

ARTICLE IV

STORMWATER MANAGEMENT

SECTION 401 DESIGN STANDARDS

1. General Requirements.
 - A. The Developer of any Project within the Township, with the exception of those Projects exempted from the requirements of this Ordinance in Section 302 shall submit an application for and obtain approval of a Stormwater Management permit or Stormwater Management Plan, as applicable.
 - B. All Stormwater Management plans and reports prepared in accordance with this Article shall be designed, signed, and sealed by individuals registered in the Commonwealth of Pennsylvania and qualified to perform such duties.
 - C. When a Project is proposed to be developed in phases or sections and the Developer submits Stormwater Management plan for each section or phase, all proposed temporary facilities required for construction of a section or phase shall be included in the submitted Stormwater Management plan for that section.
 - D. Where applicable, Stormwater Management Facilities shall comply with the requirements of Chapter 105. These requirements apply to the Construction, Modification, operation or maintenance of both existing and proposed water obstructions and encroachments throughout the Watershed, including work in wetlands.
 - E. Stormwater Management Facilities that involve a state highway shall also be subject to the approval of PennDOT.
 - F. Stormwater Management Facilities located within or affecting the Floodplain or any Watercourse shall also be subject to the requirements of Section 401.4 of this Ordinance, the Zoning Ordinance, any ordinance which regulates construction and Development within Areas of the Township subject to Flooding, and any other applicable requirements of Act 166, the Pennsylvania Floodplain Management Act.
 - G. Runoff from Impervious Surface Areas shall be drained to pervious Areas of the Project Site.

- H. Roof drains shall not be connected to sanitary or storm sewers, roadside ditches, or to streets or gutters through the curbing.
- I. Stormwater Runoff from a Project Site shall flow directly into a natural Watercourse or into an existing Storm Sewer system, or onto adjacent properties in an Approved manner similar to the Runoff characteristics of the pre-Development flow.
- J. Stormwater Runoff shall not be transferred from one Watershed to another unless the Watersheds are sub-Watersheds of a common Watershed which join together within the perimeter of the Project Site, or the effect of the transfer does not alter the Peak Discharge onto downstream lands, or Drainage Easements from the affected Landowners are provided.
- K. All Stormwater Runoff flowing over the Project Site shall be considered in the design of the Stormwater Management Facilities. This includes existing points of concentrated drainage that discharge onto adjacent property. Existing concentrated drainage shall not be relocated and shall be subject to any applicable discharge criteria specified in this Ordinance.
- L. Where a Project Site is traversed by Watercourses other than permanent streams, the Developer shall provide a Drainage Easement conforming substantially to the line of such Watercourses. The terms of the Easement shall prohibit excavation, the placing of fill or Structures, and any alterations that may affect adversely the flow of Stormwater within any portion of the Easement. Requirements of the Easement shall also conform to the Riparian Buffer Area standards.
- M. Where watercourses traverse a site and are eroded, or have been channelized or “armored”, the project shall include natural stream channel design techniques to stabilize and recreate natural habitat. Natural products and native species shall be used. The design and construction shall comply with the principles and requirements of *Stream Corridor Restoration: Principles, Processes, and Practices, by the Federal Interagency Stream Restoration Working Group*.
- N. Stormwater drainage systems shall be provided in order to permit unimpeded flow along natural Watercourses.
- O. Other innovative methods for the management of Stormwater Runoff rates and volumes may also be Approved by the Township. Various combinations of methods should be tailored to suit the particular requirements of the type of Development and the topographic features of the Project Site. The following is a partial listing of control methods which can be utilized in Stormwater Management systems where appropriate and when approved by the Township Engineer.

- (1) Infiltration Pits, Infiltration Trenches or other Infiltration Structures.
- (2) Concrete lattice block surfaces.
- (3) Grassed Channels and vegetated strips.
- (4) Cisterns and underground reservoirs.
- (5) Routed flow over grass.
- (6) Decreased Impervious Surface coverage.
- (7) Constructed wetlands.
- (8) Retention Basins subject to prior Township approval.
- (9) Roof-top storage.
- (10) Detention Basins (extended or conventional).
- (11) Other Best Management Practices.

P. Pre-Development and post-Development drainage area maps including time of concentration (Tc) segmental flow path information, existing and proposed features, and acreages.

2. Permanent Stormwater Management Standards. The Developer shall demonstrate by substantial evidence that the Stormwater Management Facilities for the Project will meet or exceed all of the following standards independently:

A. Standard 1: Water volume controls shall be implemented using the Design Storm Method in Subsection A or the Simplified Method in Subsection B below. For regulated activity areas equal or less than one (1) acre that do not require hydrologic routing to design the stormwater facilities, this Ordinance establishes no preference for either methodology; therefore, the applicant may select either methodology on the basis of economic considerations, the intrinsic limitations on applicability of the analytical procedures associated with each methodology, and other factors.

B. The Design Storm Method (CG-1 in the BMP Manual) is applicable to any size of regulated activity. This method requires detailed modeling based on site conditions.

1. Do not increase the post-development total runoff volume for all storms equal to or less than the two (2)-year 24-hour duration precipitation.

2. For modeling purposes:
 - a. Existing (pre-development) non-forested pervious areas must be considered meadow.
 - b. Twenty percent (20%) of the existing impervious area of a project site, when present, shall be considered meadow in the model for existing conditions.
- C. The Simplified Method (CG-2 in the BMP Manual) provided below is independent of site conditions and should be used if the Design Storm Method is not followed. This method is not applicable to regulated activities greater than one (1) acre or for projects that require design of stormwater storage facilities.

