ORDINANCE NO. 243

BOROUGH OF AVONDALE
CHESTER COUNTY, PENNSYLVANIA

AN ORDINANCE AMENDING THE STORMWATER MANAGEMENT ORDINANCE.

The Council of the Borough of Avondale ("Borough"), Chester County, Pennsylvania, hereby ORDAINS that the Borough Stormwater Management Ordinance, Ordinance No. 216, as amended, is hereby further amended by replacing it entirely with the text appended hereto, which amendments shall be effective immediately.

Passed by Borough Council, this 28 day of January, 2014.

William D. Shore, Jr.
President, Borough Council

Approved by the Mayor, this 28 day of January, 2014.

Doris Howell
Mayor

Enacted, this 28 day of January, 2014.

BOROUGH OF AVONDALE

Rebecca Brownback
Borough Secretary

AVONDALE BOROUGH
STORMWATER MANAGEMENT ORDINANCE

ORDINANCE NO. 243 OF _____

AVONDALE BOROUGH, CHESTER COUNTY,

PENNSYLVANIA

Adopted at a Public Meeting held on

January 28, 2014

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ARTICLE I – GENERAL PROVISIONS

Section 101. Short Title

This Ordinance shall be known as the "Avondale Borough Stormwater Management Ordinance."

Section 102. Statement of Findings

The Borough Council of Avondale Borough finds that:

A. Inadequate management of accelerated stormwater runoff resulting from land disturbance and development throughout a watershed increases flooding, flows and velocities, contributes to erosion and sedimentation, overtaxes the capacity of streams and storm sewers, greatly increases the cost of public facilities to convey and manage stormwater, undermines floodplain management and flood reduction efforts in upstream and downstream communities, reduces infiltration and groundwater recharge, increases nonpoint source pollution to waterways, and threatens public health and safety.

B. Inadequate planning and management of stormwater runoff resulting from land disturbance and development throughout a watershed can 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 New Development, Redevelopment, and other Earth Disturbance Activities causing accelerated runoff and erosion and loss of natural infiltration, is fundamental to the public health, safety, and general welfare of the people of the Avondale Borough and all of the people of the Commonwealth, their resources, and the environment.

D. Stormwater is an important water resource that provides infiltration and groundwater recharge for water supplies and baseflow of streams, which also protects and maintains surface water quality.

E. Impacts from stormwater runoff can be minimized by reducing the volume of stormwater generated and by using project designs that maintain the natural hydrologic regime and sustain high water quality, infiltration, stream baseflow, and aquatic ecosystems. Cost-effective and environmentally sensitive stormwater management can be achieved through the use of nonstructural Site design techniques that minimize Impervious Surfaces, reduce disturbance of land and natural resources,

avoid sensitive areas (i.e., riparian buffers, floodplains, steep slopes, wetlands, etc.), and consider 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 Avondale Borough to implement a program of stormwater controls. The Borough is required to obtain a permit and comply with its provisions for stormwater discharges from its Separate Storm Sewer System under the National Pollutant Discharge Elimination System (NPDES).

H. Non-stormwater discharges to municipal or other storm sewer systems can contribute to pollution of the Waters of the Commonwealth.

Section 103. Purpose

The purpose of this Ordinance is to protect public health, safety and general welfare, property and water quality by 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 Borough:

A. Reduce the frequency and magnitude of flooding and stormwater impacts affecting people, property, infrastructure and public services.

B. Sustain or improve the natural hydrologic characteristics and water quality of groundwater and surface waters.

C. Protect natural resources, including riparian and aquatic living resources and habitats.

D. Maintain the natural hydrologic regime of Land Development Sites and their receiving watersheds.

E. Minimize land disturbance and protect and incorporate natural hydrologic features, drainage patterns, infiltration, and flow conditions within land development Site designs.

F. Reduce and minimize the volume of stormwater generated, and manage and release stormwater as close to the source of runoff as possible.

G. Provide infiltration and maintain natural groundwater recharge to protect groundwater supplies and stream baseflows, prevent degradation of surface water and groundwater quality, and to otherwise protect water resources.

H. Reduce stormwater pollutant loads to protect and improve the chemical, physical, and biological quality of ground and surface waters.

I. Reduce scour, erosion and sedimentation of stream channels.

J. Reduce flooding impacts and preserve and restore the natural flood-carrying capacity of streams and their floodplains.

K. Protect adjacent and downgradient lands from adverse impacts of direct stormwater discharges.

L. Minimize Impervious Surfaces and connected Impervious Surfaces to promote infiltration and reduce the volume and impacts of stormwater runoff.

M. Provide proper long-term operation and maintenance of all permanent stormwater management facilities, BMPs and Conveyances that are implemented within the Borough.

N. Reduce the impacts of runoff from existing developed land undergoing Redevelopment while encouraging New Development and Redevelopment in urban areas and areas designated for growth.

O. Implement an illicit discharge detection and elimination program that addresses non-stormwater discharges.

P. Provide performance standards and design criteria based on watershed-based stormwater management planning.

Q. Provide standards to meet certain NPDES stormwater permit requirements.

R. Meet legal water quality requirements under State law, including regulations at 25 PA Code Chapter 93, to protect, maintain, reclaim and restore the existing and designated uses of the Waters of the Commonwealth.

S. Implement the requirements of Total Maximum Daily Load (TMDLs) where applicable to waters within or impacted by the Borough

T. Provide review procedures and performance standards for stormwater planning and management.

U. Fulfill the purpose and requirements of PA Act 167 (PA Act 167, Section 3):

> *"(1) Encourage planning and management of storm water runoff in each watershed which is consistent with sound water and land use practices.*
>
> *(2) Authorize a comprehensive program of stormwater management designated to preserve and restore the flood carrying capacity of Commonwealth streams; to preserve to the maximum extent practicable natural storm water runoff regimes and natural course, current and cross-*

section of water of the Commonwealth; and to protect and conserve ground waters and ground-water recharge areas.

(3) Encourage local administration and management of storm water consistent with the Commonwealth's duty as trustee of natural resources and the people's constitutional right to the preservation of natural, economic, scenic, aesthetic, recreational and historic values of the environment."

Section 104. Statutory Authority

Avondale Borough 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, P.L. 864 (Act 167) 32 P.S., Section 680.1 et seq., as amended, the "Storm Water Management Act" (hereinafter referred to as "the Act");

B. Borough Code, 53 P.S. Section 46201 et seq.;

C. Act of July 31, 1968, P.L. 805, No. 247, 53 P.S. Section 10101, et seq., as amended, the Pennsylvania Municipalities Planning Code, Act 247 hereinafter referred to as the "MPC").

Section 105. Applicability

A. The following activities are regulated by this Ordinance:

1. All Regulated Activities as defined in this Ordinance including, but not limited to, New Development, Redevelopment, and Earth Disturbance Activities that are located within the Borough shall be subject to regulation by this Ordinance.

2. When a building and/or grading permit is required for any Regulated Activity on an existing parcel or approved lot created by a subdivision and/or improved as a land development project, issuance of the permit shall be conditioned upon adherence to the terms of this Ordinance.

3. This Ordinance contains the stormwater management performance standards and design criteria that are necessary from a watershed-based perspective. The Borough's stormwater management Conveyance and system 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 ordinance(s) and applicable State regulations, or as included in Section 311 of this Ordinance.

B. Duty of Persons Engaged in a Regulated Activity or the Alteration of Land

Notwithstanding any provision(s) of this Ordinance, including exemptions, any Landowner or any person engaged in a Regulated Activity, including, but not limited to the alteration or development of land, which may affect stormwater runoff characteristics, shall implement such measures as are reasonably necessary to prevent injury to health, safety and other property. Such measures shall include such actions as are required to manage the rate, volume, direction, and quality of resulting stormwater runoff in a manner which otherwise adequately protects health, property, and water quality of Waters of the Commonwealth.

C. Phased and Incremental Project Requirements

1. Any Regulated Activity (including but not limited to New Development, Redevelopment, or Earth Disturbance) that is to take place incrementally or in phases, or occurs in sequential projects on the same parcel or property, shall be subject to regulation by this Ordinance if the cumulative Proposed Impervious Surface or Earth Disturbance exceeds the corresponding threshold for exemption (as presented in Table 106.1 "Thresholds for Regulated Activities that are Exempt from the Provisions of this Ordinance as Listed Below").

2. The date of adoption of this Ordinance shall be the starting point from which to consider tracts as parent tracts relative to future subdivisions, and from which Impervious Surface and Earth Disturbance computations shall be cumulatively considered.

   For example:

   If, after adoption of this Ordinance, an Applicant proposes construction of an impervious improvement of one hundred (100) square foot, that project would be exempted from the requirements of this Ordinance as noted in Table 106.1. If, at a later date, an Applicant proposes to construct a two hundred (200) square foot addition on the same property, the Applicant would then be required to implement the stormwater management and plan submission requirements of this Ordinance for the cumulative total of three hundred (300) square feet of additional Impervious Surface added to the property since adoption of this Ordinance.

D. Applicability of Article VIII, Prohibitions.

The provisions of Article VIII, Prohibitions shall apply to all activities, persons, and properties within the Borough

Section 106. Exemptions and Modified Requirements

A. Requirements for Exempt Activities

1. An exemption from any requirement of this Ordinance shall not relieve the Applicant from implementing all other applicable requirements of this Ordinance or from implementing such measures as are necessary to protect public health, safety, and welfare, property and water quality.

2. An exemption shall not relieve the Applicant from complying with the requirements for State-designated special protection waters designated by PADEP as high quality (HQ) or exceptional value (EV) waters, or any other current or future State or municipal water quality protection requirements.

3. An exemption under this Ordinance shall not relieve the Applicant from complying with all other applicable municipal ordinances or regulations.

4. Does not concentrate runoff on adjacent properties.

5. Does not block, impede or divert the path of natural runoff in order to prevent accelerated erosion and protect the integrity of adjacent properties.

B. General Exemptions

Regulated Activities that:

1. Involve less than one hundred-fifty (150) square feet of Proposed Impervious Surfaces AND less than five hundred (500) square feet of Earth Disturbance; or

2. Are listed in Subsection 106.C, are exempt from those (and only those) requirements of this Ordinance that are included in the sections and articles listed in Table 106.1. Exemptions are for the items noted in Table 106.1 only, and shall not relieve the Landowner from other applicable requirements of this Ordinance. Exemption shall not relieve the Applicant from implementing such measures as are necessary to protect health, safety, and welfare, property, and water quality.

TABLE 106.1
Thresholds for Regulated Activities that are Exempt from the Provisions of this Ordinance as Listed Below (see Notes below)

	Not Exempt	Not Exempt	Not Exempt
	Not Exempt	Not Exempt	Not Exempt
	Not Exempt	Not Exempt	Not Exempt
	Exempt	Exempt	Not Exempt
	Exempt	Exempt	Not Exempt
	Exempt	Exempt	Not Exempt
	Exempt	Exempt	Not Exempt
	Exempt	Exempt	Not Exempt
	Not Exempt	Not Exempt	Not Exempt
	Not Exempt	Not Exempt	Not Exempt
	Must comply with Title 25, Chapter 102 of the PA Code and other applicable State and municipal codes, including the Clean Streams Law.		

Table 106.1 Notes:

- Specific activities listed in Subsection 106.C are exempt from the indicated requirements, regardless of size.
- A proposed Regulated Activity must be less than BOTH the Proposed Impervious Surfaces and proposed Earth Disturbance thresholds to be eligible for exemption from the requirements listed in this table.
- "Proposed Impervious Surface" - as defined in this Ordinance.
- "Exempt" – Regulated Activities are exempt from the requirements of listed section(s) only; all other provisions of this Ordinance apply.

C. Exemptions for Specific Activities

The following specific Regulated Activities are exempt from the requirements of Sections 301, 304, 305, 306, 307, 308, 309, and 310, and Article IV, Article V, Article VI and Article VII) of this Ordinance (as shown in Table 106.1), unless otherwise noted below. All other conveyance and system design standards established by the Borough in other codes or ordinances shall be required, and all other provisions of this Ordinance shall apply.

1. Emergency Exemption - Emergency maintenance work performed for the protection of public health, safety and welfare. This exemption is limited to repair of the existing facility; upgrades, additions or other improvements are not exempt. A written description of the scope and extent of any emergency work performed shall be submitted to the Borough within two (2) calendar days of the commencement of the activity. A detailed plan shall be submitted no later than thirty (30) days following commencement of the activity. If the Borough finds that the work is not an emergency, then the work shall cease immediately and the requirements of this Ordinance shall be addressed as applicable.

2. Maintenance - Any maintenance to an existing stormwater management system, facility, BMP or Conveyance made in accordance with plans and specifications approved by the Municipal Engineer or Avondale Borough.

3. Existing Landscaping - Use of land for maintenance, replacement or enhancement of existing landscaping.

4. Gardening - Use of land for gardening for home consumption.

5. Agricultural Related Activities –

   a. Agricultural Activities (as defined in Article II), when performed in accordance with the requirements of 25 PA Code Chapter 102.

   b. Conservation Practices (as defined in Article II) that do not involve construction of any new or expanded Impervious Surfaces.

6. Forest Management - Forest management operations, which are consistent with a sound forest management plan as filed with the Borough and which comply with the Pennsylvania Department of Environmental Protection's management practices contained in its publication "Soil Erosion and Sedimentation Control Guidelines for Forestry" (as amended or replaced by subsequent guidance). Such operations are required to have an Erosion and Sedimentation Control Plan, which meets the requirements of 25 PA Code Chapter 102 and meets the erosion and sediment control standards of Section 303 of this Ordinance.

7. Maintenance of Existing Paved Surfaces - Replacement of existing paved surfaces shall meet the erosion and sediment control requirements of 25 PA Code Chapter 102 and Section 303 of this Ordinance, and is exempt from all other requirements of this Ordinance listed in Subsection 106.C above. Resurfacing of existing paved surfaces is exempt from the requirements of this Ordinance listed above. Construction of new or additional Impervious Surfaces shall comply with all requirements of this Ordinance as indicated in Table 106.1.

8. Municipal Roadway Shoulder Improvements - Shoulder improvements conducted within the existing roadway cross-section of municipal owned roadways, unless an NPDES permit is required, in which case the proposed work must comply with all requirements of this Ordinance.

9. In-Place Replacement of Residential Dwelling Unit - The replacement in the exact footprint of an existing one- or two-family dwelling unit.

10. In-Place Replacement, Repair, or Maintenance of Residential Impervious Surfaces - The replacement of existing residential patios, decks, driveways, pools, garages, and/or sidewalks that are accessory to an existing one- or two-family dwelling unit in the exact footprint of the existing Impervious Surface.

D. Modified Requirements for Small Projects

Regulated Activities that involve more than one hundred-fifty (150) square feet but less than five hundred (500) square feet of Proposed Impervious Surfaces and less than one thousand (1,000) square feet of proposed Earth Disturbance may apply the modified requirements presented in the "Simplified Approach to Stormwater Management for Small Projects" (Simplified Approach) (Appendix A) to comply with the requirements of Sections 301, 304, 305, 306, 307, 308, 309, and 310, and Article IV, Article V, Article VI and Article VII of this Ordinance (as shown in Table 106.2). The Applicant shall first contact the Municipal Engineer: to confirm that the proposed project is eligible for use of the Simplified Approach and is not otherwise exempt from these Ordinance provisions; to determine what components of the proposed project are to be considered as Impervious Surfaces; and to determine if other known Site or local conditions exist that may preclude the use of any techniques included in the Simplified Approach. Appendix A includes instructions and procedures for preparation, submittal, review and approval of documents required when using the Simplified Approach and shall be adhered to by the Applicant. All other provisions of this Ordinance shall apply.

TABLE 106.2
Thresholds for Regulated Activities that are Eligible for "Modified" Requirements for the Provisions of this Ordinance that are Listed Below

	All Provisions Apply
	All Provisions Apply
	All Provisions Apply
	Exempt if Modified Requirements of Subsection(s) 106.D and E are Applied
	Exempt if Modified Requirements of Subsection(s) 106.D and E are Applied
	Exempt if Modified Requirements of Subsection(s) 106.D and E are Applied
	Exempt if Modified Requirements of Subsection(s) 106.D and E are Applied
	Exempt if Modified Requirements of Subsection(s) 106.D and E are Applied
	All Provisions Apply
	All Provisions Apply
	Must comply with Title 25, Chapter 102 of the PA Code and other applicable State and municipal codes, including the Clean Streams Law.

Table 106.2 Notes:

- "Modified Requirements" – Regulated Activities listed within the Subsections of this Ordinance noted in Table 106.2 are eligible for exemption only from the indicated sections and subsections of this Ordinance and only if the modified requirements of [Subsections 106.D and E are met to the satisfaction of the Borough; all other provisions of this Ordinance apply.

E. Modified Requirements for Agricultural Structures

It is the declared policy of the Commonwealth to conserve and protect and to encourage the development and improvement of its agricultural lands for the production of food and other agricultural products. Municipalities must encourage the continuity, development and viability of agricultural operations within its jurisdiction.

