATER DISTRICTS**



ORDINANCE APPENDIX G

REFERENCES

REFERENCES

BMP Manuals

California

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

Georgia

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

Maryland

2000 Maryland Stormwater Design Manual -

[http://www.mde.state.md.us/Programs/Waterprograms/SedimentandStormwater/stormwater design/index.asp](http://www.mde.state.md.us/Programs/Waterprograms/SedimentandStormwater/stormwater%20design/index.asp)

Massachusetts

Stormwater Management, Volume Two: Stormwater Technical Handbook (Massachusetts, 1997) - separate file available at <http://www.state.rna.us/dep/brp/stormwtr/stormpub.htm>

Minnesota

Minnesota Urban Small Sites BMP Manual: Stormwater Best Management Practices for Cold Climates (July 2001)-

<http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm>

New Jersey

Revised Manual for New Jersey: Best Management Practices for Control of Nonpoint Source Pollution from Stormwater (Fifth Draft May 2000) -

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New York

New York State Stormwater Management Design Manual (2001)-

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Pennsylvania

Pennsylvania Department of Environmental Protection *Pennsylvania Stormwater Best Management Practices Manual*, Pub. No. 363-0300-002, December 30, 2006

Washington

Stormwater Management Manual for Western Washington (August 2001)

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

Federal

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

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Riparian Buffer References

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

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Rupprecht, R., Kilgore, C., and Gunther, R., "Riparian and Wetland Buffers for Water-Quality Protection." *Stormwater* Nov.-Dec. 2009, Vol 10, No. 8: 46-51. Print.

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

ORDINANCE APPENDIX H
WEST NILE VIRUS GUIDANCE

WEST NILE VIRUS GUIDANCE

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

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

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

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

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

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

Mosquitoes

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

species have been identified as vectors of West Nile Virus while four more have been identified as potential vectors.

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

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

Stormwater Facilities

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

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

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

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

Conclusion

The Conservation District understands the pressure faced by municipalities when dealing with multifaceted issues such as stormwater management and encourages the incorporation of water quality management techniques into stormwater designs. As Monroe County continues to grow, conservation design, infiltration, and constructed wetlands and ponds should be among the preferred design options to reduce the impacts of increases in impervious surfaces. When designed and constructed appropriately, the runoff mitigation benefits to the community from these design options will far outweigh their potential to become breeding grounds for mosquitoes.

ORDINANCE APPENDIX J

RIPARIAN BUFFER TRAIL GUIDELINES

Riparian Buffer Trail Guidelines

[Note to Municipality: The following riparian buffer trail guidelines may be modified provided that the buffer meets all minimum width and vegetation requirements detailed in Section 306 of the ordinance as well as all federal, state and local, stormwater, floodplain, and other requirements and regulations.]

Introduction

Riparian buffers are used as non-structural best management practices (BMPs) for protecting and enhancing water quality. Depending on their size, location, and design, riparian buffers often supply additional environmental, economic, aesthetic, and recreational value. Passive recreational trails can be a compatible use within riparian buffers if the trails are sized and placed appropriately. The trail guidelines below are meant to supplement Section 306, Water Quality Requirements, and do not alter or modify the regulations set forth in Section 301 General Requirements. All other applicable rules and requirements should be followed, including all federal, state, permitting, and local stormwater and floodplain ordinances.

Installing a trail does not relieve a developer or municipality of the minimum buffer and vegetation requirements described in Section 306-C, or infiltration and peak rate controls in Sections 305 and 308. Effort shall be made to mitigate water quality and peak rate adjacent the trail structure to avoid collecting runoff in a large facility and creating a point discharge. This can be accomplished by trail-side stone filtration trenches, vegetative filter strips, small bio-retention facilities, and other mechanisms subject to site constraints and municipal engineer approval. See Figure J-1. In situations where site constraints negate the feasibility of trail-side mitigation methods, effort shall be made to collect runoff in multiple stormwater facilities for segmented portions of the trail, in place of detaining stormwater in one large facility. Level spreaders shall be constructed at facility outlets to decrease point-source discharges.

As with all trails, adequate land acquisition, easements, and/or landowner permission should be obtained in advance of any trail placement. Care should be given when designing and installing trails so as not to compromise the buffer's ability to protect water quality. Many factors such as slope, vegetation, and soil type will determine the type, size, and placement of the trail within the riparian buffer. Heavily used trails and trails with wide impervious surfaces should be set back farther from the stream edge to help mitigate the effects of any associated increase in runoff. Note: failure to comply with these guidelines (Installing a trail with inadequate setback from the stream bank) could result in increased stormwater runoff, decreased water quality, stream bank degradation, and damage to the buffer or trail.