For new impervious surfaces:

1. Stormwater facilities shall capture at least the first two (2) inches of runoff from all new impervious surfaces.
 2. At least the first one (1) inch of runoff from new impervious surfaces shall be permanently removed from the runoff flow, i.e., it shall not be released into the surface waters of this Commonwealth. Removal options for the first one (1) inch of runoff include reuse, evaporation, transpiration, and infiltration.
 3. Wherever possible, infiltration facilities should be designed to accommodate infiltration of the entire permanently removed runoff; however, in all cases at least the first 0.5 inch of the permanently removed stormwater runoff shall be infiltrated.
 4. This method is exempt from the requirements of Section 304. Rate Controls.
- A. Standard 2: After installation of Impervious or Semi-Impervious surfaces or other construction, the post-Development peak rate of Stormwater discharges from the Project Site for all Design Storms up to and including a 100-year frequency rainfall shall not exceed the pre-Development peak rate discharges from the site of the same Design Storms before disturbance. Design Storms include:
- 1-year, 24-hour storm;
 - 2-year, 24-hour storm;
 - 5-year, 24-hour storm;

- 10-year, 24-hour storm;
- 25-year, 24-hour storm;
- 50-year, 24-hour storm;
- 100-year, 24-hour storm.

- B. Standard 3: The volume and rate of any stormwater discharges allowed by this Ordinance must be managed to prevent the physical degradation of receiving waters, such as by streambank scour and erosion. If a detention facility is proposed that is part of the BMPs approved for a project, the facility(ies) must be designed to provide for a 24-hour extended detention of the 1-year, 24-hour storm event (i.e., the stormwater runoff will be released over a minimum of 24 hours for the 1-year, 24-hour storm event). This shall be calculated incrementally with the smallest allowable vertical increment of 0.25 feet unless otherwise approved by the Township Engineer.
- C. Standard 4: The Township shall impose the following additional restrictions on the Stormwater discharges:
- (1) When probable risk to downstream Structure(s) or unique natural Area(s) exists or previous (historical) Flooding problems could be further aggravated, the Township shall require the Developer to further restrict peak discharge for each Design Storm. Restricted peak discharge shall be 75% of pre-Development peak discharge for the 10, 25, 50, and 100-year storm events, and 50% of pre-Development peak discharge for the 1, 2, and 5-year storm events.
 - (2) The Township shall impose measures to protect against ground or surface water pollution from significant pollution producing sources (so called "hot spots" including but not limited to industrial uses, gas stations, fast food and other commercial uses generating large numbers of vehicle trips, and other uses at the determination of the Township) or where the nature of the soils or bedrock underlying a Stormwater Management Structure constitutes substantial risk of contamination, such as Carbonate Areas. The Developer shall install special provisions that act to remove pollutant loadings (including but not limited to filtration devices like sand peat filters, multiple chamber catch basins and inlets, oil separators, and others).
 - (3) Where groundwater yields are very low or where a groundwater supply already is heavily used or where maintenance of downstream wetlands is of special concern, the Township shall require that the entire volume of the 2-year frequency rainfall (3.1 inches in 24 hours) from the Project Site be retained and infiltrated.

If substantial irrigation needs are anticipated, portion of stored Stormwater may be re-used for irrigation purposes.

3. Stormwater Management Calculation Methods.

- A. For computation of pre-development peak discharge rates, twenty percent (20%) existing impervious area of a project site, when present, shall be considered meadow.
- B. The peak discharge of the calculated post-Development runoff to an adjacent property shall be designed so that the peak discharge of the calculated post-Development runoff to an adjacent property does not exceed the peak discharge of the calculated pre-Development runoff for a Type II storm event.

Runoff calculates for the pre- and post-development comparison shall be based upon the peak flow from a one (1), two (2), five (5), ten (10), twenty-five (25), fifty (50), and one hundred (100) year storm frequency. The peak discharges and volumes of runoff shall be determined by using the latest version of Technical Release No. 55, Urban Hydrology for Small Watersheds. Other methods of analyzation will be considered on a case-by-case basis, subject to Township Engineer approval.

Runoff Coefficients must consider slope and soil type.

- C. If the soil-cover-complex method is used, stormwater runoff shall be based on the following Type II 24-hour storm events:

Storm Event	Inches of Rainfall
1 year	2.5"
2 years	3.2"
5 years	4.2"
10 years	5.0"
25 years	5.6"
50 years	6.3"
100 years	7.1"

In establishing the antecedent conditions for calculating Runoff prior to Land Disturbance, the following assumptions shall apply:

- (a) Antecedent Moisture Condition II (AMC II);
- (b) A type II distribution storm;

- (c) Woodland shall be used as the prior condition for those portions of the site having trees of greater than 6 inches caliper DBH or where such trees existed within 3 years of application;
 - (d) Lawn shall be used for all other Areas including Areas of existing cultivation or Impervious Surface; unless actual condition will result in a lower CN value. All cover conditions shall be assumed to be in “good” condition.
 - (e) Woodland Mannings n shall assume heavy underbrush
- C. Runoff calculations shall include a hydrologic and hydraulic analysis indicating volume and velocities of flow and the grades, sizes, and capacities of water carrying Structures, Sediment Basins, retention and detention Structures and sufficient design information to construct such Stormwater Management Facilities. Runoff calculations shall also indicate both pre-Development and post-Development Peak Discharge rates and volumes of Stormwater Runoff from the Project Site.
- D. For post-Development computations, all Runoff coefficients within the Project Site shall be based on actual or proposed land use assuming winter or poor land cover conditions. Off Project Site land use conditions used to determine storm flows for designing Stormwater Management facilities shall be based on existing land uses assuming winter or poor land cover conditions.
- E. Criteria and assumptions to be used in the determination of stormwater runoff and design of management facilities are as follows:
- (1) Runoff coefficients shall be based on the information contained in Appendices B1 and B2 if the actual land use is listed in those Appendices or shall be based on an acceptable engineering design method, subject to Township Engineer approval. If the actual land use is not listed in these Appendices, runoff coefficients shall be chosen from other published documentation and a copy of said documentation shall be submitted with this stormwater management report.
 - (2) Appropriate values of rainfall intensity shall be from the latest edition of the commonwealth of Pennsylvania, Department of Transportation *Design Manual, Part 2, Highway Design, Chapter 10*. See Appendix D for chart.
 - (3) Times of concentration shall be based on the following segmental design parameters:

- (a) Sheet flow: The maximum length for each reach of sheet or overland flow before shallow concentrated or open channel flow develops is one hundred fifty (150) feet. Flow lengths greater than one hundred (100) feet shall be justifiable based on the actual conditions at each development site.
 - (b) Shallow concentrated flow: Travel time for shallow concentrated flow shall be determined using Figure 3-1 from TR-55, Urban Hydrology for small watersheds, as shown in Appendix G.
 - (c) Open Channel flow: At points where sheet and shallow concentrated flows concentrate in field depressions, swales, gutters, curbs, or pipe collection systems, the travel times and downstream end of the development site between these design points shall be based upon Manning's Equation and/or acceptable engineering design standards as determined by the municipal engineer.
- F. In calculating Runoff after Development, those Areas covered by concrete lattice blocks on an appropriate base, porous pavement Areas on an appropriate base, and roof Areas which drain to properly designed and installed storage/groundwater infiltration beds, shall be considered adequate to infiltrate any increased Runoff from a 2-year storm for those Areas.
- 4. Floodplain Methodology. All submittals shall comply with the methodology set forth below:
 - A. The Developer shall delineate the existing and proposed 100-year Floodplains and Floodplain elevations on the Stormwater Management plan for all watercourses. When the drainage area to the watercourse is greater than 75 acres, the 100-year floodplain should be defined as described in Sections 301.4.C and 301.4.D. For watercourses with drainage areas less than 75 acres, the 100-year floodplain shall be defined as a zone extending 15 feet outward from the top of the bank(s) of the watercourse. In the event existing flood-prone areas or suspected flood-prone areas as a result of development where the drainage area to these locations is less than 75 acres, the Township may require the Developer to perform flood study.
 - B. The Developer may use 100-Year Floodplain and Floodplain elevations as mapped by FEMA as part of the National Flood Insurance Program for the Township as last revised where the following conditions are met:

- (1) FEMA 100-year flow values do not differ by more than 10% from flow values established by a study performed by an Engineer. Methods utilized to determine 100-Year Flood values for this study shall be based on the methods set forth in Section 401.4.C.
 - (2) Sufficient FEMA Floodplain cross-sections are located within and adjacent to the proposed Project Site, as determined by the Township Engineer.
- C. If the Floodplains are not mapped by FEMA as part of the National Flood Insurance Program, the horizontal and vertical limits of the Floodplains shall be determined utilizing the standard step method (i.e., HEC-RAS or similar Approved computer model). The Developer shall submit a computer disc containing all input files for the calculations to expedite the Floodplain review. The 100-year peak flow values used in the flood study should be calculated in accordance with calculation methodology described in Section 401.3 of this Ordinance. Where available, 100-year peak flow values from approved Act 167 plans should be used.
5. Design Standards for Infiltration Systems for Stormwater Management Plans.
- A. The Developer shall select Infiltration Structures based on suitability of soils, slope and depth to bedrock, depth to seasonal high water table, proximity to building foundations and wellheads, and site conditions. Measures may include porous pavement with underground infiltration beds, vegetated infiltration beds, swales and trenches, or other Infiltration Structures as proposed in the most recent edition of the Pennsylvania Handbook of Best Management Practices for Developing Areas and related references prepared by the EPA, the NRCS, DEP, or other guidance documents.
 - B. A detailed soils evaluation of the project site shall be performed to determine the suitability of infiltration BMPs. The evaluation shall be performed by a Geologist, and at a minimum, address soil permeability, depth to bedrock, susceptibility to sinkhole formation, 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 watershed to determine general areas of suitability for infiltration BMPs
 - (2) Provide field testing data to determine appropriate percolation rate and / or hydraulic conductivity
 - (3) Design infiltration BMPs for required stormwater volume based on

field-determined capacity at the level of the proposed infiltration surface

- C. The lowest elevation of the infiltration Area shall be at least 2 feet above the Seasonal High Water Table (SHWT) and bedrock, except in the case of carbonate geology formations, in which case the use of infiltration systems will be determined on a case-by-case basis. The Carroll Township Comprehensive Plan may be referenced for further information on carbonate geology.
- D. Roof drains shall discharge to infiltration systems, with appropriate measures, such as leaf traps and cleanouts, taken to prevent clogging by vegetation.
- E. All infiltration systems shall have appropriate positive overflow controls.
- F. All infiltration systems shall have a minimum setback of 20 feet from all residential Structures. The Developer shall prevent any seepage into sub-grade structures.
- G. All infiltration systems shall be designed to infiltrate the stored volume within 48 hours.
- H. All surface inflows shall be treated to prevent the direct discharge of sediment into the infiltration system. Site design should consider directing Runoff from pervious surfaces (i.e. landscaped Areas) away from Infiltration Structures to prevent clogging.
- I. The Developer shall employ special provisions when using infiltration BMPs in carbonate areas or mined areas to avoid groundwater contamination and solution channel/sinkhole formation.
 - (1) The Developer shall submit a detailed geological evaluation of the Project Site to determine the suitability of infiltration facilities, including the potential for groundwater contamination and sinkhole formation. The evaluation shall be conducted by a Geologist and at a minimum, address soil permeability, depth to bedrock, depth to bedrock, seasonal high water table, susceptibility for sinkhole formation, suitability of Stormwater Management Facilities, subgrade stability and maximum infiltration capacity in depth of water per unit area.
 - (2) In Carbonate Areas, BMPs that disperse Stormwater over the largest feasible Area should be used (e.g. subtle berms and level spreaders) so as not to significantly modify the natural hydrologic regime. Use of infiltration BMPs that result in significant

increases (more than a 100% increase) in the pre-Development rate of infiltration per unit Area should be avoided in carbonate Areas, unless a detailed geologic evaluation demonstrated that the potential for sinkhole formation is minimal.