Except as necessary to protect the public health, safety and welfare, Regulated Activities involving proposed new or expanded Impervious Surfaces associated with Agricultural Activities are exempt from the requirements of Sections 301, 304, 305, 306, 307, 308, 309, and 310, and Article IV, Article V, Article VI and Article VII of this Ordinance (and listed in Table 106.2) only when it has been demonstrated to the satisfaction of the Borough that the proposed project will comply with all of the requirements listed below. The property owner/applicant must submit a Drainage and Grading Permit Application with all necessary supporting plans for review to determine eligibility for an exemption. All other provisions of this Ordinance shall apply. To be eligible for exemption from the Ordinance provisions stated above, the proposed Regulated Activity shall:

1. Be directly associated with an Agricultural Activity (as defined in Article II);
2. Include less than ten thousand (10,000) square feet of proposed new or expanded Impervious Surface (excluding adjoining vehicle parking and movement areas) and not more than an additional five thousand (5,000) square feet of adjoining vehicle parking and movement area;
3. Be installed on a farm or mushroom operation that has a current Mushroom Farm Environmental Management Plan (MFEMP) reviewed and deemed adequate by the Conservation District, or an Agricultural Erosion and Sediment Control Plan or Conservation Plan (as defined in Article II) that complies with the requirements of 25 PA Code 102;
4. Divert runoff from the proposed new or expanded Impervious Surfaces (including vehicle parking and movement area) entirely away from animal management, waste management and crop farming areas and any other source of pollutants;
5. Include BMP(s) that will permanently retain at least one (1) inch of rainfall runoff from the total area of proposed new or expanded Impervious Surfaces and vehicle parking and movement areas;
6. Be designed so that any point of discharge of runoff from the proposed new or expanded Impervious Surface (excluding vehicle movement area):
    a. Is not directly connected to, and is not directly connected to any constructed Conveyance that is connected to, a municipal Separate Storm Sewer System or public roadway;
    b. Is located at least one hundred fifty (150) feet from any municipal Separate Storm Sewer System or public roadway, or any constructed Conveyance connected to any municipal Separate Storm Sewer System or public roadway.
7. Either:
    a. Have all proposed new or expanded Impervious Surfaces and proposed vehicle parking and movement areas and BMP(s) included within the current MFEMP or current Agricultural Erosion and Sediment Control Plan or a Conservation Plan for the farm or mushroom operation;

        OR

    b. Be constructed per design plans prepared and sealed by a Licensed Professional in conformance with the PADEP "Best Practices for

Environmental Protection in the Mushroom Farm Community" (2003 or as amended), or per design plans prepared and sealed by a Licensed Professional (or Conservation District staff person designated by NRCS) that comply with USDA NRCS standards and specifications, and for which completion of construction will be certified by the Licensed (or NRCS-designated design) Professional responsible for the design; and

8. Not be eligible for exemption if an NPDES permit is required."

Section 107. Repealer

Any ordinance or ordinance provision of the Borough inconsistent with any of the provisions of this Ordinance are hereby repealed to the extent of the inconsistency only.

Section 108. Severability

If any sentence, clause, section or part of this Ordinance is for any reason found to be unconstitutional, illegal or invalid, such unconstitutionality, illegality or invalidity shall not affect or impair any of the remaining provisions, sentences, clauses, sections or parts of this Ordinance. It is hereby declared the intent of the Borough Council of the Borough that this Ordinance would have been adopted had such unconstitutional, illegal or invalid provision, sentence, clause, section or part thereof not been included herein.

Section 109. Compatibility with Other Ordinances or Legal Requirements

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

B. To the extent that this Ordinance imposes more rigorous or stringent requirements for stormwater management than any other code, rule, act, law, regulation or ordinance, the specific requirements contained in this Ordinance shall take precedence.

C. Nothing in this Ordinance shall be construed to affect any of the Borough'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.). The requirements of this Ordinance shall supersede any conflicting requirements in other municipal ordinances or regulations.

Section 110. Financial Security

For all activities requiring submittal of a Stormwater Management (SWM) Site Plan that involve subdivision or land development, the Applicant shall post financial security to the Borough for the timely installation and proper construction of all stormwater management facilities as required by the approved SWM Site Plan and this Ordinance, and such financial security shall:

A. Be equal to or greater than the full construction cost of the required facilities except to the extent that financial security for the cost of any of such improvements is required to be and is posted with the Pennsylvania Department of Transportation in connection with a highway occupancy permit application;

   AND

B. Be determined, collected, applied and enforced in accordance with Sections 509-511 of the MPC and the provisions of the Borough's Subdivision and Land Development Ordinance (SALDO).

Section 111. Waivers

A. General
   The requirements of this Ordinance are essential and shall be strictly adhered to. For any Regulated Activity where, after a close evaluation of alternative Site designs, it proves to be impracticable to meet any one or more of the mandatory minimum standards of this Ordinance on the Site, the Borough may approve measures other than those in this Ordinance, subject to Subsections 111.B and 111.C.

B. The Borough Council shall have the authority to waive or modify the requirements of one or more provisions of this Ordinance if the literal enforcement will exact undue hardship because of peculiar conditions pertaining to the land in question, provided that such modification will not be contrary to the public interest and that the purpose and intent of the Ordinance is observed. Cost or financial burden shall not be considered a hardship. Modification may also be considered if an alternative standard or approach can be demonstrated to provide equal or better achievement of the results intended by the Ordinance. A request for modification shall be in writing and accompany the SWM Site Plan submission. The request shall state in full the grounds and facts on which the request is based, the provision or provisions of the Ordinance involved and the minimum modification necessary.

C. PADEP Approval Required

   For any proposed Regulated Activity involving Earth Disturbance equal to or greater than one (1) acre, the Borough may approve measures for minimum volume and infiltration control other than those required in this Ordinance only after consultation with and evaluation by PADEP that the alternate Site design meets State water quality

requirements and does not conflict with State law, including, but not limited to, the PA Clean Streams Law, 35 P.S. Section 691.1, et seq.

Section 112. 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.

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, partnership, public or private association or corporation, firm, trust, estate, Avondale Borough, governmental unit, public utility or any other legal entity whatsoever which is recognized by law as the subject of rights and duties. Whenever used in any section prescribing or imposing a penalty, the term "person" shall include the members of a partnership, the officers, members, servants and agents of an association, officers, agents and servants of a corporation, and the officers of Avondale Borough.

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."

F. The definitions in this Ordinance are for the purposes of enforcing the provisions of this Ordinance and have no bearing on other municipal regulations or ordinances.

Section 202. Definitions (Terms noted by an (*) may not be deleted and the definition may not be amended without written approval from the Pennsylvania Department of Environmental Protection)

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

Applicant – A Landowner, developer, or other person who has filed an application to the Borough for approval to engage in any Regulated Activity as defined in this Ordinance.

As-Built Plans (Drawings) – Engineering or Site plans or drawings that document the actual locations, dimensions and elevations of the improvements, and building components, and changes made to the original design plans. The final version of these documents, or a copy of same, are signed and sealed by a qualified Licensed Professional and submitted to the Borough at the completion of the project, as per the requirements of Section 502 of this Ordinance as "final As-Built Plans".

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.

BMP (Best Management Practice) – Activities, facilities, designs, measures, or procedures used to manage stormwater impacts from Regulated Activities, to provide water quality treatment, infiltration, volume reduction, and/or peak rate control, to promote groundwater recharge, and to otherwise meet the purposes of this Ordinance. Stormwater BMPs are commonly grouped into one (1) of two (2) broad categories or measures: "structural" or "nonstructural." In this Ordinance, nonstructural BMPs or measures refer to operational and/or behavior-related practices that attempt to minimize the contact of pollutants with stormwater runoff whereas structural BMPs or measures are those that consist of a physical device or practice that is installed to capture and treat stormwater runoff. Structural BMPs include, but are not limited to, a wide variety of practices and devices from large-scale retention ponds and constructed wetlands to small-scale underground treatment systems, infiltration facilities, filter strips, low impact design, bioretention, wet ponds, permeable paving, grassed swales, riparian or forested buffers, sand filters, detention basins, and manufactured devices. Structural stormwater BMPs are permanent appurtenances to the Site.

Borough Engineer – A professional engineer licensed as such in the Commonwealth of Pennsylvania, duly appointed as the engineer for the Borough..

Borough – Avondale Borough, Chester County, Pennsylvania.

Buffer – See Riparian Buffer.

Carbonate Geology (or carbonate rock formations) – See Karst.

CFS – Cubic Feet per Second.

Channel – A natural or artificial open drainage feature that conveys, continuously or periodically, flowing water and 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.

CN – Curve number.

Commonwealth – Commonwealth of Pennsylvania.

Conservation District – The Chester County Conservation District.

Conservation Plan (*) – A plan written by a planner certified by NRCS that identifies Conservation Practices and includes site specific BMPs for agricultural plowing or tilling activities and animal heavy use areas.

Conservation Practices (*) – Practices installed on agricultural lands to improve farmland, soil and/or water quality which have been identified in a current Conservation Plan.

Conveyance – A natural or manmade, existing or proposed 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.

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

Detention (or To Detain) – Capture and temporary storage of runoff in a stormwater management facility for release at a controlled rate.

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 shortly after any given rainfall event.

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

Developer – A person who seeks to undertake any Regulated Activities at a Site in the Borough.

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

Disturbed Area (*) – Land area disturbed by or where an Earth Disturbance Activity is occurring or has occurred.

Drainage Area - That land area contributing runoff to a single point (including but not limited to the point/line of interest used for hydrologic and hydraulic calculations) and that is enclosed by a natural or man-made ridge line.

Earth Disturbance (or 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; land development; building construction; and the moving, depositing, stockpiling, or storing of soil, rock, or earth materials.

Easement – A right of use granted by a Landowner to allow a grantee the use of the designated portion of land for a specified purpose, such as for stormwater management or other drainage purposes.

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

Erosion and Sediment Control Plan – A plan required by the Conservation District or the Borough to minimize accelerated erosion and sedimentation, and that must be prepared and approved per the applicable requirements.

FEMA – Federal Emergency Management Agency.

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 delineated by applicable FEMA maps and studies as being a Special Flood Hazard Area.

Floodway - The channel of the watercourse and those portions of the adjoining floodplains that are reasonably required to carry and discharge the one hundred (100)-year 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 one hundred (100)-year floodway, it is assumed, absent evidence to the contrary, that the floodway extends from the centerline of the stream and to fifty (50) feet beyond the top of the bank of the stream on both sides.

Forest Management/Timber Operations – Planning and activities necessary for the management of forest lands. These include timber inventory, preparation of forest management plans, silvicultural treatment, cutting budgets, logging road design and construction, timber harvesting, Site preparation, and reforestation.

Freeboard – A vertical distance between the design high-water elevation and the elevation of 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.

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.

Governing Body - The Borough Council of Avondale Borough.

Grade/Grading – 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.

Groundwater – Water that occurs in the subsurface and fills or saturates the porous openings, fractures and fissures of under-ground soils and rock units.

Groundwater Recharge – The replenishment of existing natural groundwater supplies from infiltration of rain or overland flow.

HEC-1 – The U.S. Army Corps of Engineers, Hydrologic Engineering Center (HEC) hydrologic runoff model.

HEC-HMS – The U.S. Army Corps of Engineers, Hydrologic Engineering Center (HEC) - Hydrologic Modeling System (HMS).

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

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

Hydrologic Soil Group (HSG) – A classification of soils by the Natural Resources Conservation Service (NRCS), into four (4) 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 has been compacted or covered with a layer of material so that it prevents or is resistant to infiltration of water, including but not limited to: structures such as roofs, buildings, storage sheds; other solid, paved or concrete areas such as streets, driveways, sidewalks, parking lots, patios, tennis or other paved courts; or athletic playfields comprised of synthetic turf materials. For the purposes of determining compliance with this Ordinance, compacted soils or stone surfaces used for vehicle parking and movement shall be considered impervious. Surfaces that were designed to allow infiltration (i.e. areas of porous pavement), decks and swimming pools will be considered on a case-by-case basis by the Municipal Engineer, based on appropriate documentation and condition of the material, etc.

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 Facility – A stormwater BMP designed to collect and discharge runoff into the subsurface in a manner that allows infiltration into underlying soils and groundwater (e.g., French drains, seepage pits, or seepage trenches, etc.).

Intermittent Stream – A defined channel in which surface water is absent during a portion of the year, in response to seasonal variations in precipitation or groundwater discharge.

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

Karst – A type of topography that is formed over limestone or other carbonate rock formations by dissolving or solution of the rock by water, and that is characterized by closed depressions, sinkholes, caves, a subsurface network of solution conduits and fissures through which groundwater moves, and no perennial surface drainage features.

Land Development – Any of the following activities:

A. The improvement of one (1) lot or two (2) or more contiguous lots, tracts, or parcels of land for any purpose involving:
   1. 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
   2. 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;
B. A subdivision of land;
C. Development in accordance with Section 503(1.1) of the Pennsylvania Municipalities Planning Code (as amended).

Landowner – The legal or beneficial owner or owners of land including the holder of an option or contract to purchase (whether or not such option or contract is subject to any condition), a lessee if they are authorized under the lease to exercise the rights of the Landowner, or other person having a proprietary interest in the land.

Licensed Professional – A Pennsylvania Registered Professional Engineer, Registered Landscape Architect, Registered Professional Land Surveyor, or Registered Professional Geologist, or any person licensed by the Pennsylvania Department of State or qualified by law to perform the work required by the Ordinance within the Commonwealth of Pennsylvania.

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

A. A seasonal high water table, whether perched or regional, determined by direct observation of the water table or indicated by other subsurface or soil conditions.
B. 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.
C. A rock formation, other stratum, or soil condition that is so slowly permeable that it effectively limits downward passage of water.

MPC - Act of July 31, 1968, P.L. 805, No. 247, 53 P.S. Section 10101, et seq., as amended, the Pennsylvania Municipalities Planning Code, Act 247.

MFEMP – Mushroom Farm Environmental Management Plan.

MS4 - Municipal Separate Storm Sewer System.

Maintenance - The action taken to restore or preserve the as-built functional design of any facility or system.

NOAA - National Oceanic and Atmospheric Administration.

New Development (*) – Any Regulated Activity involving placement or construction of new Impervious Surface or grading over existing pervious land areas not classified as Redevelopment as defined in this Ordinance.

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

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

Nonstructural Best Management Practice (BMPs) – See Best Management Practice (BMP).

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

NRCS – Natural Resource Conservation Service (previously Soil Conservation Service, SCS), an agency of the U.S. Department of Agriculture.

PADEP – Pennsylvania Department of Environmental Protection.

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

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

PennDOT – Pennsylvania Department of Transportation.

Pennsylvania Stormwater Best Management Practices Manual (PADEP BMP Manual) - Document Number 363-0300-002 (December 2006, and as subsequently amended).

Pervious Surface (or Pervious Area) (*)– Any area not defined as Impervious Surface.

Planning Committee – The Planning Committee of the Borough.

Point Source – Any discernible, confined, and discrete Conveyance including, but not limited to, any pipe, ditch, channel, tunnel, or conduit from which stormwater is or may be discharged, as defined in State regulations at 25 Pennsylvania Code § 92.a.

Post-construction (*) – Period after construction during which Disturbed Areas are stabilized, stormwater controls are in place and functioning, and all proposed improvements approved by the Avondale Borough are completed.

Predevelopment(*) – Land cover conditions assumed to exist within the proposed Disturbed Area prior to commencement of the Regulated Activity for the purpose of calculating the Predevelopment water quality volume, infiltration volume, and peak flow rates as required in this Ordinance.

Pretreatment – Techniques employed in stormwater BMPs to provide storage or filtering, or other methods to trap or remove coarse materials and other pollutants before they enter the stormwater system, but may not necessarily be designed to meet the entire water quality volume requirements of this Ordinance.

Proposed Impervious Surface (*) - All new, additional and replacement Impervious Surfaces.

Rainfall Intensity - The depth of accumulated rainfall per unit of time.

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

Redevelopment(*) - Any Regulated Activity that involves demolition, removal, reconstruction, or replacement of existing Impervious Surface(s).

Regulated Activity(*)- Any Earth Disturbance Activity(ies) or any activity that involves the alteration or development of land in a manner that may affect stormwater runoff.

Regulated Earth Disturbance Activity(*) – Any activity involving Earth Disturbance subject to regulation under 25 Pennsylvania Code Chapter 92.a, Chapter 102, or the Clean Streams Law.

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

Retention Basin – An impoundment that is designed to temporarily detain a certain amount of stormwater from a catchment area and which may be designed to permanently retain stormwater runoff from the catchment area; retention basins always contain water.

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

Return Period - The average interval, in years, within which a storm event of a given magnitude can be expected to occur one (1) time. For example, the twenty-five (25)-year return period rainfall would be expected to occur on average once every twenty-five (25) years; or stated in another way, the probability of a twenty-five (25)-year storm occurring in any one (1) year is four-one hundredths (0.04) (i.e., a four (4)% chance).

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 vegetation to protect the integrity of stream channels and shorelines, to reduce the impact of upland sources of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals, and to supply food, cover and thermal protection to fish and other aquatic species and wildlife.

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

SALDO – See Subdivision and Land Development Ordinance.

SCS – Soil Conservation Service, now known as the Natural Resources Conservation Service.

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

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

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

Site – Total area of land in the Avondale Borough where any proposed Regulated Activity, as defined in this Ordinance, is planned, conducted, or maintained or that is otherwise impacted by the Regulated Activity.

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).

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.

Storm Frequency – (see Return Period).

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

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

Stormwater Management (SWM) Site Plan – The plan prepared by the Applicant or its representative, in accordance with the requirements of Article IV of this Ordinance, indicating how stormwater runoff will be managed at a particular Site in accordance with this Ordinance, and including all necessary design drawings, calculations, supporting text, and documentation to demonstrate that Ordinance requirements have been met, herein referred to as "SWM Site Plan." All references in this Ordinance to "final" or "approved" SWM Site Plans shall incorporate the approved SWM Site Plan and all subsequent approved revisions thereto.