Trail Recommendations

Location, Size, and Orientation

All trails should be a reasonable width appropriate for the site conditions. It is not recommended that the width of any paved trail exceed twenty five (25) percent of the total buffer width. All trail designs and specifications are subject to approval by the municipality.

Natural vegetation must be present throughout the buffer as described in Section 306 of the ordinance. Grassy areas should be managed as meadows or be reforested and should not be mowed as lawn in any part of the buffer. Where existing vegetation is insufficient to protect water quality, additional native species should be planted to enhance the buffer.

Paved trails, if appropriate to the site, are permitted and must be located at least twenty-five (25) feet from the top of the stream bank. In limited instances, paved trails be placed closer to a stream due to topography, or in order to accommodate passive educational and recreational activities, but must always be at least ten (10) feet from the top of the stream bank. Although this can be achieved by diverting the entire trail closer to the stream, more conservative methods should be considered, such as smaller spur trails or loop trails. These smaller trails provide access to the stream, but reduce the total traffic along the sensitive stream bank.

In rare instances where the buffer width is reduced due to zoning setback or geographical constraints, the municipality should strongly consider whether the benefits of a trail outweigh the benefits of a wider buffer.

Signage

The installation of interpretive and educational signage is strongly encouraged along the trail. Signs should point out local natural resources and educate the public on how riparian buffers protect the watershed. There should be minimum disturbance in the vegetated buffer between the trail and the stream. Therefore, all appurtenances (e.g. benches, educational signs, kiosks, fountains, etc.) should be installed on the landward side of the trail, if possible. All appurtenances shall be installed in compliance with federal, state, local, stormwater, floodplain, and other regulations and permitting requirements (e.g. anchoring, etc.)

Parking Areas

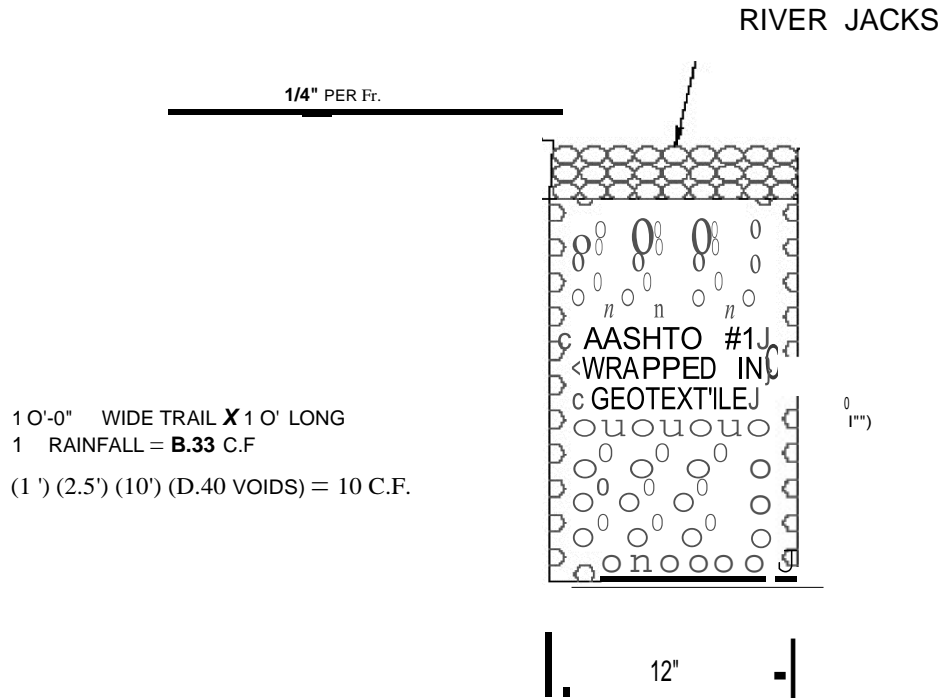
New trailheads and trail parking areas shall meet all the infiltration, rate control, and minimum setback requirements of this ordinance. Every effort should be made to coordinate trail access with existing parking areas. Any new parking areas and trailhead clearings should not encroach on the riparian buffer in any way.

Trail Maintenance

The installation and maintenance of all trails should be performed in a manner that minimizes site disturbance and prevents runoff and erosion. Soil disturbance should be avoided if possible. The removal of native trees and other native vegetation should also be kept to a minimum. If large or heavy equipment is required for trail installation, special care should be given not to damage existing trees and tree roots.

FIGURE J-1

**EXAMPLE DESIGN OF A TRAIL-SIDE
STONE FILTRATION TRENCH**



Source:
James MacCombie, Herbert E. MacCombie Jr. P.E. Consulting Engineers & Surveyors Inc.