- (3) Stormwater Runoff from significant pollutant producing sources (so called “hot spots” including but not limited to industrial uses, gas stations, fast food restaurants, other commercial uses generating large numbers of vehicle trips, and other uses at the determination of the Township) shall be filtered and/or pretreated using a water quality BMP before being discharged in Carbonate Areas.
- J. The Developer shall construct infiltration facilities at various locations throughout the Project Site to promote even distribution of infiltrated Runoff.
- K. The Developer shall construct all underground infiltration facilities in accordance with the following requirements:
- (1) The developer shall use the Townships standard infiltration pit detail, unless alternate designs are approved by the Township Engineer.
 - (2) The Developer shall use Geotextile fabric at all soil interfaces.
 - (3) A minimum of one foot of cover shall be maintained over all underground facilities.
 - (4) Underground infiltration facilities shall be constructed using AASHTO #1 stone.
 - (5) All piping shall be made of reinforced concrete or plastic.
 - (6) Piping within the infiltration area shall be perforated, with perforations to be located around the full circumference and the full length of the pipe within the infiltration pit.
 - (7) A PVC observation port, having a minimum diameter of 4 inches and connected to an open tee located at the bottom of the infiltration pit, shall be installed in the underground infiltration facility.
 - (8) A minimum distance of 20 feet shall be maintained from all existing or proposed wells both on the Project Site and off the Project Site.

- (9) A minimum distance of 20 feet shall be maintained from all existing and proposed on-lot sanitary sewer systems both on the Project Site and off the Project Site.
- (10) Infiltration facilities shall be constructed a minimum distance of 20 feet from all Structures and Streets, or street right of way.
- (11) Methods of excavation for infiltration facilities should be noted on the plans. Construction equipment shall not be allowed on the bottom of the infiltration facility.
- (12) The Developer shall provide a method of directing overflow from infiltration structures away from Structures and Streets and must safely bypass the 100-year storm event without flooding.

L. The Developer shall construct all above ground infiltration facilities in accordance with the following requirements:

- (1) The infiltration volume shall be stored to a depth of no more than 18 inches.
- (2) The Developer shall provide a method of directing overflow away from Structures and Streets and must safely convey the 100-year storm event without flooding.
- (3) A minimum distance of 100 feet shall be maintained from all existing or proposed wells both on the Project Site and off the Project Site.
- (4) A minimum distance of 20 feet shall be maintained from all existing and proposed on-lot sanitary sewer systems both on the Project Site and off the Project Site.
- (5) Infiltration facilities shall be constructed a minimum distance of 20 feet from all Structures and Streets or street right of way.

6. Design Standards for Water Carrying Facilities.

A. The Developer shall design all Storm Sewer Pipes, Culverts and Bridges (excluding Detention and Retention Basin outfall Structures) conveying water originating only from within the boundaries of the Project Site for a 25-year storm event without surcharging. All Structures shall be designed to convey the 100-Year Flood without roadway overtopping. Drainage Easements shall be provided to contain and convey the 100-year frequency

Flood throughout the Project Site. Easements shall begin at the furthest upstream property line of the proposed Development in a Watershed.

- B. Inlets shall be along the curb line and are not permitted along the curb radius at an intersection. Inlets shall be located to avoid conflicts with driveways and crosswalks. In no case shall inlets be spaced more than six hundred (600) feet apart and shall be designed in accordance with the *PennDOT Design Manual*. All inlets shall have concrete flow channels.
- C. Minimum floor elevations for all Structures that would be affected by a basin, other temporary impoundments, or open conveyance systems where ponding may occur shall be 2 feet above the 100-year water surface.
- D. A concentrated discharge of Stormwater to an adjacent property shall be contained within an existing Watercourse or the Developer shall obtain an Easement.
- E. All proposed stormwater pipe shall have a minimum diameter of fifteen (15") inches and maintain a minimum cover of two (2) feet in non-paved areas or one (1) foot below the pavement structure. Corrugated smooth lined polyethylene pipe is allowed with proper bedding. Class IV reinforced cement concrete pipe is also allowed. Corrugated metal pipe is not allowed. The Township, through its engineer, reserves the right to require design and installation of slotted storm pipe with geotechnical fabric, to act as a combination drain.
- F. Storm Sewer Pipes and Culverts shall be installed on sufficient slopes to provide a minimum velocity of 3 feet per second when flowing full.
- G. If pipes are less than forty-eight (48) inches in diameter, curves in pipes or box Culverts without an inlet or manhole are prohibited. Tee joints, elbows, and wyes are always prohibited.
- H. Manholes, inlets, headwalls and endwalls shall conform to the requirements of PennDOT Publication 408 in effect at the time the Developer submits the Stormwater Management plan.
- I. Concrete headwalls and endwalls shall be used where Stormwater Runoff enters or leaves the Storm Sewer horizontally from a natural or manmade Channel. Headwalls and endwalls more than 5' in height shall be designed by a professional engineer considering actual soil conditions and loadings, and in accordance with American Concrete Institute Specifications.
- J. Inlets shall be placed on both sides of the Street at low spots, at a maximum of 600 feet apart along a Storm Sewer Pipe or Culvert, at points