Stream – A natural watercourse.

Structure – See Impervious Surface

Structural Stormwater Management Practices - See BMP (Best Management Practices).

Subdivision - The division or re-division of a lot, tract, or parcel of land as defined in The Pennsylvania Municipalities Planning Code, Act of July 31, 1968, P.L. 805, No. 247 (as amended).

Subdivision and Land Development Ordinance – Subdivision and Land Development ordinance of Avondale Borough, Chester County, PA, as amended.

Swale – An artificial or natural waterway or low-lying stretch of land that gathers and conveys stormwater or runoff, and is generally vegetated for soil stabilization, stormwater pollutant removal, and infiltration.

SWM Site Plan – See Stormwater Management Site Plan.

Timber Operations – See Forest Management.

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

USDA – United States Department of Agriculture.

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

Water Table – The upper most level of saturation of pore space or fractures by groundwater. Seasonal High Water Table refers to a water table that rises and falls with the seasons due either to natural or man-made causes.

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.

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(*)- Any land area of at least one-quarter (0.25) acre with a natural or naturalized ground cover (excluding manicured turf grass) and that has an average density of two (2) or more viable trees per one thousand five hundred (1,500) square feet with a DBH of six (6) inches or greater ***and where such trees existed at any time within three (3) years of the time of land development application submission of the proposed project.*** The land area to be considered Woods shall be measured from the outer drip lines of the outer trees.

ARTICLE III – STORMWATER MANAGEMENT STANDARDS

Section 301. General Requirements

A. Applicants proposing Regulated Activities in the Avondale Borough which are not exempt under Section 106 shall submit a Stormwater Management Site Plan (SWM Site Plan) to the Avondale Borough for review and approval in accordance with Articles III and IV. SWM Site Plans approved by the Avondale Borough shall be on Site throughout the duration of the Regulated Activity.

B. The stormwater management and runoff control criteria and standards in this Ordinance shall apply to the total proposed Regulated Activity, even if it is to take place in stages. The measurement of Impervious Surfaces shall include all of the Impervious Surfaces in the total proposed Regulated Activity even if the development is to take place in stages.

C. No Regulated Activity within the Avondale Borough shall commence until:

   1. The Avondale Borough issues approval of a SWM Site Plan, which demonstrates compliance with the requirements of this Ordinance; and

   2. The Applicant has received a letter of adequacy or approval for the Erosion and Sediment Control Plan review by the Avondale Borough and the Conservation District (if required), and has received all other local, State and Federal permit approvals required for the project involving the Regulated Activity.

D. Neither submission of an SWM Site Plan under the provisions herein nor compliance with the provisions of this Ordinance shall relieve any person from responsibility for damage to any person or property otherwise imposed by law.

E. The Applicant shall design the Site to minimize disturbances to land, Site hydrology, and natural resources, and to maintain the natural hydrologic regime, drainage patterns and flow conditions. The Applicant shall apply the procedures set forth in Section 304 for the overall Site design and for selection, location and design of features and BMPs to be used to comply with the requirements of this Ordinance.

F. To the maximum extent practicable, Post-construction stormwater shall be discharged within the drainage area of the same stream or water body receiving the runoff prior to construction of the proposed Regulated Activity.

G. Existing drainage peak rate discharges up to and including the one hundred (100)-year storm onto or through adjacent property(ies) or downgradient property(ies), including diffuse drainage discharge, from a Regulated Activity, shall not be altered in any manner without written permission from, and, where applicable as determined by the Avondale Borough an easement and agreement with, the affected

Landowner(s) for conveyance of discharges onto or through their property(ies). Such discharge shall be subject to any applicable discharge criteria specified in this Ordinance. Stormwater runoff shall discharge to a suitable natural watercourse (except where prohibited by a riparian buffer as defined in this Ordinance) or storm sewer system.

1. For Regulated Activities with less than one thousand (1,000) square feet of proposed Earth Disturbance AND less than five hundred (500) square feet of Proposed Impervious Surfaces, the Applicant shall provide written notification to the affected Landowner(s) describing the proposed Regulated Activity and proposed discharge(s), unless otherwise required by the Avondale Borough.

H. Areas located outside of the Site (i.e., areas outside of the Regulated Activity) that drain through a proposed Site are not subject to water quality and volume control, infiltration, stream channel protection, or peak flow rate control requirements (as presented in Sections 305, 306, 307, and 308). Drainage facilities located on the Site shall be designed to safely convey flows from outside of the Site through the Site.

I. If Site conditions preclude capture of runoff from limited portions of the Disturbed Area for achieving water quality volume control standards, stream channel protection standards, and the 2-year, 5-year, 10-year, 25-year and 50–year storm event peak runoff rate reduction standards for New Development required by this Ordinance, the Applicant shall propose alternate methods to mitigate the bypass of the BMPs, subject to the approval of the Municipal Engineer. In no case shall resulting peak rate be greater than the Pre-development peak rate for the equivalent design storm.

J. For all Regulated Activities, erosion and sediment control BMPs shall be designed, implemented, operated, and maintained during the Regulated Activities (i.e., during construction) as required to meet the purposes and requirements of this Ordinance, to meet the erosion and sediment control requirements of the Avondale Borough, if applicable, and to meet all requirements under Title 25 of the PA Code and the Clean Streams Law.

K. For all Regulated Activities, permanent BMPs and Conveyances shall be designed, implemented, operated, and maintained to meet the purposes and requirements of this Ordinance and to meet all requirements under Title 25 of the Pennsylvania Code, the Clean Streams Law, and the Storm Water Management Act.

L. The design of all BMPs and Conveyances shall incorporate sound engineering principles and practices in a manner that does not aggravate existing stormwater problems as identified by the Avondale Borough. The Avondale Borough reserves the right to disapprove any design that would result in construction in an area affected by existing stormwater problem(s) or continuation of an existing stormwater problem(s).

M. Existing wetlands, either on the Site or on an adjacent property, shall not be used to meet the minimum design requirements for stormwater management or stormwater

runoff quality treatment. Stormwater discharges to existing wetlands shall not degrade the quality or hydrologic integrity of the wetland.

N. Hotspots Runoff Controls –

Specific structural or pollution prevention practices may be required, as determined to be necessary by the Municipal Engineer, to pretreat runoff from Hotspots prior to infiltration. Following is a list of examples of Hotspots:

1. Vehicle salvage yards and recycling facilities;
2. Vehicle fueling stations;
3. Vehicle service and maintenance facilities;
4. Vehicle and equipment cleaning facilities;
5. Fleet storage areas (bus, truck, etc.);
6. Industrial sites based on Standard Industrial Classification Codes;
7. Marinas (service and maintenance areas);
8. Outdoor liquid container storage;
9. Outdoor loading/unloading facilities;
10. Public works storage areas;
11. Facilities that generate or store hazardous materials;
12. Commercial container nursery;
13. Contaminated sites/brownfields;
14. Other land uses and activities as designated by the Avondale Borough.

O. Contaminated and Brownfield Sites -

Where BMPs may contribute to the migration of contaminants in groundwater, the water quality and runoff volume, stream channel protection, and peak rate control standards shall be met; however, at the Municipal Engineer's discretion, the minimum infiltration requirement may be reduced or eliminated commensurate with the contaminated area and the required water quality and runoff control measures may be increased to mitigate the reduced infiltration requirement for the contaminated area.

P. Additional Water Quality Requirements -

The Avondale Borough may require additional stormwater control measures for stormwater discharges to special management areas including, but not limited to:

1. Water bodies listed as "impaired" by PADEP.

2. Any water body or watershed with an approved Total Maximum Daily Load (TMDL).

3. Areas of known existing flooding problems.

4. Critical areas with sensitive resources (e.g., State designated special protection waters, cold water fisheries, carbonate geology or other groundwater recharge areas that may be highly vulnerable to contamination, drainage areas to water supply reservoirs, etc.).

Q. 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.

R. For areas underlain by karst or carbonate geology that may be susceptible to the formation of sinkholes and other karst features, the location, type, and design of infiltration BMPs shall be based on a Site evaluation conducted by a qualified Licensed Professional and based on the PA BMP Manual or other design guidance acceptable to the Municipal Engineer.

S. All Regulated Activities located within a Special Flood Hazard Area designated by the Federal Emergency Management Agency (FEMA) shall comply with Ordinance 199 – Flood Hazard District and shall be designed to maintain the flood carrying capacity of the floodway such that the base flood elevations are not increased, either upstream or downstream. The natural conveyance characteristics of the Site and the receiving floodplain shall be incorporated into the stormwater management practices proposed for the Site.

T. Disturbance of existing ground cover during construction of the proposed Regulated Activity is prohibited within fifty (50) feet of top-of-bank of all perennial and intermittent waterways, water bodies (lakes, ponds, etc.) and wetlands, except for activities otherwise approved by State or local agencies (e.g. stream restoration projects, road crossings, subsurface utility projects, etc.). At the Municipal Engineer's discretion, and with Conservation District and PADEP approval where necessary, the non-disturbance buffer may be reduced because of setback or other Site constraints, but never be less than ten (10) feet.

Section 302. Permit Requirements by Other Governmental Entities

The following permit or other regulatory requirements may apply to certain Regulated Activities and shall be met prior to (or as a condition of) final approval by the Avondale Borough of the SWM Site Plan and prior to commencement of any Regulated Activities, as applicable:

A. All Regulated Activities subject to permit or regulatory requirements by PADEP under regulations at Title 25 Pennsylvania Code Chapter 102, or erosion and sediment control requirements of the Avondale Borough.

B. Work within natural drainage ways subject to permit by PADEP under Title 25 Pennsylvania Code Chapter 105.

C. Any BMP or Conveyance 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 BMP or Conveyance that would be located on or discharge to a State highway right-of-way, or require access to or from a State highway and 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

A. No Regulated Activity within the Avondale Borough shall commence until:

1. The Avondale Borough receives documentation that the Applicant has received:

   a. A "letter of adequacy" from the Conservation District or other approval from 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. A PADEP NPDES Construction Activities Permit as required under Title 25 Pennsylvania Code Chapter 92.a, if applicable;

   c. Evidence of any other permit(s) or approvals required for the Regulated Activities; and

2. An Erosion and Sediment Control Plan has been approved by the Avondale Borough, if required.

B. A copy of the Erosion and Sediment Control Plan and any required permit(s), as required by PADEP regulations, shall be available on the Site at all times.

C. Additional erosion and sediment control measures shall be applied where infiltration BMPs are proposed, at a minimum including those required in Subsection 306.M.

Section 304. Site Design Process

The Applicant shall design the Site to minimize the disturbances to land, Site hydrology, and natural resources, and to maintain the natural hydrologic regime, drainage patterns and flow conditions. For Regulated Activities with five hundred (500) or more square feet of proposed Earth Disturbance OR hundred fifty (150) square feet or more of Proposed Impervious Surfaces, the Applicant shall demonstrate in its SWM Site Plan (as required in Subsection 402.C) that the design sequence, objectives and techniques described below were applied to the maximum extent practicable in the Site design of the Regulated Activity while complying with all other requirements of this Ordinance. The Site design shall:

A. First, identify and delineate all existing natural resources and natural and man-made hydrologic features listed in Subsection 402.B.8 that are located within the Site, or receive discharge from, or may be impacted by the proposed Regulated Activity.

B. Second, provide a prioritized listing of these resources and features to identify:

1. Those to be incorporated into the Site design in a manner that provides protection from any disturbance or impact from the proposed Regulated Activity;

2. Those to be protected from further disturbance or impact but for which the proposed Regulated Activity will provide improvement to existing conditions;

3. Those that can be incorporated into and utilized as components of the overall Site design in a manner that protects or improves their existing conditions while utilizing their hydrologic function within the limits of their available capacity (e.g., for infiltration, evapotranspiration, or reducing pollutant loads, runoff volume or peak discharge rates, etc.) to reduce the need for or size of constructed BMPs; and

4. Those that may be considered for alteration, disturbance or removal.

C. Third, develop the Site design to achieve the following:

1. Recognize and incorporate the priorities identified in Section 304.B as the basis for the proposed Site layout, grading, construction, and permanent ground cover design;

2. Minimize Earth Disturbance (both surface and subsurface);

3. Maximize protection of or improvement to natural resources and special management areas;

4. Minimize the disturbance of natural Site hydrology, in particular natural drainage features and patterns, discharge points and flow characteristics, natural infiltration patterns and characteristics, and natural channel and floodplain conveyance capacity;

5. Incorporate natural hydrologic features and functions identified in Subsection 304.B into the Site design to protect and utilize those features and their hydrologic functions to reduce the need for or size of constructed BMPs;

6. Maximize infiltration and the use of natural Site infiltration features, patterns and conditions, and evapotranspiration features;

7. Apply selective grading design methods to provide final grading patterns or preserve existing topography in order to evenly distribute runoff and minimize concentrated flows;

8. Minimize the cumulative area to be covered by Impervious Surfaces and:

   a. Minimize the size of individual Impervious Surfaces,

   b. Separate large Impervious Surfaces into smaller components,

   c. Disconnect runoff from one Impervious Surface to another, and

   d. Utilize porous materials in place of impervious wherever practicable;

9. Minimize the volume and peak discharge rates of stormwater generated;

10. Avoid or minimize stormwater runoff pollutant loads and receiving stream channel erosion;

11. Locate infiltration and other BMPs:

    a. At or as near to the source of generation as possible, and

b. At depths that are as shallow as possible;

12. Prioritize the selection and design of BMPs as follows:

    a. Nonstructural and vegetation BMPs, then

    b. Structural (surface and subsurface) BMPs;

13. For flow volumes requiring conveyance from the source of generation to a BMP for management, give preference to open channel conveyance techniques that provide infiltration and water quality benefits, and landscaped-based management in common open space areas, where practicable; and

14. Consider additional guidance for incorporating natural hydrology into the Site and BMP designs, methods and techniques that support the objectives of Subsections 304.B and 304.C. Appendix B presents additional discussion of natural hydrology site design and sources of information for "Conservation Design", "Low Impact Design", and "Sustainable Design".

D. The procedures set forth above shall be utilized to the maximum extent practicable for the overall Site design and selection, location and design of features and BMPs to be used to comply with the requirements of Sections 305, 306, 307 and 308.

Section 305. Water Quality and Runoff Volume Requirements

To control Post-construction stormwater impacts from Regulated Activities and meet State water quality requirements, BMPs shall be provided in the Site design that replicate Predevelopment stormwater infiltration and runoff conditions, such that Post-construction stormwater discharges do not degrade the physical, chemical, or biological characteristics of the receiving waters. The Applicant shall comply with the following water quality and runoff volume requirements for all Regulated Activities, including all New Development and Redevelopment activities:

A. The Post-construction total runoff volume shall not exceed the Predevelopment total runoff volume for all storms equal to or less than the two (2)-year, twenty-four (24)-hour duration precipitation (design storm). The water quality and runoff volume to be managed shall consist of any runoff volume generated by the proposed Regulated Activity over and above the Predevelopment total runoff volume and shall be captured and permanently retained or infiltrated on the Site. Permanent retention options may include, but are not limited to, reuse, evaporation, transpiration, and infiltration.

B. For modeling purposes, the Predevelopment ground cover conditions shall be determined using the corresponding ground cover assumptions presented in Subsection 309.D of this Ordinance.

C. The design of the facility outlet shall provide for protection from clogging and unwanted sedimentation.

D. BMPs that moderate the temperature of stormwater shall be used to protect the temperature of receiving waters.

E. Water quality improvement shall be achieved in conjunction with achieving the infiltration requirements of Section 306. The infiltration volume required under Section 306 may be included as a component of the water quality volume. If the calculated water quality and runoff volume is greater than the volume infiltrated, then the difference between the two (2) volumes shall be managed for water quality and runoff volume control through other techniques or practices but shall not be discharged from the Site.

F. Runoff from the Disturbed Area shall be treated for water quality prior to entering existing waterways or water bodies. If a stormwater management practice does not provide water quality treatment, then water quality BMPs shall be utilized to provide pre-treatment prior to the runoff entering the stormwater management practice.

G. The Avondale Borough may require additional water quality and runoff control measures for stormwater discharging to special management areas such as those listed in Subsection 301.P.

H. When the Regulated Activity contains or is divided by multiple drainage areas, the water quality and runoff volume shall be separately addressed for each drainage area.

I. Weighted averaging of runoff coefficients shall not be used for manual computations or input data for water quality and runoff volume calculations.

J. Areas located outside of the Site (i.e., areas outside of the Regulated Activity) may be excluded from the calculation of the water quality and runoff volume requirements.

K. Water quality and volume control practices shall be selected and designed to meet the criteria of Subsection 304.C that apply to water quality and volume control.

Section 306. Infiltration Requirements

Providing for infiltration consistent with the natural hydrologic regime is required to compensate for the reduction in the recharge that occurs when the ground surface is disturbed or Impervious Surface is created or expanded. The Applicant shall achieve the following infiltration requirements:

A. Wherever possible, infiltration should be designed to accommodate the entire water quality and runoff volume required in Section 305.

B. For Regulated Activities involving New Development, the volume of a minimum of one (1)-inch of runoff from all Proposed Impervious Surfaces shall be infiltrated.

C. For Regulated Activities involving Redevelopment, whichever is less of the following volume options shall be infiltrated:

1. The volume of a minimum of one (1)-inch of runoff from all Proposed Impervious Surfaces;

   OR

2. The total water quality and runoff volume required in Section 305 of this Ordinance.

D. If the requirements of Subsections 306.B or 306.C cannot be physically accomplished, then the Applicant shall be responsible for demonstrating with data or calculations to the satisfaction of the Municipal Engineer why this infiltration volume cannot be physically accomplished on the Site (e.g., shallow depth to bedrock or limiting zone, open voids, steep slopes, etc.) and what alternative volume can be infiltrated; however in all cases at least the first one-half (0.5) inch of runoff volume shall be infiltrated.

E. Only if a minimum of at least one-half (0.5) inch infiltration requirement cannot be physically accomplished on the Site, shall a waiver from Section 306 be considered by the Borough.

F. If Site conditions preclude capture of runoff from portions of the Impervious Surfaces, the infiltration volume for the remaining area shall be increased an equivalent amount to offset the loss.

G. When a project contains or is divided by multiple watersheds, the infiltration volume shall be separately addressed for each watershed.

H. Existing Impervious Surfaces located in areas outside of the Site (i.e., outside of the Regulated Activity) may be excluded from the calculation of the required infiltration volume.

I. A detailed soils evaluation of the Site shall be conducted by a qualified professional and at a minimum shall address soil permeability, depth to bedrock, and subgrade stability. The general process for designing the infiltration BMP shall be conducted by a qualified Licensed Professional and shall be consistent with the PA BMP Manual (as amended) (or other guidance acceptable to the Municipal Engineer) and in general shall:

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 such as double ring infiltrometer or other hydraulic conductivity tests (at the elevation of the proposed infiltration surface) to determine the appropriate hydraulic conductivity rate. Standard septic/sewage percolation tests are not acceptable for design purposes.

3. Design the Infiltration Facility for the required retention (infiltration) volume based on field-determined infiltration capacity (and apply safety factor as per applicable design guidelines) at the elevation of the proposed infiltration surface.

4. On-lot infiltration features are encouraged; however, it shall be demonstrated to the Municipal Engineer that the soils are conducive to infiltration on the identified lots.

J. Infiltration BMPs shall be selected based on suitability of soils and Site conditions and shall be constructed on soils that have the following characteristics:

1. A minimum depth of twenty-four (24) inches between the bottom of the BMP and the top of the Limiting Zone. Additional depth may be required in areas underlain by karst or carbonate geology (see Subsection 306.N).

2. An infiltration rate sufficient to accept the additional stormwater volume and drain completely as determined by field tests conducted by the Applicant.

3. The Infiltration Facility shall completely drain the retention (infiltration) volume within three (3) days (seventy-two (72) hours) from the end of the design storm.

K. All infiltration practices shall:

1. Be selected and designed to meet the criteria of Subsection 304.C that are applicable to infiltration;

2. Be set back at least fifteen (15) feet from all buildings and features with sub-grade elements (e.g., basements, foundation walls, etc.), and property lines unless otherwise approved by the Municipal Engineer;

3. For any infiltration practice that collects runoff from shared or multiple features and that is located within twenty-five (25) feet of a building or feature with sub-grade elements (e.g., basements, foundation walls, etc.), the bottom elevation shall be set below the elevation of the sub-grade element.

L. Infiltration Facilities shall, to the maximum extent practicable, be located to avoid introducing contaminants to groundwater:

1. When a Hotspot is located in the area draining to a proposed infiltration facility, an evaluation of the potential of groundwater contamination from the proposed infiltration facility shall be performed, including a hydrogeologic investigation (if necessary) by a qualified Licensed Professional to determine what, if any, pre-treatment or additional design considerations are needed to protect groundwater quality.

2. When located within a "well head protection area" of a public water supply well, infiltration practices shall be in conformance with the applicable approved source water protection assessment or source water protection plan.

3. The Applicant shall provide appropriate safeguards against groundwater contamination for land uses that may cause groundwater contamination should there be a mishap or spill.

M. During Site construction, all infiltration practice components shall be protected from compaction due to heavy equipment operation or storage of fill or construction material. Infiltration areas shall also be protected from sedimentation. Areas that are accidentally compacted or graded shall be remediated to restore soil composition and porosity. Adequate documentation to this effect shall be submitted to the Municipal Engineer for review. All areas designated for infiltration shall not receive runoff until the contributory drainage area has achieved final stabilization.

N. Consideration of infiltration BMPs for areas underlain by karst or carbonate geology is encouraged, but only where the design, supporting calculations, results of soils or other Site investigations or other documentation are provided to the Avondale Borough demonstrating that the potential or likelihood of subsidence or sinkholes is minimal. Evaluation of Site conditions and infiltration design shall rely on guidance in the PA BMP Manual (as amended) or other guidance acceptable to the Municipal Engineer.

O. Groundwater quality of the carbonate aquifer shall be protected from infiltration of pollutants. At a minimum, stormwater runoff from Hotspots (i.e., sources of significant pollutant runoff) shall first be discharged through a water quality BMP(s) to remove pollutants prior to infiltration. Where soil characteristics are insufficient to provide removal of pollutants from sources other than Hotspots, stormwater runoff shall first be discharged through a water quality BMP(s) to remove pollutants prior to infiltration.

P. Where sediment transport in the stormwater runoff is anticipated to reach the infiltration system, appropriate permanent measures to prevent or collect sediment shall be installed prior to discharge to the infiltration system.

Q. Where roof drains are designed to discharge to infiltration practices, they shall have appropriate measures to prevent clogging by unwanted debris (for example, silt,

leaves and vegetation). Such measures shall include but are not limited to leaf traps, gutter guards and cleanouts.

R. All infiltration practices shall have appropriate positive overflow controls.

S. No sand, salt or other particulate matter may be applied to a porous surface material for winter ice conditions.

T. The following procedures and materials shall be required during the construction of all subsurface facilities:

1. Excavation for the Infiltration Facility shall be performed with equipment that will not compact the bottom of the seepage bed/trench or like facility.

2. The bottom of the bed and/or trench shall be scarified prior to the placement of aggregate.

3. Only clean aggregate with documented porosity, free of fines, shall be allowed.

4. The tops, bottoms and sides of all seepage beds, trenches, or like facilities shall be covered with drainage fabric. Fabric shall be non-woven fabric acceptable to the Municipal Engineer.

5. Stormwater shall be distributed throughout the entire seepage bed/trench or like facility and provisions for the collection of debris shall be provided in all facilities.

Section 307. Stream Channel Protection Requirements

A. For Regulated Activities involving New Development with one (1) or more acres of Earth Disturbance, the Applicant shall comply with the following stream channel protection requirements to minimize stream channel erosion and associated water quality impacts to the receiving waters or in accordance with the methodology contained in Table 309.1.

B. The peak flow rate of the Post-construction two (2)-year, twenty-four (24)-hour design storm shall be reduced to the Predevelopment peak flow rate of the one (1)-year, twenty-four (24)-hour duration precipitation, using the SCS Type II distribution or in accordance with the methodology contained in Table 309.1.

C. To the maximum extent practicable, and unless otherwise approved by the Municipal Engineer, the Post-construction one (1)-year, twenty-four (24)-hour storm flow shall be detained for a minimum of twenty-four (24) hours and a maximum not to exceed seventy-two (72) hours from a point in time when the maximum volume of water from the one (1)-year, twenty-four (24)-hour storm is stored in a proposed BMP (i.e.,

when 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 orifice is at the invert of the proposed BMP).

D. For modeling purposes, the Predevelopment ground cover conditions shall be determined using the corresponding ground cover assumptions presented in Subsection 309.D of this Ordinance.

E. The minimum orifice size in the outlet structure to the BMP shall be three (3) inches in diameter unless otherwise approved by the Municipal Engineer, and a trash rack shall be installed to prevent clogging. For Sites with small drainage areas contributing to the BMP that do not provide enough runoff volume to allow a twenty-four (24) hour attenuation with the three (3)-inch orifice, the calculations shall be submitted showing this condition.

F. 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.

G. All proposed stormwater facilities shall make use of measures to extend the flow path and increase the travel time of flows in the facility.

H. When a Regulated Activity contains or is divided by multiple drainage areas, the peak flow rate control shall be separately addressed for each drainage area.

Section 308. Stormwater Peak Rate Control Requirements

The Applicant shall comply with the following peak flow rate control requirements for all Regulated Activities including those that involve New Development and Redevelopment.

A. Post-construction peak flow rates from any Regulated Activity shall not exceed the Predevelopment peak flow rates as shown for each of the design storms specified in Table 308.1.

TABLE 308.1
Peak Rate Control Standards

(Peak Flow Rate of the Post-construction Design Storm Shall be Reduced to the Peak Flow Rate of the Corresponding Predevelopment Design Storm Shown in the Table)

2-Year	1-Year	2-Year
5-Year	2-Year	5-Year
10-Year	2-Year	10-Year
25-Year	10-Year	25-Year
50-Year	25-Year	50-Year
100-Year	100-Year	100-Year

B. For modeling purposes, the Predevelopment ground cover conditions shall be determined using the corresponding ground cover assumptions presented in Subsection 309.D of this Ordinance.

C. For Regulated Activities involving only Redevelopment, no peak flow rate controls are required when and **only if** the total Proposed Impervious Surface area is at least twenty percent (20%) less than the total existing Impervious Surface area to be disturbed by the Regulated Activity. In all cases where this requirement is not met, the Redevelopment Regulated Activity shall achieve the peak flow rate controls presented in Table 308.1, using the Redevelopment Ground Cover Assumptions presented in Subsection 309.D.

D. Only the area of the proposed Regulated Activity shall be subject to the peak flow rate control standards of this Ordinance. Undisturbed areas for which the discharge point has not changed are not subject to the peak flow rate control standards.

E. Areas located outside of the Site (i.e., areas outside of the Regulated Activity) that drain through a proposed Site are not subject to peak flow rate control requirements. Drainage facilities located on the Site shall be designed to safely convey flows from outside of the Site through the Site.

F. When a Regulated Activity contains or is divided by multiple drainage areas, the peak flow rate controls shall be separately addressed for each drainage area.

G. The effect of structural and non-structural stormwater management practices implemented as part of the overall Site design may be taken into consideration when calculating total storage volume and peak flow rates.

Section 309. Calculation Methodology

A. Stormwater runoff from all Regulated Activity Sites with a drainage area of greater than five (5) acres shall be calculated using a generally accepted calculation technique(s) that is based on the NRCS Soil Cover Complex Method. Table 309.1 summarizes acceptable computation methods. The method selected for use 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 by the Municipal Engineer.

TABLE 309.1

ACCEPTABLE COMPUTATION METHODOLOGIES FOR SWM SITE PLAN

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 are met.
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 Avondale Borough.
Other Methods	Varies	Other computation methodologies approved by the Avondale Borough.

B. All calculations using the Soil Cover Complex Method shall use the appropriate design rainfall depths for the various return period storms consistent with this Ordinance. Rainfall depths used shall be obtained from NOAA Atlas 14 values consistent with a partial duration series. When stormwater calculations are performed for routing procedures or infiltration, water quality and runoff volume functions, the duration of rainfall shall be twenty-four (24) hours.

C. 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). 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 Manning's equation.

D. The Applicant shall utilize the following ground cover assumptions for all Predevelopment water quality and runoff volume, infiltration volume and peak flow rate calculations:

1. For Regulated Activities involving New Development, the following ground cover assumptions shall be used:

   a. For areas that are Woods (as defined in Article II of this Ordinance), Predevelopment calculations shall assume ground cover of "Woods in good condition".

   b. For all other areas (including all Impervious Surfaces), Predevelopment calculations shall assume ground cover of "meadow".

2. For Regulated Activities involving Redevelopment, the following ground cover assumptions shall be used:

   a. For areas that are Woods (as defined in Article II of this Ordinance), Predevelopment calculations shall assume ground cover of "Woods in good condition".

   b. For areas that are not Woods or not Impervious Surfaces, Predevelopment calculations shall assume ground cover of "meadow".

   c. For areas that are Impervious Surfaces, Predevelopment calculations shall assume at least twenty percent (20%) of the existing Impervious Surface area to be disturbed as "meadow" ground cover.

3. The Applicant shall determine which stormwater standards apply to the proposed Regulated Activity as follows:

    a. Stormwater standards for New Development shall apply to all proposed Regulated Activities that involve only New Development activities as defined in this Ordinance.

    b. Stormwater standards for Redevelopment shall apply to all proposed Regulated Activities that involve only Redevelopment activities as defined in this Ordinance.

    c. At the discretion of the Municipal Engineer, Regulated Activities that involve a combination of both New Development and Redevelopment activities, as defined in this Ordinance, may either:

        i. Apply the stormwater standards (Redevelopment or New Development) that are associated with the activity that involves the greatest amount of land area; or

        ii. Apply the Redevelopment and New Development stormwater standards to the corresponding Redevelopment and New Development portions of the proposed Regulated Activity.

E. Runoff curve numbers (CN) for both Predevelopment and proposed (Post-construction) conditions to be used in the Soil Cover Complex Method shall be obtained from Table C-1 in Appendix C of this Ordinance.

F. Runoff coefficients (C) for both Predevelopment and proposed (Post-construction) conditions for use in the Rational Method shall be obtained from Table C-2 in Appendix C of this Ordinance.

G. Weighted averaging of runoff coefficients shall not be used for manual computations or input data for water quality and runoff volume calculations.

H. 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, as amended). 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, as amended). Values for Manning's roughness coefficient (n) shall be consistent with Table C-3 in Appendix C of the Ordinance.

I. Runoff calculations shall include the following assumptions:

1. Average antecedent moisture conditions (for the Soil Cover Complex Method only for example, TR-55, TR-20).

2. A type II distribution storm (for the Soil Cover Complex Method only for example, TR-55, TR-20).

Section 310. Other Requirements

A. Any BMP intended to hold standing water for four (4) days or longer shall be designed to incorporate biologic controls consistent with the West Nile Guidance found in Appendix D, PADEP document 363-0300-001 "Design Criteria – Wetlands Replacement/Monitoring" (as amended), (or contact the Pennsylvania State Cooperative Wetland Center or the Penn State Cooperative Extension Office for design information.)

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 safely convey flow up to and including the one hundred (100)-year proposed conditions. The height of embankment shall provide a minimum 1.0 foot of Freeboard above the maximum pool elevation computed when the facility functions for the one hundred (100)-year proposed conditions inflow. Should any BMP require a dam safety permit under PA Chapter 105 regulations, the facility shall be designed in accordance with and meet the regulations of PA Chapter 105 concerning dam safety. PA Chapter 105 may require the safe conveyance of storms larger than one hundred (100)-year event.

C. Any drainage Conveyance facility and/or channel not governed by PA Chapter 105 regulations shall be designed to convey, without damage to the drainage facility or roadway, runoff from the twenty-five (25)-year storm event. Larger storm events (fifty (50)-year and one hundred (100)-year storms) shall also be safely conveyed in the direction of natural flow without creating additional damage to any drainage facilities, nearby structures, or roadways.

D. Conveyance facilities to or exiting from stormwater management facilities (i.e., detention basins) shall be designed to convey the design flow to or from the facility.

E. Roadway crossings or structures located within designated floodplain areas shall 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 shall comply with PennDOT minimum design standards and permit submission and approval 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, as amended) and the PADEP Erosion and Sediment Pollution Control Program Manual (Publication No. 363-2134-008, as amended), or other design guidance acceptable to the Municipal Engineer.

Section 311. Other Conveyance and System Design Standards

The design of basins and other conveyance systems shall be in accordance with the following standards:

A. Any stormwater facility located on state highway rights-of-way shall be subject to approval by PennDOT.

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

C. Any stormwater management facility (i.e., detention 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 one (1) foot 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 DEP 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 be required to pass storms larger than the 100-year event.

D. Any facilities that constitute water obstructions (e.g., culverts, bridges, outfalls, or stream enclosures) and any work involving wetlands governed by DEP Chapter 105 regulations (as amended or replaced from time to time by DEP) shall be designed in accordance with Chapter 105 and will require a permit from DEP.

E. Any other drainage conveyance facility that does not fall under Chapter 105 regulations must be able to convey, without damage to the drainage structure or roadway, runoff from the 25-year design storm with a minimum one (1.0) foot of freeboard measured below the lowest point along the top of the roadway. Any facility that constitutes a dam as defined in DEP Chapter 105 regulations may require a permit under dam safety regulations. Any facility located within a PennDOT right-of-way must meet PennDOT minimum design standards and permit submission requirements.

F. 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 design storm. Conveyance facilities to or exiting from stormwater management facilities (i.e., detention basins) shall be designed to convey the design flow to or from that structure. Roadway crossings located within designated floodplain areas must be able to convey runoff from a 100-year design storm. Any facility located within a PennDOT right-of-way must meet PennDOT minimum design standards and permit submission requirements.

G. The design of all stormwater management facilities shall incorporate sound engineering principles and practices. The Borough reserves the right to disapprove any design that would result in construction in or continuation of a stormwater problem area.

H. Outlet Structures. Outlet structures shall meet the following specifications:

1. To minimize clogging and to facilitate cleaning and inspecting, outlet pipes for all basins with a drainage area of one (1) acre or more shall have an internal diameter of at least fifteen (15) inches and a minimum grade of one percent (1%).

2. Anti-seep collars shall be provided on all outlet pipes within a constructed berm.

3. All principal outlet structures shall be built using reinforced concrete with watertight construction joints.

4. Outlet pipes shall be constructed of reinforced concrete with rubber gaskets in conformance with AASHTO M170, M198 and M207.

5. Basin outlet structures shall have childproof non-clogging trash racks over all design openings exceeding twelve (12) inches in diameter except those openings designed to carry perennial stream flows. Periodic cleaning of debris from trash racks shall be included in the operation and maintenance plan.