of abrupt changes in the horizontal or vertical directions of Storm Sewers, and at points where the flow in gutters exceeds 3 inches for the 25-year storm event. Inlets shall normally be along the curb line at, or beyond the curb radius points. For the purpose of inlet location at corners, the depth of flow shall be considered for each gutter. At intersections, the depth of flow across the through Streets (proposed and existing) shall not exceed 1 inch for the 25-year storm event. Inlets shall be depressed 2 inches below the Grade of the gutter or ground surface. Manholes may be substituted for inlets at locations where inlets are not required to handle surface Runoff. Inlets shall not be placed in Areas other than Streets and Parking Lots, unless otherwise Approved by the Township.

- K. Water carrying facilities, roof drains, and sump pump discharges shall not directly discharge water into a Street Right-of-Way or sanitary sewer.
- L. All existing and natural Watercourses, Channels, Drainage Systems and Areas of surface water concentration shall be maintained in their existing condition unless an alteration such as stream restoration is approved by the Township.
- M. Flow velocities from any Storm Sewer may not result in Erosion of the receiving channel.
- N. Energy dissipaters shall be placed at the outlets of all Storm Sewer Pipes, Culverts, Swales, and Bridges where flow velocities exceed maximum permitted Channel velocities, as specified below:
 - (1) 3 feet per second where only sparse vegetation can be established and maintained because of shade or soil Erosion.
 - (2) 4 feet per second where normal growing conditions exist and vegetation is to be established by seeding.
- O. Developer shall meet or exceed the following conditions for all Swales:
 - (1) Capacities and velocities shall be computed using the Manning equation. The minimum design parameters shall be as follows:
 - a. For vegetated Swales two design considerations shall be met:
 - (i) The first shall consider Channel velocity and stability based upon a low degree of retardance ("n" of .03);

- (ii) The second shall consider Channel capacity based upon a high degree of retardance (.05). All vegetated Swales shall have a minimum slope of 1% unless otherwise Approved by the Township.
 - b. The "n" factors to be used for paved or rip-rap Swales or gutters shall be based upon accepted engineering design practices as Approved by the Township Engineer.
 - (2) All Swales shall be designed to concentrate low flows to minimize siltation and meandering.
 - (3) Swales must be designed and constructed with a uniform slope to avoid ponding water within the swale. Swales designed or constructed at less than 1.5% slope may be required to include an underdrain at the swale bottom.
- P. The capacities of the pipes, inlets, culverts, outlet structures, and swales shall be designed to consider all possible hydraulic conditions.
- (1) Inlets, culverts and basin discharge systems shall be designed for the worst case condition. Inlet capacity shall be based on design standards provided by latest edition of the Pennsylvania Department of Transportation's *Design Manual, Part 2, Highway Design, Chapter 10*. If acceptable information is not available, inlets in non-ponding areas shall be designed for a maximum capacity of four (4) cubic feet per second. Stormwater conveyance facilities must be designed so that the hydraulic grade line of the system shows that no surcharging will exist.
- Q. Developer shall use the chart of Manning "n" values for design of closed conduits as included as Appendix C.
- R. Culvert, and Bridge materials shall be as concrete.
- S. All Storm Sewer crossings of Streets shall be perpendicular to the Street centerline.
- T. All Stormwater Structures inlets and outlets smaller than 48 inches equivalent diameter which convey Stormwater from residential Lots to a Street or from a Street to residential Lots shall extend from the Street Right-of-Way a minimum distance of 2/3 the length of the longest adjacent Lot dimension.

- U. Prior to dedication of any Areas for public use, the Developer shall submit record topographic surveys of all Drainage Easements and basins to all of the boundaries of their respective Easements.
 - V. Capacity Improvements – If the Developer can demonstrate that it would be feasible to provide capacity improvements to relieve the capacity deficiency in the existing drainage network, such adequate capacity improvements could be provided by the Developer in lieu of Stormwater Management facilities on the Project Site where Approved by the Township. Developer shall design all capacity improvements based on Development of all Areas tributary to the improvements and the capacity criteria specified in this Ordinance. The type and amount of Development that the Developer must consider shall be based on the current zoning. It shall be assumed that all new Development upstream of a proposed capacity improvement would implement applicable Stormwater Management techniques, consistent with this Ordinance.
 - W. All directly connected Pipes shall discharge to a Pipe of equal to, or larger cross sectional Area.
 - X. Stormwater Management Facilities not located within a public Right-of-Way shall be contained in and centered within an Easement.
 - Y. The Developer shall provide adequate Erosion protection along all open Channels and at all points of discharge.
 - Z. Driveways must be paved to full width within the road right-of-way, and maintain stormwater flow along the gutter or adjacent shoulder or swale.
 - AA. Storm sewer trench within 6’ of street pavement, or in existing or proposed pavement must be compacted to 98% S.S.D. in 12” lifts within 2% optimum moisture content per ASTM D-1557 and tested with a Nuclear Density Gauge.
 - AB. Vegetated swales (including temporary swales for erosion control purposes) may traverse Landscape Buffers, but shall not be located longitudinally within Landscape Buffers. Stormwater pipes and vegetated swales may traverse a Landscape Screen provided their direction can be varied within the Landscape Screen in order to not interrupt the visual separation of the Landscape Screen. Non-vegetated drainage swales, ditches, and channels shall not be located within Landscape Buffers or Screens.
7. Design Standards for Detention and Retention Basins.