6. Anti-vortex devices, consisting of a thin vertical plate normal to the basin berm, shall be provided at the top of all circular risers or stand pipes.

7. Outlet structures for all basins shall be designed to permit the facility to be completed drained, if needed, for maintenance.

I. Discharge Points. For all drainage areas of one (1) acre or more, the discharge (or outfall) as well as the emergency spillway, dam breast areas, or water storage area shall be located at least twenty-five (25) feet from the original property line of the parcel being developed. The minimum distance between a proposed discharge point (including the energy dissipater, etc.) and a downstream property boundary shall in

no case be less than ten (10) feet. Where there is discharge onto or through adjacent properties prior to release to a stream, designers shall demonstrate how downstream properties are to be protected. The Borough Engineer may require that the setback distance be increased based upon factors such as topography, soil conditions, the size of structures, the location of structures, and discharge rates. A drainage easement may also be required. For all drainage areas of one (1) acre or more, the discharge (or outfall) as well as the emergency spillway, dam breast areas, or water storage area shall be located at least twenty-five (25) feet from the original property line of the parcel being developed.

Section 312. Conveyance System Design Standards

The design of storm sewers, storm drainage structures and swales shall be in accordance with the following standards:

A. The stormwater conveyance system, inlets, pipes, overland flow and swales, shall be designed utilizing the Rational Method. Storm drainage collection systems, inlets and pipes, shall be designed to convey a twenty-five (25) year storm event without surcharging an inlet. Adequate controls to ensure the one-hundred (100) year storm event is conveyed to the stormwater management facility must be incorporated into the design.

B. Cross-pipes, box culverts and bridges shall be designed to convey a one-hundred (100) year storm event.

C. Any drainage facility crossing a State Highway shall conform to all applicable Pennsylvania Department of Transportation (DOT) Design Standards.

D. Pipe Materials – All storm pipe material shall be in accordance with PennDOT. Specifications. Piping shall be saw-cut at ends, as needed, and not hammered or broken. Reinforced concrete pipe shall be used in all roads. Other materials may be considered for use in other areas, as approved by the Borough Engineer

E. Minimum Pipe Size – Minimum pipe diameter shall be fifteen (15) inches.

F. Flow Velocity – Stormwater systems shall be designed to produce a minimum velocity of 3.0 feet per second when flowing full. The maximum permissible velocity shall be 10.0 feet per second. The minimum pipe slope shall be 0.5 percent.

G. Inlets shall be located at tangents on the uphill side of street intersections and at intervals along the gutter line to control the maximum amount of encroachment of runoff on the roadway pavement so that same does not exceed a width of four (4) feet during the design storm event. Design and location of curb inlets shall be approved by the Borough. The maximum amount of flow through an intersection may not exceed one (1) inch.

H. Inlets and manholes shall be spaced at intervals not exceeding 300 feet, and shall be located wherever branches are connected or sizes are changed, and wherever there is a change in alignment or grade.

I. All storm sewer pipes shall be laid to a minimum depth of one (1) foot from subgrade to crown of pipe. Minimum and maximum cover shall be in accordance with PennDOT specifications.

J. The capacity of all inlets shall be based on a maximum surface flow to the inlet of 4.0 cubic feet per second or a maximum spread of flow of one-half of the travel lane for roads (public or private), calculated based on the twenty-five (25) year design storm event. The maximum flow to inlets located in low points (such as sag vertical curves) shall include the overland flow directed to the inlet as well as all bypass runoff from upstream inlets. The bypass flow from upstream inlets shall be calculated using inlet efficiency curves included in PennDOT Design Manual Part 2, latest edition or other equivalent computer program. If the surface flow to an inlet exceeds 4.0 cubic feet per second or in the case of roads, the spread of flow is greater than one-half of the travel lane, additional inlets shall be provided upstream of the inlet to intercept the excessive surface flow.

K. The capacity of all stormwater pipes shall be calculated utilizing the Manning's Equation for open channel flow as applied to closed conduit flow. The Manning's roughness coefficient for concrete pipe shall be 0.13. In cases where pressure flow may occur, the hydraulic grade line shall be calculated throughout the storm sewer system to verify that at least one-half (1/2) foot of freeboard will be provided in all inlets and manholes for the design storm event.

L. Culverts shall be designed based on procedures contained in Hydraulic Design of Highway Culverts, HDS #5, U.S. Department of Transportation, Federal Highway Administration.

M. Inlet and Manhole Construction -- Inlet and manhole castings and concrete construction shall be equivalent to PennDOT Roadway Construction Standards, latest edition.

N. Open end pipes must be fitted with concrete endwalls in accordance with PennDOT Roadway Construction Standards, latest edition.

O. Stormwater pipes must be oriented as close to right angles to electric, water, sanitary sewer, and gas utilities when crossing above or beneath the same. Crossing angles of less than 90 degrees will only be permitted at the discretion of the Borough Engineer. When skewed crossings are permitted, interior angles between alignment of the storm sewer pipe and utility may not be less than 45 degrees.

P. Modified inlet boxes shall be used when required in accordance with the PennDOT Roadway Construction Standards, latest edition. Pipes shall not be allowed to enter

the corner of boxes for all inlets. The crown of the pipe shall be at least four (4) inches below the top of the precast inlet or manhole box.

Q. All manholes, endwalls, inlet boxes, inlet grates and inlet hoods shall be constructed in accordance with PennDOT Publication 408 and Roadway Construction Standards, latest edition.

R. Open swales shall be stabilized with vegetation or other materials in accordance with Title 25 Chapter 102 Rules and Regulations of the Pennsylvania Department of Environmental Protection. Slopes for swale banks shall be in minimum of one (1) foot vertical for four (4) feet horizontal.

S. All grassed swales must have a minimum slope of 2%.

T. Adequate erosion protection shall be provided along all open channels and at all points of discharge.

U. A minimum of twenty (20) foot wide easement shall be provided for and centered on all storm sewers and open swales not located within the public right-of-way.

ARTICLE IV – STORMWATER MANAGEMENT (SWM) SITE PLAN REQUIREMENTS

Section 401. General Requirements

For any Regulated Activity, unless exempt per the provisions of Section 106:

A. Preparation and implementation of an approved SWM Site Plan is required.

B. No Regulated Activity shall commence until the Avondale Borough issues written approval of a SWM Site Plan, which demonstrates compliance with the requirements of this Ordinance and, if required, a letter of adequacy has been issued by the Conservation District for an Erosion and Sediment Control Plan.

C. The preliminary or final approval of subdivision and/or land development plans, and the issuance of any building or occupancy permit shall not proceed until the Applicant has received written approval of a SWM Site Plan from the Avondale Borough.

D. The SWM Site Plan approved by the Avondale Borough shall be on Site throughout the duration of the Regulated Activity.

Section 402. SWM Site Plan Contents

The SWM Site Plan shall consist of a general description of the project including 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 Avondale Borough in a format that is clear, concise, legible, neat, and well organized; otherwise, the SWM Site Plan shall not be accepted for review and shall be returned to the Applicant.

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

A. General

1. A general description of the proposed project;

2. A listing of all regulatory approvals required for the proposed project and the status of the review and approval process for each. Final approval or adequacy letters must be submitted to the Avondale Borough prior to (or as a condition of) the Avondale Borough's issuing final approval of the SWM Site Plan. Proof of application or documentation of required permit(s) or approvals for the programs listed below shall be part of the SWM Site Plan, if applicable:

    a. NPDES Permit for Stormwater Discharges from Construction Activities;

    b. PADEP permits as needed:

        i. PADEP Joint Permit Application,

        ii. Chapter 105 (Dam Safety and Waterway Management),

        iii. Chapter 106 (Floodplain Management);

    c. PennDOT Highway Occupancy Permit;

    d. Erosion and Sediment Control Plan letter of adequacy; and

    e. Any other permit under applicable State or Federal regulations.

3. A statement, signed by the Applicant, acknowledging that any revision to the approved SWM Site Plan shall be submitted to and approved by the Avondale Borough, and that a revised Erosion and Sediment Control Plan shall be submitted to, and approved by, the Conservation District or Avondale Borough (as applicable) for a determination of adequacy prior to construction of the revised features.

4. The following signature block signed and sealed by the qualified Licensed Professional responsible for the preparation of the SWM Site Plan:

   "I (name), on this date (date of signature), hereby certify to the best of my knowledge that the SWM Site Plan meets all design standards and criteria of the Avondale Borough Ordinance No. ___ Stormwater Management Ordinance." *[Note: include signature, name, discipline of professional license, and license stamp or seal here]*

B. Maps or Plan Sheets

Map(s) or plan sheets of the Site shall be submitted on minimum twenty-four (24)-inch by thirty-six (36)-inch sheets and shall be prepared in a form that meets the requirements for recording at the Chester County Office of the Recorder of Deeds and the requirements of the Operation and Maintenance (O&M) Plan and O&M Agreement (Article VII). If the SALDO has additional or more stringent criteria than this Ordinance, then the SALDO criteria shall also apply. Unless otherwise approved by the Municipal Engineer, the contents of the maps or plan sheets shall include, but not be limited to:

1. A location map, with a scale of one (1) inch equals two thousand (2,000) feet or greater, showing the Site location relative to highways, municipal boundaries, or other identifiable landmarks.

2. The name of the project, tax parcel number(s), and the names, addresses and phone numbers of the owner of the property, the Applicant, and firm preparing the plan.

3. Signature and seal of the qualified Licensed Professional(s) responsible for preparation of the maps and plan sheets.

4. The date of SWM Site Plan submission and revision dates, as applicable.

5. A graphic and written scale of one (1) inch equals no more than fifty (50) feet.

6. A north arrow.

7. Legal property boundaries, including:

   a. The total project property boundary and size with distances marked to the nearest foot and bearings to the nearest degree.

   b. Boundaries, size and description of purpose of all existing easements and deed-restricted areas of the project property, with distances marked to the nearest foot and bearings to the nearest degree.

8. Existing natural resources and natural or man-made hydrologic features that are located within the Site or receiving discharge from, or that may otherwise be impacted by, the proposed Regulated Activity, including but not limited to:

   a. All existing natural resources, hydrologic features and drainage patterns including natural waterways, water bodies, wetlands, streams (intermittent and perennial), ponds, lakes, vernal pools, etc., natural infiltration areas and patterns, areas of significant natural evapotranspiration, and other water features and aquatic resources.

   b. Any existing man-made drainage features, BMPs, Conveyances, facilities, open channels, swales, drainage patterns, or other flood, stormwater or drainage control features.

   c. For the Site, discharge points and locations of concentrated flows and their drainage areas.

   d. For named waters, show names and their watershed boundaries within the Site.

   e. Special management areas (as per Subsection 301.P).

   f. For the water bodies, streams and wetlands identified in Subsection 402.B.8.a, label or otherwise show the following attributes, if applicable:

      i. The Designated Use as determined by PADEP (25 PA Code Chapter 93);

      ii. Impairments listed on the PADEP "Integrated List" (as updated) and the listed source and cause of impairment;

      iii. Name, date, and target pollutant(s) for any approved Total Maximum Daily Load (TMDL); and

      iv. Drainages to water supply reservoirs.

   g. Areas that are part of the Pennsylvania Natural Diversity Inventory (PNDI) and a list of potential impacts and clearances received (for Regulated Activities involving one (1) acre or more proposed Earth Disturbance).

   h. Woods, vegetated riparian buffers and other areas of natural vegetation.

   i. Topography using contours (with elevations based on established bench marks) at intervals of two (2) feet. In areas of slopes greater than twenty –five (25) percent five (5)-foot contour intervals may be used. The datum used and the location, elevation and datum of any bench marks used shall be shown.

j. Areas classified by the Avondale Borough as steep slopes.

k. Soil names and boundaries, general type of soils with Hydrologic Soil Group noted, and in particular note areas most conducive to infiltration BMPs, such as groups A and B, etc., estimated permeabilities in inches per hour, and location and other results of all soil tests and borings.

l. If present, areas with underlying carbonate geologic units, existing sinkholes, subsidence or other karst features, and any associated groundwater recharge areas with increased vulnerability to contamination.

m. Any contaminated surface or subsurface areas of the Site.

n. Water supply wells –

   i. Location of existing well(s) on the project property and delineation of the(ir) recharge area(s) (if known), or a fifty (50) foot diameter assumed recharge area;

   ii. Location of existing well(s) within fifty (50) feet beyond the boundary of the project property boundary (if public water supply is proposed for the Regulated Activity); and

o. Current FEMA one hundred (100)-year floodplain boundaries, elevations, and Floodway boundaries for any Special Flood Hazard Areas on or within one hundred (100) feet of the property.

p. Boundaries of a fifty (50) foot construction non-disturbance buffer to protect streams (intermittent and perennial), wetlands and other water bodies during construction of the proposed Regulated Activity.

9. Location of the proposed Regulated Activity, limits of Earth Disturbance (Disturbed Area), and BMPs and Conveyances relative to the location of existing natural resources and hydrologic features and special management areas resulting from the Site design process of Section 304.

10. Description of existing and proposed ground cover and land use including the type and total area.

11. Existing and proposed man-made features including roads, paved areas, buildings, and other Impervious and Pervious Surfaces on the project property (or an appropriate portion of the property as determined in consultation with the Municipal Engineer) and within the proposed Disturbed Area, and including the type and total area of the following:

a. Existing Impervious Surfaces;

b. Existing Impervious Surfaces proposed to be replaced;

c. Existing Impervious Surfaces to be permanently removed and replaced with pervious ground cover;

d. New or additional Impervious Surfaces; and

e. Percent of the Site covered by Impervious Surfaces for both the existing and proposed Post-construction conditions.

12. The total extent of the upstream area draining through the Site.

13. All BMPs, Conveyances and other stormwater management facilities shall be located on the plan sheets, including design drawings, profile drawings, construction details, materials to be used, description of function, etc.

14. Complete delineation of the flow paths used for calculating the time of concentration for the Predevelopment and Post-construction conditions shall be included.

15. The locations of all existing and proposed utilities, sanitary sewers, on-lot wastewater facilities (including subsurface tanks and leach fields), and water supply lines within the Site and within fifty (50) feet beyond the proposed limits of Earth Disturbance.

16. A grading plan, including all areas of proposed Earth Disturbance and the proposed Regulated Activity and delineating the boundary or limits of Earth Disturbance of the Site. The total Disturbed Area of the Site shall be noted in square feet and acres.

17. Proposed final grade elevations and contours at intervals of two (2) feet. In areas of steep slopes (greater than twenty-five (25) percent), five (5)-foot contour intervals may be used.

18. For each proposed BMP and Conveyance included in the SWM Site Plan (including any to be located on any property other than the property being developed by the Applicant), the following shall be included on the SWM Site Plan map or plan sheets:

    a. Identification of the person responsible for ongoing inspections, operation, repair, and maintenance of the BMP or Conveyance after completion of construction.

b. Delineation of the land area, structures, Impervious Surfaces, and Conveyances draining to and from the BMP or Conveyance.

c. Easements, as per the requirements of Article VII, that shall include:

   i. Boundaries labeled with distances shown in feet and bearings to the nearest degree;

   ii. Notes or other documentation, as needed, to grant the Avondale Borough the right of access to all BMPs and Conveyances for the purposes of inspection and enforcement of the requirements of this Ordinance, and any applicable O&M Plans and O&M Agreements;

   iii. Notes or other documentation, as needed, to grant the Avondale Borough the right of access to all roadways necessary to access all BMPs and Conveyances, where roadways are not to be dedicated to the Avondale Borough;

   iv. Notes or other documentation as needed to grant the owner of any BMP or Conveyance the right of access for the purpose of inspection, operation, maintenance, and repair of the BMP or Conveyance that is to be owned, operated and maintained by a person other than the Avondale Borough, and other than the owner of the property on which the BMP or Conveyance is located;

   v. A minimum ten (10) foot wide perimeter (or other width as determined in consultation with the Municipal Engineer) around all BMPs and Conveyances;

   vi. Sufficient vehicular ingress to and egress from a public right-of-way or roadway, as determined in consultation with the Municipal Engineer; and

   vii. Accompanying notes or other documentation as needed, and in accordance with Article VII describing the type, purpose and total area of easements, who the easement is granted to, and the rights, duties and obligations of the parties with respect to every BMP or Conveyance.

d. Boundaries of land areas (if any) for which deed restrictions are required for the purpose of protecting and prohibiting disturbance to a BMP or Conveyance, indicating the area to which the restriction applies with distances shown in feet and bearings to the nearest degree, and a written description of the type, purpose and nature of the restriction.

e. Other items that may be needed to comply with all other requirements of Article VII.

C. A written description of the following information shall be included in the SWM Site Plan:

1. Existing features, conditions, natural resources, hydrologic features, and special management areas (as listed in Subsection 402.B.8);

2. How the Site design achieves the requirements of Section 304, and if applicable, where they could not be achieved and why;

3. The overall stormwater management design concept for the project and how the Site design achieves the requirements of Sections 301 through 311 of Article III;

4. Proposed features and conditions, proposed erosion and sediment control features, proposed BMPs, Conveyances, and any other stormwater facilities;

5. A description of the effect of the project (in terms of flow alteration and runoff volumes, water quality and peak flows, etc.) on existing natural resources, hydrologic features and special management areas, adjacent and downgradient properties, and any existing municipal or other stormwater Conveyance system(s), that may be affected by or receive runoff from the Regulated Activity (whether located within or outside of the area of the Regulated Activity), and specifics of how erosion, water quality and flow impacts will be avoided or otherwise mitigated;

6. Proposed nonpoint source pollution controls and justification and confirmation that the proposed project will not result in any increased pollutant loadings to any existing stream or stream impairment identified by PADEP, or to any receiving water body;

7. Expected project time schedule; and

8. Description of construction stages or project phases, if so proposed.

D. A detailed Site evaluation conducted by a qualified Licensed Professional for projects proposed in areas of carbonate geology or karst topography, and other environmentally sensitive areas, such as contaminated sites and brownfields, as described in Subsections 301.O and 301.R of this Ordinance.

E. Stormwater runoff design computations and documentation, such as hydrologic, hydraulic, and structural computations, assumptions, BMP loading ratios, etc., consistent with the guidelines and criteria presented in the PA BMP Manual (as amended) or other guidance acceptable to the Municipal Engineer, and used in the design of the BMPs, Conveyances and other features proposed to be utilized for stormwater management, or as otherwise necessary to demonstrate that the requirements of this Ordinance have been met, specifically including the requirements in Sections 301 and 304 through 309.

F. Inspections, Operation and Maintenance Requirements

The following documents shall be prepared and submitted to the Avondale Borough for review and approval as part of the SWM Site Plan, in accordance with the requirements of Article VII, for each BMP and Conveyance included in the SWM Site Plan (including any to be located on any property other than the property being developed by the Applicant):

1. An O&M Plan;

2. An O&M Agreement;

3. Any easement agreements that are needed to ensure access, inspection, maintenance, operation, repair and permanent protection of any permanent BMP(s) and Conveyances associated with the Regulated Activity;

4. Any written deed, deed amendment or equivalent document (if needed) to be recorded against a subject property, as shown on the SWM Site Plan maps or plan sheets, or recorded plan sheets for the purpose of protecting and prohibiting disturbance to a BMP or Conveyance; and

5. Written approval, easement agreements, or other documentation for discharges to adjacent or downgradient properties when required to comply with Subsection 301.G and Article VII of this Ordinance.

G. An Erosion and Sediment Control Plan, where applicable, as prepared for and submitted to the Conservation District and/or Avondale Borough. A letter of adequacy from the Conservation District, if applicable, must be submitted to the Avondale Borough prior to (or as a condition of) the Avondale Borough's final approval of the SWM Site Plan.

H. A Highway Occupancy Permit from the Pennsylvania Department of Transportation (PennDOT) District Office must be submitted to the Avondale Borough prior to (or as a condition of) the Avondale Borough's final approval of the SWM Site Plan when utilization of a PennDOT storm drainage system is proposed.

Section 403. SWM Site Plan Submission

A complete SWM Site Plan that complies with all applicable provisions of Section 402 shall be submitted to the Avondale Borough for review and approval, as follows:

A. The SWM Site Plan shall be coordinated with the applicable State and Federal permit process and the Municipal SALDO review process. All permit approvals or letters of adequacy not yet received by the Applicant at the time of submittal of the SWM Site

Plan to the Avondale Borough must be submitted to the Avondale Borough prior to (or as a condition of) the Avondale Borough's final approval of the SWM Site Plan.

B. 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.

C. For Regulated Activities that do not require SALDO approval, the SWM Site Plan shall be submitted by the Applicant for review in accordance with instructions from the Avondale Borough.

D. The number of copies of the SWM Site Plan to be submitted by the Applicant for review shall be in accordance with instructions from the Avondale Borough.

E. The corresponding review fee shall be submitted to the Avondale Borough simultaneously with the SWM Site Plan, per the Avondale Borough's fee schedule.

F. Any submissions to the Avondale Borough that are found to be incomplete shall not be accepted for review and shall be returned to the Applicant within thirty (30) days, with a notification in writing of the specific manner in which the submission is incomplete.

G. Financial security, per the requirements of Section 110, shall be submitted to the Avondale Borough prior to approval of the SWM Site Plan.

Section 404. SWM Site Plan Review

A. The SWM Site Plan shall be submitted to the Avondale Borough for review by the Municipal Engineer for consistency with this Ordinance and the respective PA Act 167 Stormwater Management Plan(s). The Municipal Engineer will review the SWM Site Plan for any subdivision or land development for compliance with this Ordinance and the Municipal SALDO provisions not otherwise superseded by this Ordinance.

B. If applicable, the Applicant shall have received a "letter of adequacy" from the Conservation District or other PADEP approval for the proposed Regulated Activity prior to (or as a condition of) final approval by the Avondale Borough.

C. The Municipal Engineer will notify the Applicant and the Avondale Borough in writing, within forty-five (45) calendar days, whether the SWM Site Plan is consistent with the requirements of this Ordinance. If the SWM Site Plan involves a subdivision and land development Plan, the notification shall occur within the time period allowed by the MPC (as amended). If a longer notification period is provided by other statute, regulation, or ordinance, the Applicant will be so notified by the Avondale Borough.

1. If the Municipal Engineer determines that the SWM Site Plan is consistent with this Ordinance, the Municipal Engineer shall forward a letter of consistency to the Avondale Borough, who shall then forward a copy to the Applicant.

2. The Avondale Borough may approve the SWM Site Plan with conditions reasonably defined to make the SWM Site Plan compliant with the terms of this Ordinance, and, if so, shall provide the conditions for approval in writing.

3. If the Municipal Engineer determines that the SWM Site Plan is inconsistent or noncompliant with this Ordinance, the Municipal Engineer will forward a letter to the Avondale Borough, 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 this Ordinance. Any SWM Site Plans that are inconsistent or noncompliant may be revised by the Applicant and resubmitted in accordance with Section 406 when consistent with this Ordinance. Resubmission will commence a new municipal review and notification time period.

D. The Avondale Borough will not grant final approval to any proposed subdivision, land development, or Regulated Activity specified in this Ordinance if the SWM Site Plan has been found to be inconsistent with this Ordinance.

E. All required permits from PADEP shall be obtained and submitted to the Avondale Borough prior to (or as a condition of) final approval of any proposed subdivision, land development, or other Regulated Activity by the Avondale Borough.

F. No building permits for any Regulated Activity will be approved by the Avondale Borough if the SWM Site Plan has been found to be inconsistent with this Ordinance, as determined by the Municipal Engineer. All required permits from PADEP shall be obtained prior to issuance of a building permit.

G. The Avondale Borough's approval of a SWM Site Plan shall be valid for a period not to exceed five (5) years commencing on the date that the Avondale Borough approved the SWM Site Plan. If stormwater management facilities included in the approved SWM Site Plan have not been constructed, or if constructed, As-Built Plans of these facilities have not been approved within this five (5) year time period, then the Applicant may seek reinstatement of approval of the expired SWM Site Plan. If the Avondale Borough determines that the expired SWM Site Plan is consistent and compliant with current regulations and requirements, then the expired SWM Site Plan will be reinstated; otherwise, it will be rejected. The Applicant will be prohibited from conducting any Regulated Activity until a reinstated or newly approved SWM Site Plan is obtained in accordance with Section 406 of this Ordinance.

H. All or portions of the final approved SWM Site Plan shall be recorded (as "record plans") per the instructions of the Avondale Borough.

I. Upon completion of construction, the Applicant shall be responsible for completing final As-Built Plans of all BMPs, Conveyances, or other stormwater management facilities included in the approved SWM Site Plan as per the requirements of Section 502 of this Ordinance.

Section 405. Revision of SWM Site Plans

A. A submitted SWM Site Plan under review by the Avondale Borough shall be revised and resubmitted for any of the following reasons:

   1. A change in stormwater management BMPs, Conveyances, facilities or techniques;

   2. Relocation or redesign of stormwater management BMPs, Conveyances, or facilities; or

   3. Soil or other Site conditions are not as stated on the SWM Site Plan as determined by the Municipal Engineer, and the new conditions necessitate design changes.

   The revised SWM Site Plan shall be resubmitted in accordance with Section 403 and subject to review as specified in Section 404 of this Ordinance.

B. A revision to an approved SWM Site Plan shall be submitted to the Avondale Borough, accompanied by the applicable municipal review fee.

Section 406. Resubmission of Inconsistent or Noncompliant SWM Site Plans

Any SWM Site Plan deemed inconsistent or noncompliant may be revised and resubmitted with the revisions addressing the Municipal Engineer's concerns documented in writing. The submission shall be addressed to the Avondale Borough 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 fee shall accompany a resubmission of a SWM Site Plan previously determined to be inconsistent or noncompliant.

ARTICLE V – PERFORMANCE AND INSPECTION OF REGULATED ACTIVITIES, AND FINAL AS-BUILT PLANS

Section 501. Performance and Inspection of Regulated Activities

A. All Regulated Activities shall be conducted, operated and maintained in accordance with the requirements set forth in Articles III, VII, and VIII of this Ordinance. When a SWM Site Plan is required by this Ordinance, all Regulated Activities shall be performed in accordance with the requirements of the final approved SWM Site Plan.

B. The Municipal Engineer or other municipal designee shall be provided access to the Site to inspect all phases of the erosion and sediment control measures and installation of the permanent BMPs and Conveyances at such times as deemed appropriate by the Municipal Engineer or other municipal designee.

C. Periodic inspections may be made by the Municipal Engineer or other designee during construction. A set of design plans approved by the Avondale Borough shall be on file and available for viewing at the Site throughout the duration of the construction activity.

D. Inspections, including but not limited to a final inspection, of all constructed BMPs, Conveyances, or other stormwater facilities, and related improvements may be conducted by the Municipal Engineer or other designee to confirm compliance with this Ordinance and with the final approved SWM Site Plan prior to the issuance of any occupancy permit, use permit, or other form of final approval of the project by the Avondale Borough.

E. Upon completion of construction, every permanent stormwater BMP, Conveyance or other stormwater facility constructed or used as part of the Regulated Activity shall be operated, maintained and inspected by the Landowner, or other designated person, in accordance with the O&M Plan and O&M Agreement approved by the Avondale Borough.

F. The Avondale Borough or its designee may periodically inspect any permanent stormwater BMP, Conveyance or facility for compliance with this Ordinance, an approved O&M Plan, or an approved O&M Agreement, per the provisions of Article IX. The Avondale Borough may inspect at any time it has reason to believe a violation exists. The Avondale Borough may pursue enforcement for violations consistent with the provisions of Article IX.

Section 502. Final As-Built Plans

A. For Regulated Activities involving one (1) acre or more of Earth Disturbance, the Applicant shall provide to the Avondale Borough final As-Built Plans (signed and sealed by a qualified Licensed Professional) of all BMPs, Conveyances, other stormwater facilities, and related improvements shown in the final approved SWM Site Plan.

B. The final As-Built Plans shall include the following for all BMPs, Conveyances, other stormwater facilities and related improvements:

   1. The location, elevations, dimensions, and as-built conditions of all BMPs, Conveyances, other stormwater facilities, and related improvements including topographic contours and all typical details for storm drainage and conveyance systems, stormwater management facilities and Impervious Surfaces (existing, proposed, or constructed) included in the approved SWM Site Plan; and

   2. Explanation of any discrepancies or variations from the final approved SWM Site Plan, other related approved construction plans, calculations and specifications (and approved revisions thereto).

C. The final As-Built Plans shall include a certification of completion signed and sealed by a qualified Licensed Professional verifying that all permanent BMPs and Conveyances have been constructed according to the final approved SWM Site Plan and related approved construction plans, calculations and specifications.

D. All areas of the Regulated Activity draining to BMPs must be stabilized prior to submittal of the As-Built Plans.

E. After receipt of the As-Built Plans by the Avondale Borough, the Avondale Borough or its designee may review the As-Built Plans for consistency with this Ordinance, the final approved SWM Site Plan, other related approved construction plans, and subsequent approved revisions thereto, as well as actual conditions at the Site, and the Avondale Borough may conduct a final inspection, as per Subsection 501.D.

F. The As-Built Plans must be received, reviewed and determined to be acceptable by the Avondale Borough prior to:

   1. Close out of the drainage permit or other close out of the project by the Avondale Borough;

   2. Release of the financial security or other performance guarantee; and

   3. Dedication of the stormwater facilities to the Avondale Borough, or conveyance to a homeowners association, or other person responsible for operation, maintenance and repair.

G. Final occupancy permit(s) or Use Permit or other final approval to use or operate the constructed improvement may not be issued by the Avondale Borough until the final As-Built Plans have been accepted.

H. Upon final acceptance of the final As-Built Plans by the Avondale Borough, the Applicant shall review and, if required by the Avondale Borough, revise and re-record the O&M Plan and the O&M Agreement to reflect the final as-built conditions and information for each permanent BMP or Conveyance, in accordance with the requirements of Article VII.

I. All or portions of the final As-Built Plans shall be recorded if required by the Avondale Borough.

ARTICLE VI – FEES AND EXPENSES

Section 601. Avondale Borough SWM Site Plan Review and Inspection Fees

Fees, charges and escrow funds may be established by Borough Council by resolution and amended from time to time, to reimburse the Borough for its plan review and construction inspection costs. All fees and estimated costs listed in Subsection 602.A, as established by such resolution, shall be paid by the Applicant at the time of SWM Site Plan submission and/or at such other times as the resolution provides.

Plan & O&M Agreement review and inspection fees and escrow deposits, established by resolution of the Borough Council may be based on the size of the Regulated Activity and the Borough's costs for reviewing SWM Site Plans, O&M Plans and Agreements and As-Built Plans, and conducting inspections pursuant to Section 501.

Section 602. Expenses Covered by Fees and Escrow Deposit

A. The fees and escrow deposit required of the Applicant by this Ordinance shall at a minimum cover:

   1. Administrative costs;

   2. The review of the SWM Site Plan by Avondale Borough, the Municipal Engineer, Solicitor and other municipal consultants;

   3. Coordination and meetings with the Applicant;

   4. The inspection of erosion and sediment control measures, BMPs, Conveyances and other related improvements during construction;

   5. Review of project communications, reports, and additional supporting information;

   6. Other Site inspections;

   7. The final inspection upon completion of the BMPs, Conveyances, and other stormwater management facilities and related improvements presented in the SWM Site Plan; and

   8. Review of final As-Built Plan submission and revised calculations, and inspections as needed.

B. The Applicant shall also reimburse all expenses incurred by Avondale Borough for any additional work or municipal consultant fees, including but not limited to, solicitor's fees required to enforce any permit provisions regulated by this Ordinance, correct violations, and ensure proper completion of remedial actions.

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

Section 701. General Requirements for Protection, Operation and Maintenance of Stormwater BMPs and Conveyances

The following shall apply to all Regulated Activities in accordance with the requirements of the subsequent sections of this Article VII.

A. Continuing operations and maintenance responsibilities of all permanent BMPs, Conveyances, or other stormwater management facilities shall be reviewed and approved by Avondale Borough along with the SWM Site Plan. Avondale Borough may require an offer of a dedication of such facilities as part of the requirements for approval of the SWM Site Plan. Such a requirement is not an indication that the Borough will accept the facilities. The Borough reserves the right to accept or reject the operations and maintenance responsibility for any portion of or all of the BMPs, Conveyances or other stormwater controls and facilities.

B. An Operation and Maintenance (O&M) Plan shall be submitted to the Borough for review and approval for all existing and proposed permanent BMPs and man-made Conveyances or other stormwater facilities identified in the SWM Site Plan. Multiple BMPs or Conveyances may be addressed by a combined O&M Plan where all such facilities are similar in O&M requirements and ownership.

C. The O&M Plan(s) and O&M Agreement(s) shall name the person identified in the SWM Site Plan who shall be the owner of and be responsible for ongoing inspections, operation, repair, and maintenance of each BMP or Conveyance following completion of construction.

D. For any BMP or man-made Conveyance (including any to be located on any property other than the property being developed by the Applicant) to be owned by a person other than Avondale Borough:

   1. An O&M Agreement shall be submitted to the Borough for review and approval; and

   2. The O&M Plan shall be attached to, incorporated within, and recorded as a public record along with a fully executed O&M Agreement, all of which shall be recorded as a restrictive covenant that runs with the land and shall be binding upon the Landowner and any heirs, administrators, successors in interest or assigns of the Landowner.

E. The following shall be provided for all BMPs and Conveyances (including any to be located on any property other than the property being developed by the Applicant) by an O&M or other agreement or by otherwise establishing covenants, easements, deed restrictions, or by dedication to the Borough:

1. Permanent protection of the BMP or Conveyance from disturbance or alteration;

2. Right of entry and access for the Avondale Borough for inspection and enforcement of this Ordinance (including Subsection 903.G) and any applicable O&M Plan or O&M Agreement; and

3. Right of entry and access for the person owning the BMP or Conveyance and responsible for fulfilling the O&M requirements when that person is not Avondale Borough and is different from the owner of the property on which the BMP or Conveyance is located (such as may be applicable for Subsection 301.G of this Ordinance).

F. All O&M and other agreements, covenants, easements and deed restrictions shall:

1. Be submitted to the Borough for review and approval;

2. Be recorded as a public record, upon approval, against each parcel(s) which is part of the SWM Site Plan or otherwise contains any BMP or Conveyance comprising part of the Regulated Activity which is the subject of an O&M Agreement; and

3. Run with the land and be binding upon the Landowner, its heirs, administrators, successors in interest, and assigns.

G. The materials, documents and content required by this Article VII may be prepared in conjunction with and incorporated with similar materials, documents and content required for other permit or approval applications, such as those required by PADEP for the Post Construction Stormwater Management Plan.