A. The Developer shall design and install all permanent Detention and Retention Basins (where Approved) to meet or exceed the following standards:

- (1) The maximum water depth shall not exceed 6 feet.
- (2) The minimum top width of all berms shall be 8 feet.
- (3) Detention basins shall be designed with a minimum one (1') foot freeboard above the design elevation of the one hundred (100) year water surface at the emergency spillway.
- (4) The side slopes shall not be less than 3 horizontal to 1 vertical for nonresidential zones, and 4 horizontal to 1 vertical for residential zones.
- (5) All basins shall be structurally sound and shall be constructed of sound and durable materials. The completed Structure and the foundation of all basins shall be stable under all probable conditions of operation. The Developer shall provide an emergency spillway for the basin which shall be capable of discharging the 100-year peak rate of Runoff which enters the basin after Development in a manner which will not damage the integrity of the basin and will not create a downstream hazard. Spillways shall not be used for non-emergency operations. Where practical, the Developer shall construct the emergency spillway in undisturbed ground.
- (6) Stormwater Runoff from a basin shall flow directly into a natural Watercourse or into an existing Storm Sewer system, or onto adjacent properties in an Approved manner similar to the Runoff characteristics of pre-Development flow.
- (7) Normally dry, open-top storage facilities, designed as such, shall completely drain both the volume control and rate control capacities over a period of time not less than 24 hours and not more than 72 hours from the end of the design storm. However, any designed infiltration at such facilities is exempt from the minimum 24-hour standard, i.e., any infiltration facility is discharged directly into the surface waters of the commonwealth. (Inordinately rapid infiltration rates may indicate the presence of large fractures or other conditions for which an additional soil buffer may be required.)
- (8) The Developer shall provide a cutoff trench of impervious material within all basin embankments.

- (9) All Structures passing through basin embankments shall have properly spaced concrete cutoff collars and "O-ring" rubber gaskets.
- (10) All discharge control devices and piping with appurtenances shall be made of reinforced concrete and stainless steel.
- (11) Minimum slope within a basin shall be 1% positive Grade from the low flow Channel.
- (12) Low flow Channels shall be provided from each water carrying facility to the outlet Structure. Low flow Channels shall be 1% minimum slope.
- (13) The Developer shall incorporate standard outlet Structures into the basin design.
- (14) Design Storms for the computation of Detention Basin volumes shall be a duration sufficient to maximize the required volumes, up to a maximum 24-hour storm.
- (15) Design Storms for the computation of Retention Basins (where Approved) volumes shall be based upon a 24-hour storm.
- (16) Whenever a basin will be located in a Carbonate Area, a detailed geological evaluation of the proposed location shall be conducted to determine the suitability for recharge, including both the potential for groundwater contamination and potential for sinkhole formation. The evaluation shall be performed by a Geologist, and at a minimum, address soil permeability, depth to bedrock, susceptibility to sinkhole formation, suitability of Stormwater Management Facilities, and subgrade stability. The design and installation of all Stormwater Management Facilities over carbonate geology formations shall include measures to prevent ground water contamination and, where necessary, sinkhole formation. Soils used for the construction of basins shall have low-erodibility factors ("K factors"). The Township may require an impermeable liner to be installed up to the 100-year design water surface elevation.
- (17) The volume of Retention Basins shall be determined based upon an assumption of zero percolation.
- (18) Stormwater basins located in known sinkhole-prone areas must retain a minimum cover of four feet of undisturbed soil, in order to

help prevent migration of groundwater that would create sinkholes. If cover cannot be retained then the basin must be lined.

Discharge structures shall have stainless steel trash racks.

Basins that are not designed to release all storm water shall be specifically identified as retention basins or permanent pond basins. Unless specifically designed as a Best Management Practice basin, all other basins shall have provisions for de-watering, particularly the bottom, and shall not create swamp and/or any other condition that is not maintainable. Low flow channels shall be used to de-water the bottom of a basin. Discharge structures shall be designed to minimize the possibility of blockage during operation.

- (19) Stormwater shall not be discharged into sinkholes.
- (20) Basins shall not be located over any existing or proposed utility line.
- (21) The toe of slope for the exterior berm, or in the case of a berm excavated into the earth, the outside edge of the berm shall not be closer than 30 feet from existing or proposed Township or Private Right-of-Way.
- (22) Emergency spillways that discharge to or towards a public or private right-of-way shall be designed as grass, or interlocking concrete pavers.
- (23) Stormwater outfall structures and berms must be designed to be accessible to construction equipment via a path with a maximum slope of 20% and a level width of 8'.
- (24) Detention pond, swale bottom, and site elevations shall not be excavated lower than any wetland or natural watercourse.
- (25) The lowest elevation of detention ponds must be a minimum of 2 feet above the Seasonal High Water Table.
- (26) Provide a cross section through the berm showing outlet structure(s) set 3' below grade, orifice elevations, concrete cut-off collar(s), outfall pipe, endwalls, and water surface elevations for all design storms.
- (27) Detention pond berms constructed in a fill condition shall be compacted to 95% saturated surface dry condition per ASTM

D1557 within 2% of optimum moisture content. Compaction and moisture content shall be verified with use of a nuclear density gauge.

- (28) Pond outfall structures shall be reinforced concrete box with a Type M top unit, and precast staged orifices.
- (29) Impervious clay cores shall run the length of all berms in fill, and be keyed into existing grade.
- (30) Stormwater and basin outfall pipes and drainage structures shall not be located longitudinally within detention pond berms.
- (31) Outside berms of stormwater basins, tops of stormwater basin berms, and inside side slopes of stormwater basins may be located within Landscape Buffers and Screens provided the maximum depth of the basin from basin bottom to top of berm at any single point is limited to four (4) feet, and the maximum slope of the Landscape Buffer or Screen is not exceeded as required elsewhere by Ordinance, and the basin bottom is located outside of the Landscape Buffer or Screen. Temporary Basins and Traps for erosion control purposes shall not be located within Landscape Buffers or Screens.

- B. The Developer shall consider the effect on downstream Areas if the basin embankment fails in the design of all basins. Where possible, the basin shall be designed to minimize the potential damage caused by such failure of the embankment.
- C. All developments shall be designed to convey the post development one hundred (100) year peak flows through the site.
- D. All outlet Structures and emergency spillways shall include a satisfactory means of dissipating the energy of flow at its outlet to assure conveyance of flow without endangering the safety and integrity of the basin and the downstream drainage Area.
- E. All outlets discharging onto adjacent property owner's properties must have adjacent property owner's written permission.

8. Erosion and Sedimentation Control During Land Development

- A. Earth disturbances of 5,000 square feet of greater require design, implementation and maintenance of erosion and sediment control BMPs that control erosion and prevent sediment pollution during earth disturbance activities.

- B. The BMPs shall be identified on the plan, and a permit if applicable, as required by PADEP regulations at 25 Pa. Code Chapter 102.
 - C. The York County Conservation District is frequently delegated the authority to issue permits and other approvals by PADEP. Evidence of any necessary permits for the earth disturbance activities from the appropriate PADEP regional office, or the York County Conservation District, if delegated by DEP, must be provided to the Municipality.
 - D. A copy of the Erosion and Sediment Control plan and any required permit, under 25 Pa. Code Chapter 102, shall be available at the project site at all times.
 - E. All land disturbance facilities shall conform to the requirements of the Pennsylvania Department of Environmental Protection *Soil Erosion and Sedimentation Control Manual*. And must have an approved Erosion Control plan, (and NPDES permit for discharge of stormwater if necessary) prior to final plan approval.
9. Various Other Project Site Development Requirements.
- A. The Developer shall establish procedures for protecting soils or geologic Structures with water supply potential from contamination by surface water or other disruption by Construction activity in consultation with the Township and such Areas shall include, at minimum, those underlain by carbonate geology formations. The Township may require pollution control facilities to be provided on existing or proposed Stormwater Management systems within or adjacent to the Project Site.
 - B. The Developer shall implement provisions for protecting existing wells or other water supplies.
 - C. Graded slopes shall not be steeper than 3 horizontal units to 1 vertical unit.
 - D. The Developer shall obtain all approvals required for construction within steep slope areas prior to earthmoving or stripping of vegetation.
 - E. The Developer shall provide a minimum of 4 inches of topsoil on all disturbed Areas prior to final seeding and mulching.
 - F. The Developer shall retain and protect mature healthy trees of at least 6 inches DBH and other significant existing vegetation within the limits of earth disturbance, which shall be located in the field and on the Stormwater Management plan. Developer shall remove only such trees shall as provided on the Approved Stormwater Management plan. The

filling of soil over the roots of trees to be preserved is prohibited (roots are presumed to extend from the tree as far as the tree's branches extend outward). The Developer shall comply with all applicable Zoning Ordinance requirements.

- G. Easements shall be provided where storm water or surface water drainage facilities are existing or proposed, whether located within or beyond the boundaries of the property. Easements for maintenance of pipes and culverts shall run from outlet to inlet. Easements shall have a minimum width of twenty (20') feet and shall be adequately designed to provide area for (a) the collection and discharge of water, (b) the maintenance, repair, and reconstruction of the drainage facilities, and (c) the passage of machinery for such work. Easements shall include a description of an ownership and maintenance program in an appropriate form for recording with the York County Recorder of Deeds that clearly sets forth responsibility for all temporary and permanent storm water management facilities.
- H. In order to ensure the facilities will operate as designed, as-built plans prepared by a licensed surveyor are required. These shall show the topography of the basin, critical elevations, and locations of all stormwater facilities. If the as-built survey reveals that the plan was not constructed in accordance with the design, the developer's engineer may submit revised calculations showing the constructed facilities will comply with this Ordinance, or reconstruct the facilities to the original design specifications.

SECTION 402

STANDARDS DURING LAND DISTURBANCE

1. The Developer shall, during the period of Land Disturbance, when significant Sediment can be contained in Runoff, control Runoff prior and prevent Runoff from entering any proposed infiltration Area.
2. Peak discharges and discharge volumes from the Project Site shall comply with the appropriate sections above as well as with guidance provided by the Conservation District. In situations of special sensitivity, the Township Engineer may increase requirements, such as requiring that the entire volume of all storms up to a 2-year storm from the disturbed Areas be retained on site and that special sediment trapping facilities (including, but not limited to, check dams, etc.) be installed.
3. Construction standards of storm water management and erosion control facilities shall be in accordance with the approved Plans and accompanying Specifications. The construction details and standards of the following publications in their most recent revision shall control, or as modified by the Township Engineer.