Section 702. Operation and Maintenance Plans

The following items shall be included in the O&M Plan, unless otherwise approved by the Municipal Engineer:

A. A plan sheet(s) or map(s) showing each BMP and man-made Conveyance and which shall include, but not be limited to:

1. Property(ies) identification (owner name and address; and property address and/or lot and/or tax parcel number, etc.), property boundaries and tax parcel number of the land parcel on which the BMP or Conveyance is located.

2. Name, address, phone number, date prepared, signature and seal of the Licensed Professional responsible for preparation of the plan sheet or map.

3. Clear identification of the location, dimensions, and function of each BMP or Conveyance covered by the O&M Plan.

4. The location of each BMP and Conveyance relative to roadways, property boundaries, or other identifiable landmarks and existing natural drainage features such as streams, lakes, ponds, or other bodies of water within the immediate vicinity of, or receiving discharge from, the BMP or Conveyance.

5. Delineation of the land area, structures, Impervious Surfaces and Conveyances draining to and from the BMP.

6. Representative elevations and/or topographic contours at intervals of two (2) feet, or other as acceptable to the Municipal Engineer.

7. Other features including FEMA floodplain and floodway boundaries, sinkholes, etc. located within the immediate proximity of each BMP and Conveyance.

8. Locations of areas of vegetation to be managed or preserved that function as a BMP or Conveyance.

9. The locations of all surface and subsurface utilities, on-lot waste water facilities, sanitary sewers, and water lines within twenty (20) feet of each BMP or Conveyance.

10. The following as it pertains to any easements, covenants and deed restrictions established for each applicable BMP or Conveyance:

    a. Boundaries delineated with bearings and distances shown that encompass the BMP or Conveyance and that includes a ten (10)-foot perimeter area surrounding these features and sufficient vehicular ingress to and egress from a public right-of-way and roadway;

    b. Labels specifying the type and purpose of the easement, covenant, or deed restriction and who it benefits; and

    c. Labels with reference to any corresponding easement agreement, covenant, deed restriction or other document to be recorded.

11. The plan sheet or map shall be prepared at sufficient scale for municipal review, and ultimately for the use by the person responsible for operation and maintenance, and shall also be prepared at a legible scale that meets the requirements for recordation along with (and as an attachment to) the O&M Agreement and O&M Plan at the Chester County Office of the Recorder of Deeds.

B. The following information shall be included in the O&M Plan and written in a manner consistent with the knowledge and understanding of the person who will be responsible for the maintenance activities:

1. The name and address of the following:

   a. Property(ies) on which each BMP or Conveyance is located;

   b. Owner of the property;

   c. Owner of each stormwater BMP or Conveyance who is responsible for implementation of the O&M Plan;

   d. Person responsible for maintaining adequate liability insurance and payment of taxes; and

   e. Person preparing the O&M Plan.

2. A description of each BMP and Conveyance and how the BMPs and Conveyances are intended to function.

3. A description of actions necessary to operate, inspect, and maintain each BMP or Conveyance, including but not limited to:

   a. Lawn care, vegetation maintenance, landscaping and planting;

   b. Clean out of accumulated debris and sediment (including from grates, trash racks, inlets, etc.); and

   c. Other anticipated periodic maintenance and repair.

4. The following statement shall be included:

   > "*The Landowner acknowledges that, per the provisions of Avondale Borough's Stormwater Management Ordinance, it is unlawful to modify, remove, fill, landscape, alter or impair the effectiveness of, or place any structure, other vegetation, yard waste, brush cuttings, or other waste or debris into any permanent stormwater management BMP or Conveyance described in this O&M Plan or to allow the BMP or Conveyance to exist in a condition which does not conform to this O&M Plan, without written approval from Avondale Borough.*"

5. Inspection and maintenance schedules.

6. Explanation of the purpose and limitations of any easements, covenants, or deed restrictions associated with any BMP or Conveyance that are to be recorded against the property.

C. A statement that no BMP or man-made Conveyance may be used by the owner or others for any purpose other than its intended stormwater control function, or, if approved by the Municipal Engineer, a statement of specific allowable uses of the BMP (i.e., recreational benefits that maybe associated with certain BMPs owned by a homeowners association, or allowable uses by an individual residential Landowner).

D. A statement that establishes a reasonable time frame for remedy of deficiencies found by the owner during their inspections.

E. Language needed to fulfill the requirements of Subsections 705.B, 705.C, and 705.D of this Ordinance.

Section 703. Operation and Maintenance Agreements

A. An O&M Agreement shall be required for any BMP or man-made Conveyance to be owned by a person other than the Borough, and the Agreement shall:

1. Be between the owner of the BMP or Conveyance and the Borough, and shall be substantially the same as the O&M Agreement in Appendix E;

2. Incorporate the approved O&M Plan(s) for all BMPs or Conveyances to be covered by the O&M Agreement;

3. Set forth the rights, duties and obligations of the owner of the BMP or Conveyance and the Borough, and be consistent with the approved O&M Plan(s);

4. Be recorded as a deed restriction or restrictive covenant that runs with the land and shall be binding upon the Landowner, its heirs, administrators, successors in interest, and assigns;

5. Be submitted to the Borough for review prior to approval of the SWM Site Plan;

6. Upon approval by the Borough, be signed by the designated owner of the BMP or Conveyance and submitted for signature by the Borough; and

7. When fully executed, be recorded by the Landowner at the Chester County Office of the Recorder of Deeds following municipal approval of the O&M Plan and prior to the start of construction.

B. Other items or conditions may be required by the Borough to be included in the O&M Agreement where determined necessary by the Borough to guarantee the satisfactory operation and maintenance of all permanent BMPs and Conveyances.

C. After approval of the final As-Built Plans per the requirements of Article V, the Applicant shall review and, if necessary and if required by the Borough, revise and re-record the O&M Plan and O&M Agreement to reflect the final as-built conditions of each BMP and Conveyance if different from the information included in the original recorded documents.

Section 704. Easements and Deed Restrictions

A. Easements shall be established in connection with any Regulated Activity for all permanent BMPs and Conveyances that will not be dedicated to or otherwise owned by the Borough, (including any to be located on any property other than the property being developed by the Applicant), and shall:

1. Include all land area occupied by each BMP or Conveyance;

2. Include a ten (10) foot wide perimeter (or other width as determined in consultation with the Municipal Engineer) surrounding the feature(s);

3. Provide sufficient vehicular ingress and egress from a public right-of-way and roadway;

4. Permanently protect every BMP and Conveyance from disturbance or alteration where not otherwise protected by a recorded O&M Agreement, covenant, deed restriction or other means;

5. Grant the Borough the right, but not the duty, to access every BMP and Conveyance from a public right-of-way or public roadway to conduct periodic inspections and to undertake other actions that may be necessary to enforce the requirements of this Ordinance, or of any applicable O&M Plan or O&M Agreement; where roadways will not be dedicated to the Borough, the Borough shall be granted access to the private roadways as necessary to access every BMP and Conveyance;

6. Grant the owner of each BMP and Conveyance the right to access, inspect, operate, maintain, and repair the BMP or Conveyance when the feature is to be owned, operated and maintained by a person other than the Borough and other than the owner of the parcel on which it is located;

7. Be shown, with bearings and distances noted, on the SWM Site Plan map/plan sheets, O&M Plan map/plan sheets, final As-Built Plans, and be signed and sealed by a qualified Licensed Professional;

8. Include language legally sufficient to ensure that the easement shall run with the land and bind the Landowner granting the easement, its heirs, administrators, successors in interest and assigns, into perpetuity; and

9. Be recorded at the Chester County Office of the Recorder of Deeds following municipal approval and prior to the start of construction.

B. For any BMP or Conveyance to be owned by a person other than the Borough or the Landowner owning the parcel upon which a BMP or Conveyance is located, an easement agreement shall be prepared and executed between the Landowner and the owner of the BMP or Conveyance which shall:

1. Describe the ownership interests of all parties to the easement agreement, including the ownership of the BMP or Conveyance;

2. Include a written legal (metes and bounds) description of the easement area, with reference to a recorded plan sheet showing the legal boundaries of the easement area (or an accompanying plan sheet/map), signed and sealed by a qualified Licensed Professional;

3. Grant an easement from the Landowner to the owner of each BMP and Conveyance, establishing the right and obligation to occupy, access, inspect, operate, maintain, and repair the BMP or Conveyance;

4. Include a description of the purpose of the easement and the responsibilities of the parties involved;

5. Incorporate by reference or be recorded with, the corresponding O&M Plan and O&M Agreement;

6. Restrict the Landowner's use of the easement area of the parcel on which the BMP or Conveyance is located, consistent with the rights granted to the owner of the BMP or Conveyance;

7. Be submitted to the Borough for review and approval prior to approval of the SWM Site Plan;

8. Upon approval by the Borough, be signed by the owner of the BMP(s) or Conveyance(s) and the Landowner and submitted for signature by the Borough;

9. Include language legally sufficient to ensure that the easement will run with the land affected by the easement and that the easement agreement is binding upon the parties to the easement agreement, their heirs, administrators, successors in interest and assigns, into perpetuity;

10. Contain additional provisions or information as required by the Borough; and

11. When fully executed, be recorded by the Landowner at the Chester County Office of the Recorder of Deeds against all parcels affected by the terms of the easement agreement, within thirty (3) days of the Borough's approval of the corresponding O&M Plan.

C. For any BMP or Conveyance which is designed to receive runoff from another parcel or parcels and which is owned by the Landowner of the parcel upon which the BMP or Conveyance is located, in addition to any easement or easement agreement required pursuant to Subsection 704 A. or B., an easement agreement shall be prepared and executed between the Landowner of the parcel or parcels draining to the BMP or Conveyance and the owner of the BMP or Conveyance. This easement agreement shall:

1. Describe the ownership interests of all parties to the easement agreement, including the ownership of all affected parcels and of the BMP or Conveyance;

2. Provide for the grant of a drainage easement from the owner of the BMP or Conveyance to the Landowner of the parcel(s) draining to the BMP, which shall extend from the shared parcel boundary(ies) to the receiving BMP and shall include the connecting flow path(s) or Conveyance;

3. Include a written legal (metes and bounds) description of the easement area, with reference to a recorded plan sheet showing the legal boundaries of the easement area (or an accompanying plan sheet/map), signed and sealed by a Licensed Professional.

4. Incorporate by reference or be recorded with the corresponding O&M Plan and O&M Agreement;

5. State that the purpose of the easement agreement is to ensure the continuous right of the discharging parcel to discharge onto the parcel containing the BMP and into the BMP or Conveyance;

6. Restrict the BMP or Conveyance owner's use of the easement area of the parcel upon which the BMP or Conveyance is located, consistent with the purpose of the easement granted;

7. Establish the duty and responsibility of the Landowner of the parcel or parcels draining to the BMP or Conveyance to maintain the existing drainages on the discharging parcel or parcels as designed and constructed to discharge to the receiving BMP;

8. Include language legally sufficient to ensure that the easement will run with the land and will bind all parties to the easement agreement, their heirs, administrators, successors in interest and assigns, into perpetuity;

9. Be submitted to the Borough for review and approval prior to approval of the SWM Site Plan;

10. Contain all additional provisions or information as the Borough may require upon review; and

11. Be executed by the parties to the easement agreement and recorded at the Chester County Recorder of Deeds Office against the draining parcel(s) and the parcel upon which the BMP or Conveyance is located within thirty (30) days of the Borough's approval of the corresponding O&M Plan.

D. For any area(s) shown on the SWM Site Plan maps/plan sheets or As-Built Plan sheets as requiring, or area(s) that is otherwise determined to require, deed restriction(s) for the purpose of protecting and prohibiting disturbance to a BMP or Conveyance, such deed restrictions will be incorporated into a written deed, restrictive covenant, or equivalent document. The deed or other document shall:

1. Include a clear and understandable description of the purpose, terms and conditions of the restricted use;

2. Include the written legal description (metes and bounds description) of the area to which the restrictions apply that is consistent with the boundary shown on the O&M plan sheets and SWM Site Plan maps/plan sheets;

3. Make reference to any corresponding O&M Plan(s) and O&M Agreement(s);

4. Include language legally sufficient to ensure that the terms of the restriction run with the land and shall be binding upon the Landowner, its heirs, administrators, successors in interest, and assigns;

5. Be submitted to the Borough for review and approval prior to approval of the SWM Site Plan;

6. Upon approval by the Borough, be signed by the Landowner and owner of the BMP or Conveyance and submitted to the Borough; and

7. Be fully executed and recorded at the Chester County Office of the Recorder of Deeds within thirty (30) days of the Borough's approval of the O&M Plan.

Section 705. Other Post-construction Responsibilities

A. The provisions of Section 804 of this Ordinance shall apply to any permanent BMP or Conveyance that is constructed as part of an approved SWM Site Plan or covered by an approved O&M Plan.

B. The person responsible for the operation and maintenance of a BMP or Conveyance shall make records of the installation and of all maintenance and repairs, and shall retain the records for at least ten (10) years. These records shall be submitted to the Borough, if requested.

C. Upon final inspection, the Borough shall inform the person responsible for the operation and maintenance whether the submission of periodic (annual or other frequency) inspection and maintenance reports will be required.

D. The owner of each BMP and Conveyance shall keep on file with the Borough the name, address, and telephone number of the person responsible for maintenance activities and implementation of the O&M Plan. In the event of a change, new information shall be submitted by the BMP or Conveyance owner to the Borough within thirty (30) calendar (not working) days of the change.

Section 706. Municipal Stormwater Control and BMP Operation and Maintenance Fund

A. Persons installing stormwater controls or BMPs shall be required to pay a specified amount to the Municipal Stormwater Control and BMP Operation and Maintenance Fund to reimburse costs the Borough incurs for its periodic inspections and maintenance expenses for stormwater. The amount of the deposit shall be determined as follows:

   1. If the BMP or Conveyance is to be privately owned and maintained, the deposit shall cover the cost of periodic inspections performed by the Borough, as estimated by the Municipal Engineer, for a period of twenty-five (25) years. This is to be paid in a manner specified by the Borough. After that period of time, inspections will be performed at the expense of the Borough and may provide for incremental payment..

   2. If the BMP or Conveyance is to be owned and maintained by the Borough, the deposit shall cover the estimated costs for maintenance and inspections for twenty-five (25) years. The Borough will establish the estimated costs utilizing information submitted by the Applicant and may provide for incremental payment.

   3. The amount of the deposit to the fund shall be converted to present worth of the annual series values. The Borough shall determine the present worth equivalents, which shall be subject to the approval of the Borough Council.

B. If a BMP or Conveyance is proposed that also serves as a recreational facility (e.g., ball field or lake), the Borough may reduce or waive the amount of the maintenance fund deposit based upon the value of the land for public recreational purpose.

C. If at some future time, a BMP or Conveyance (whether publicly or privately owned) is eliminated due to the installation of storm sewers or other storage facility, the unused portion of the maintenance fund deposit will be applied to the cost of abandoning or demolishing the facility and connecting to the storm sewer system or other facility. Any amount of the deposit remaining after the costs of abandonment or demolition will be used for inspection, maintenance, and operation of the receiving stormwater management system.

D. If a BMP or Conveyance is accepted by the Borough for dedication, the Borough may require persons installing the BMP or Conveyance to pay a specified amount to the Municipal Stormwater Control and BMP Operation and Maintenance Fund to help cover the costs of operations and maintenance activities. The amount may be determined as follows:

   1. The amount shall cover the estimated costs for operations and maintenance for ten (10) years., as determined by the Borough, and

   2. The amount shall then be converted to present worth of the annual series values.

E. The Borough may require Applicants to pay a fee to the Municipal Stormwater Control and BMP Operation and Maintenance Fund to cover:

   1. Long-term maintenance of BMP(s) or Conveyance(s), and

   2. Stormwater-related problems which may arise from the land development and Earth Disturbance.

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 Borough's separate storm sewer system or the Waters of the Commonwealth is prohibited.

B. No person shall allow, or cause to allow, discharges into the Borough's separate storm sewer system or the Waters of the Commonwealth that are not composed entirely of stormwater, except:

1. As provided in Subsection 801.C below; and

2. Discharges allowed under a State or Federal permit.

C. The following discharges are authorized unless they are determined by the Borough to be significant contributors to pollution to the Borough's separate storm sewer system or to the Waters of the Commonwealth:

1. Discharges from fire fighting activities;

2. Potable water sources including water line and fire hydrant flushings;

3. Irrigation drainage;

4. Air conditioning condensate;

5. Springs;

6. Water from crawl space pumps;

7. Pavement wash waters where spills or leaks of toxic or hazardous materials have not occurred (unless all spill material has been removed) and where detergents are not used;

8. Diverted stream flows;

9. Flows from riparian habitats and wetlands;

10. Uncontaminated water from foundations or from footing drains;

11. Lawn watering;

12. Dechlorinated swimming pool discharges;

13. Uncontaminated groundwater;

14. Water from individual residential car washing; and

15. Routine external building washdown (which does not use detergents or other compounds).

D. In the event that the Borough determines that any of the discharges identified in Section 801.C significantly contribute pollutants to the Borough's separate storm sewer system or to the Waters of the Commonwealth, or is notified of such significant contribution of pollution by PADEP, the Borough will notify the responsible person to cease the discharge.

E. Upon notice provided by the Borough under Section 801.D, the discharger shall, within a reasonable time period, as determined by the Borough consistent with the degree of pollution caused by the discharge, cease 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, and wash water to enter a separate storm sewer system, and any connections to the separate storm sewer system from indoor drains and sinks.