- A. PennDOT, Form 408, Specifications.
- B. PennDOT, RC Series, Roadway Construction Standards

SECTION 403 RIPARIAN BUFFER AREA (RBA)

Areas immediately adjacent to the Township’s perennial streams, areas of springs, Watercourses, and Areas deemed by the Township to possess environmental value shall be defined as the Riparian Buffer Area (RBA). In the RBA, special requirements as set forth in this Section shall apply in order to maintain important natural functions. These RBA requirements are based on both the heightened sensitivity of the RBA and the potential to negatively impact the stream system when this RBA is disturbed, as well as the potential of this RBA to mitigate to the maximum extents the negative effects of Development in Areas adjacent to the stream system. The RBA shall include three sub-zones, Zones 1 through 3, extending landward from the top of the streambank where different requirements are imposed. These RBAs are to be established and protected, as defined below:

- 1. Area 1, a 15-foot setback zone, measured from the top of the bank of the Watercourse, where no disturbance of vegetation and soil except for restoration shall occur, in order to shade the stream with natural vegetation, to provide a source of numerous other organic inputs to the aquatic system, to anchor the streambank and Floodplain Area, and to consume and otherwise remove nitrogen, sediment, and other substances which can adversely affect stream systems.
- 2. Area 2, a managed buffer zone, extending a distance equal to 35 feet outward from Zone 1 or to the 100 year Floodplain boundary, whichever is larger, where disturbance of natural vegetative cover shall be limited to selective logging and other similar activities which minimally disrupt existing tree cover, and soil mantle, in order to maximize filtering and overall physical removal of particulate-form pollutants from Runoff generated upgradient and to promote subsurface vegetative uptake of nitrogen and other non-particulate elements from Stormwater generated upgradient.
- 3. Area 3, a zone of 50 feet extending outward from Area 2; Area 3 is defined in those cases where upslope Areas adjacent to the RBA are being disturbed during the Land Development process and where direct discharge of Stormwater would otherwise occur; Area 3 must include level spreading devices as necessary to ensure that any directly discharged Stormwater flows are properly distributed as sheet flow. Channelization and point source discharges are prohibited.
- 4. An RBA adjacent to “High Quality Waters” and “Exceptional Value Waters” designated by the DEP shall be subject to the provisions of the most recent edition of DEP *Special Protection Waters Implementation Handbook* and its amendments. To the extent that the Township and DEP requirements are not

consistent, the more restrictive requirements shall apply.

5. Subsurface utilities shall be allowed to cross the RBA, watercourses and wetlands provided the crossing is at or approximates a right angle or is otherwise situated to minimize the constructed length through the RBA, watercourse or wetland, and said utilities are installed using subsurface installation techniques (boring, directional drilling, etc.), both in order to minimize disruption to the soil mantle. Subsurface utilities shall not be installed longitudinally within the watercourse, Area 1 or Area 2.

For areas immediately adjacent to the Township's intermittent streams and wetlands, the RBA shall be defined as a zone extending 15 feet outward from the top of the bank(s) of the wetland. Within this Area, no disturbance of vegetation and soil except for the construction of roadway structures or conveyance systems in accordance with the design standards of this Ordinance and restoration shall occur. All discharges to this RBA shall be sheet flow.

SECTION 404 POST-CONSTRUCTION RUNOFF CONTROL REQUIREMENTS

1. No Regulated Earth Disturbance activities within the Municipality shall commence until approval by the Municipality of a plan which demonstrates compliance with State Water Quality Requirements after construction is complete.
2. The BMPs must be designed to protect and maintain existing uses (e.g., drinking water use; cold water fishery use) and maintain the level of water quality necessary to protect those uses in all streams, and to protect and maintain water quality in "Special Protection" streams, as required by statewide regulations at 25 Pa. Code Chapter 93 (collectively referred to herein as "State Water Quality Requirements").
3. To control post-construction stormwater impacts from Regulated Earth Disturbance activities, State Water Quality Requirements can be met by BMPs, including site design, which provide for replication of pre-construction stormwater infiltration and runoff conditions, so that postconstruction stormwater discharges do not degrade the physical, chemical or biological characteristics of the receiving waters. As described in the DEP Comprehensive Stormwater Management Policy (#392-0300-002, September 28, 2002), this may be achieved by the following:
 1. Infiltration: replication of pre-construction stormwater infiltration conditions,
 2. Treatment: use of water quality treatment BMPs to ensure filtering out of chemical and physical pollutants from the stormwater runoff, and

3. Streambank and Streambed Protection: management of volume and rate of postconstruction stormwater discharges to prevent physical degradation of receiving waters (e.g., from scouring and erosion).
4. DEP has regulations that require municipalities to ensure design, implementation and maintenance of Best Management Practices (“BMPs”) that control runoff from new development and redevelopment (hereinafter “development”) after Regulated Earth Disturbance activities are complete. These requirements include the need to implement post-construction stormwater BMPs with assurance of long-term operations and maintenance of those BMPs.

SECTION 405 STORMWATER MANAGEMENT FACILITIES FOR PENNSYLVANIA DEPARTMENT OF TRANSPORTATION AND TURNPIKE COMMISSION ROADWAYS AND ASSOCIATED FACILITIES

For the purposes of the Act 167 Stormwater Management (Plan) elements, contained within the York County Integrated Water Resources Plan, and this Ordinance, design policy pertaining to stormwater management facilities for Pennsylvania Department of Transportation (PennDOT) and Pennsylvania Turnpike Commission (PTC) roadways and associated facilities is provided in Section 13.7 (Antidegradation and Post Construction Stormwater Management Policy) of PennDOT Publication No. 13M, Design Manual Part 2 (August 2009), as developed, updated, and amended in consultation with the Pennsylvania Department of Environmental Resources (DEP). As stated in DM-2.13.7.D (Act 167 and Municipal Ordinances), PennDOT and PTC roadways and associated facilities shall be consistent with Act 167 Plans. Dm-2.13.7.B (Policy on Antidegradation and Post Construction Stormwater Management) was developed as a cooperative effort between PennDOT and DEP. DM-2.13.7.C (Project Categories) discusses the anticipated impact on the quality, volume, and rate of stormwater runoff.

Where standards in the Act 167 elements of the IWRP and this Ordinance are impractical, PennDOT or the PTC may request assistance from DEP, in consultation with the County, to develop an alternative strategy for meeting State water quality requirements and the goals and objectives of the Act 167 elements within the IWRP.