B. Any drain or Conveyance connected from a commercial or industrial land use to a separate storm sewer system, which has not been documented in plans, maps, or equivalent records and approved by the Borough.

Section 803. Roof Drains and Sump Pumps

A. Roof drains and sump pump discharges shall not be connected to sanitary sewers.

B. Roof drain, sump pump, foundation and footing drain discharges:

1. To the maximum extent practicable, shall discharge to infiltration or vegetative BMPs, or to vegetated or other areas with adequate capacity;

2. May be connected to streets, storm sewers, or roadside ditches only if determined necessary or acceptable by the Municipal Engineer; and

3. Shall be considered in stormwater management calculations to demonstrate that Conveyance and receiving facilities have adequate capacity.

Section 804. Alteration of BMPs

A. No person shall modify, remove, fill, landscape, alter, or impair the effectiveness of any stormwater BMPs, Conveyances, facilities, areas or structures unless the activity is part of an approved maintenance program, without the written approval of the Borough.

B. No person shall place any structure, fill, landscaping, additional vegetation, yard waste, brush cuttings, or other waste or debris into a BMP or Conveyance, or within a stormwater easement, that would limit or alter the functioning of the stormwater BMP or Conveyance, without the written approval of the Borough.

Section 805. Applicability

A. The Provisions of this Article – Prohibitions, shall apply to all activities, persons and properties within the Borough. (See Article I, Section 105)

ARTICLE IX – ENFORCEMENT AND PENALTIES

Section 901. Public Nuisance

A. Any Regulated Activity conducted in 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.

C. A separate violation will be found to exist for each provision of this Ordinance found to have been violated.

D. To the extent that the Borough does not enforce any provision of this Ordinance, such action or inaction shall not constitute a waiver by the Borough of its rights of future enforcement hereunder.

Section 902. Right of Entry

A. Upon presentation of proper credentials, duly authorized officers or agents of the Borough may enter at reasonable times upon any property within the Borough to inspect the implementation, condition, or operation and maintenance of all erosion and sediment controls and permanent stormwater BMPs, Conveyances, or other stormwater 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 Borough shall have the right to temporarily locate on or in any BMP, Conveyance or other stormwater facility in the Borough such devices as are necessary to conduct monitoring and/or sampling of the discharges from such BMP or Conveyance, or other stormwater facilities.

C. Failure of the Landowner or representative to grant access to the Borough within twenty-four (24) hours of notification, verbal or written, is a violation of this Ordinance.

Section 903. Enforcement

A. The Municipal Engineer or other designee is hereby authorized and directed to enforce all of the provisions of this Ordinance. The Borough Council may delegate enforcement duties, including the initial determination of Ordinance violation and service of notice, if notice is given, to such other officers or agents as the Borough shall deem qualified for that purpose.

B. It shall be the responsibility of the Landowner of the real property on which any Regulated Activity is proposed to occur, is occurring, or has occurred to comply with the applicable terms and conditions of this Ordinance.

C. All municipal inspections for compliance with the approved SWM Site Plan shall be the responsibility of the Borough or its designee.

D. During any stage of the work of any Regulated Activity, if the Municipal Engineer or other designee determines that the erosion and sediment control measures, permanent BMPs, Conveyances or other stormwater facilities are not being installed or maintained in accordance with the approved SWM Site Plan, the Borough may suspend or revoke any existing permits or other approvals until the deficiencies are corrected or until a revised SWM Site Plan is submitted and approved, if and as determined to be necessary by the Municipal Engineer or other designee.

E. In the event that the Municipal Engineer or other designee finds that a person has violated a provision of this Ordinance, or fails to conform to the requirements of any permit or approval issued by the Borough, or any O&M Plan or O&M Agreement approved by the Borough, the Borough may order compliance by written notice of the violation to the Landowner.

F. 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 and/or forfeiture of financial security;

6. Implementation of stormwater controls, BMPs, and Conveyances; and

7. Operation, maintenance or repair of BMPs, Conveyances or other stormwater facilities.

G. Such notice shall set forth the nature of the violation(s), citing to specific sections of this Ordinance which have not been met, and establish a time limit for commencement of correction and completion of correction of the violations(s). The notice shall provide for a right of the Landowner's appeal to the Borough Council in accordance with Section 906 of this Ordinance. Said notice shall further advise that, if applicable, should the violator fail to take the required action within the established

deadline, possible sanctions, clearly described, may be imposed, or the work may be done by the Borough or designee, and the expense thereof shall be charged to the violator.

H. Failure to comply within the time specified in such notice shall also subject such person to the penalty provisions of this Ordinance. All such penalties shall be deemed cumulative and shall not prevent the Borough 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 Borough may be suspended or revoked by the Borough for:

1. Noncompliance with or failure to implement any provision of the permit or approved SWM Site Plan or O&M Agreement;

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 the Regulated Activity that constitutes or creates a hazard or nuisance, or endangers the life, health, safety, or property of others; or

4. Failure to correct a violation within the allowed time period allowed per notice given by the Borough.

B. Prior to revocation or suspension of a permit, unless there is immediate danger or threat of such danger to life, public health or property, at the request of the Applicant, the Borough's Council shall schedule a hearing on the violation and proposed revocation or suspension, pursuant to public notice. The expense of a hearing shall be the Applicant's responsibility.

C. A suspended permit or approval may be reinstated by the Borough when:

1. The Municipal Engineer or other designee has inspected and approved the corrections to the BMPs, Conveyances or other stormwater facilities, or the elimination of the hazard or nuisance; and

2. The Borough is satisfied that the violation has been corrected.

D. A permit or approval that has been revoked by the Borough cannot be reinstated. The Applicant may apply for a new permit or approval in accordance with this Ordinance.

Section 905. Penalties

A. Any person violating or permitting the violation of the provisions of this Ordinance shall be subject to a fine of not more than one thousand ($1,000) dollars for each violation, recoverable with costs. The establishment of a violation for purposes of setting fines or penalties for such violation shall be in accordance with a citation to a magisterial district judge with jurisdiction and venue over the location of the violation and such an action will be subject to the procedures provided for the enforcement of summary offenses under the Pennsylvania Rules of Criminal Procedure. A separate offense shall arise for each day or portion thereof a violation is found to exist and may be determined for each provision of this Ordinance which is found to have been violated.

   To the extent that the Borough is authorized by stature (including, without limitation, the Borough Code and the Stormwater management Act) to impose a civil penalty for a violation of the Ordinance and enforce such penalty by civil proceedings, the Borough may at its option impose a civil penalty of $600.00 per violation and bring a civil enforcement proceeding before magisterial district judge.

B. In addition, the Borough may, through its solicitor, 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 legal or equitable forms of remedy or relief. Such relief may include costs, fees, and charges, including the Borough's attorney's fees (charged at the hourly rate approved by the Borough Council of the Borough) and costs, as may be permitted by law.

C. Notwithstanding any other provision of this Ordinance, Avondale Borough shall have the right at any or all times deemed necessary by the Municipal Engineer or designee to enter upon any property within the Borough to inspect and, upon determination of a violation of this Ordinance, to correct the violation, with all expenses associated with correcting the violation to be charged to the property owner responsible for the violation.

Section 906. Appeals

A. Any person aggrieved by any action of the Municipal Engineer or other designee relative to the provisions of this Ordinance may appeal to the Borough's Council within thirty (30) days of that action.

B. Any person aggrieved by any decision of the Borough's Council relative to the provisions of this Ordinance may appeal to the County Court of Common Pleas in the County where the activity has taken place within thirty (30) days of the Borough's decision.

ORDINANCE APPENDIX A

SIMPLIFIED APPROACH TO STORMWATER MANAGEMENT FOR SMALL PROJECTS

Appendix A

Simplified Approach to Stormwater Management for Small Projects

Appendix A.1 –
Applicability, Submittal and Approval Requirements

Appendix A.2 –
***"Simplified Approach to Stormwater Management for Small Projects – Handbook"* (Revised June 10, 2012)**

Appendix A.3 –
***"Simplified Approach – Stormwater Best Management Practices Operation, Maintenance and Inspection Plan and Agreement"* – Sample Agreement (Revised October 12, 2012)**

Appendix A.1

Applicability, Submittal and Approval Requirements

AVONDALE BOROUGH
Chester County, Pennsylvania

Applicability:

- Small projects with less than five (500) hundred square feet of Proposed Impervious Surfaces (as defined in the Municipality's Stormwater Management Ordinance) and with less than two (2,000) thousand square feet of proposed Earth Disturbance (as defined in the Municipality's Ordinance) may apply the "Simplified Approach to Stormwater Management for Small Projects" (Simplified Approach).

- Only projects that meet the above size thresholds as specified in the Municipality's Stormwater Management Ordinance may use this Simplified Approach and are then not required to submit a formal Stormwater Management Site plan to the Municipality. However, these projects are still required to address water quality and infiltration requirements as outlined in this Simplified Approach "Handbook".

- Any project with more than five (500) hundred square feet of Proposed Impervious Surface or more than two (2,000) thousand square feet of proposed Earth Disturbance can NOT apply this Simplified Approach.

- The Applicant should first review the planned project with the Municipal Engineer prior to initiating the Simplified Approach to confirm the following:
    - That the proposed project is not otherwise exempt from the stormwater management control and the engineered Stormwater Management Site Plan requirements of the Municipality's Stormwater Management Ordinance;
    - That the proposed project is eligible to use this Simplified Approach;
    - To determine which components of the proposed project must be included in the calculation of "impervious surfaces (areas)"; and,
    - Whether any local conditions are known to the Municipal Engineer that would preclude the use of any of the techniques included in this Simplified Approach.

Submittal and Approval Requirements:

Use of the Simplified Approach requires:

- The applicant to submit the following to the Municipality for review and approval prior to beginning construction:
    - A Simplified Stormwater Management Site Plan (i.e. sketch plan) and accompanying Worksheet; and
    - A completed, signed and notarized "Simplified Operation, Maintenance and Inspection Plan and Agreement".
- The first 1-inch of rainfall runoff from Proposed Impervious Surfaces (as defined by the Municipality's Ordinance) must be captured and removed on the applicant's property.
- The applicant to record the "Simplified Approach – Stormwater Best Management Practices Operation, Maintenance and Inspection Plan and Agreement" at the Chester County Office of the Recorder of Deeds after signature by the Municipality.
- A final inspection conducted by the Municipality after completion of construction.

Simplified Approach to Stormwater Management for Small Projects

Handbook

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STORMWATER MANAGEMENT PROCEDURES FOR MEETING THE SIMPLIFIED APPROACH REQUIREMENTS

Introduction

This Handbook has been developed to allow homeowners or applicants for small projects to comply with stormwater management requirements of the Stormwater Management Ordinance of the Municipality, including sizing, designing, locating and installing on-lot measures, referred to herein as "Best Management Practices" (BMPs). **Only projects that meet the size thresholds specified in the Municipality's Stormwater Management Ordinance may use this Simplified Approach** and are then not required to submit a formal Stormwater Management Site plan to the Municipality. However, these projects are still required to address certain requirements, such as stormwater quality, infiltration, rate and volume management goals as outlined in this Simplified Approach Handbook.

Pennsylvania Act 167 (PA Stormwater Management Act) was authorized on October 4, 1978 (32 P.S., P.L. 864) and gave Pennsylvania Municipalities the power to regulate activities that affect flooding, streambank erosion, stormwater runoff and surface and groundwater quantity and quality. The Municipality's Stormwater Management Ordinance was prepared to comply with the PA Act 167 requirements and includes provisions allowing this Simplified Approach to be used for small projects as specified in their Ordinance.

If the guidelines presented in this Handbook are followed, the applicant may not require professional engineering services to comply with these stormwater management goals. This Handbook is organized into five sections:

- **Section 1** describes requirements and a simplified approach for designing a suitable BMP, and a description of what needs to be included on the simplified stormwater management (SWM) site plan (i.e. sketch plan).
- **Section 2** presents definitions of key terms.
- **Section 3** presents options of BMPs that can be considered for on-lot stormwater management.
- **Section 4** illustrates an example of how to obtain the size and dimensions of a BMP(s) for a sample project.
- **Section 5** describes the requirements to be met for a "Simplified Approach Operation, Maintenance and Inspection Plan and Agreement".

The Simplified Approach requires:

- The applicant to submit the following to the Municipality for review and approval prior to beginning construction:
    - A Simplified Stormwater Management (SWM) Site Plan (i.e. sketch plan), and accompanying Worksheet, and
    - A completed and signed "Simplified Approach Operation, Maintenance and Inspection Plan and Agreement".

- The first 1-inch of rainfall runoff from proposed impervious surfaces (as defined by the Municipality's Ordinance) must be captured and removed from the stormwater runoff leaving the applicant's property.
- The applicant to record the "Simplified Approach Operation, Maintenance and Inspection Plan and Agreement" at the County's Recorder of Deeds after signature by the Municipality.

The purpose of requiring effective stormwater management from small projects 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 submitted to the Municipality?

☐ Simplified Approach Worksheet (Table 4)

☐ Simplified SWM site plan (i.e. sketch plan), containing the features described in Section 1, Step 1

☐ "Simplifed Approach Operation, Maintenance and Inspection Plan and Agreement" must be signed, notarized and (after approval and signature by the Municipality) recorded at the County Recorder of Deeds.

If the applicant is using a contractor to construct the project, the worksheet and sketch plan must be shared with the contractor to ensure the BMP(s) are properly installed.

1. Determination of Simplified Approach Volume Requirements

All proposed impervious areas (as required by the Municipality's Ordinance) must be included in the determination of the amount of new impervious areas and the size of proposed BMPs needed to manage stormwater. Proposed impervious areas on an individual residential lot generally include, but are not limited to: roof area, pavement, sidewalks, driveways, patios, porches, permanent pools, or parking areas, etc. See the definitions provided in Section 2 and check with the Municipal Engineer to confirm what features of the proposed project must be included in the calculation of new impervious areas. Sidewalks, driveways, or patios that are constructed with gravel or pervious pavers and will not be disturbed or altered in the future may not need to be included in this calculation (check with the Municipal Engineer). In these cases, the amount of proposed impervious area may be reduced for proposed driveways, patios, and sidewalks through the use of gravel, pervious pavement, and turf pavers. All proposed impervious areas must be constructed so that runoff is conveyed to a BMP(s); no runoff may be directed to storm sewers, inlets or other impervious areas (i.e. street) without effective stormwater management from a site.

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 the amount of impervious cover, disconnecting gutters and directing stormwater runoff to vegetated areas to infiltrate, and redirecting the flow of stormwater runoff from impervious surfaces to vegetated areas instead of the street or gutter.

Below are the steps that must be undertaken to meet the Ordinance requirements. The size and description of the proposed construction as well as important aspects related to the design of the BMP(s) must be documented in the Simplified Approach Worksheet found in Table 4. All individuals planning on using the Simplified Approach are encouraged to review the planned project with the Municipal Engineer prior to initiating the Simplified Approach to confirm the following:

- That the proposed project is not otherwise exempt from the stormwater management control and engineered Stormwater Management Site Plan requirements of the Municipality's Stormwater Management Ordinance;
- That the proposed project size is within the range eligible to use this Simplified Approach;
- To determine which components of the proposed project must be included in the calculation of "impervious areas"; and
- Whether any local conditions are known to the Municipal Engineer that would preclude the use of any of the techniques included in this Simplified Approach.

Step 1 - Prepare the Simplified SWM Site Plan (i.e. sketch plan) that includes:

- Name and address of the owner of the property, and name and address of individual preparing the plan (if different than the property owner), along with the date of submission.
- Location of all existing structures including buildings, driveways, and roads within fifty (50) feet of the project site.

- Location of proposed structures, driveways, or other paved areas with approximate size in square feet.
- Location, and distance, of any existing surface water features, such as streams, lakes, ponds, wetlands or other natural waterbodies, within fifty (50) feet of the project site and/or BMPs. Depending upon the Municipality's requirements, the following may also be required (check with the Municipal Engineer):
    - The project and/or BMPs cannot cause earth disturbance within fifty (50) feet from a perennial or intermittent stream, wetland or waterbody. Protecting this area from non-disturbance along the aforementioned features helps protect the applicant's land from erosion, the flood carrying capacity of streams, and the water quality of the waterbody. Where the applicant cannot meet the 50-foot non-disturbance width, the applicant should work with the Municipal Engineer to determine if a reduced width is acceptable, however a minimum of at least a 10 foot non-disturbance area width should be maintained.
    - If an existing buffer is legally prescribed (i.e., deed, covenant, easement, etc.) and it exceeds this requirements, the existing buffer must be maintained.
- 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-lot septic system and potable water wells showing rough proximity to infiltration facilities. See Section 3. Description of BMPs, for the appropriate setbacks for on-lot septic systems and potable water wells.

Step 2 –Determine the Impervious Area to be Managed

- Determine the total area of all proposed impervious surfaces that will need to drain to one or more BMP(s).
- Also determine the total area for proposed earth disturbance to complete the project and install the BMP(s). The total earth disturbance to complete a project is often greater than the project area to allow for access from construction vehicles, stock piling of materials and excavation. The total area of earth disturbance must account for all of the construction activities necessary to construct the project.
- Determine locations where BMP(s) need to be placed so that the appropriate amount of stormwater runoff from the proposed impervious surfaces can be captured and managed.

Step 3 – Select the BMP(s) to be Used and Determine Appropriate Sizing Criteria

- Select the BMP(s) to be used and determine the requirements of each from Section 3, Description of BMPs.
    - For instance, the back half of a garage may drain to a rain barrel and the front half of the garage and a driveway may drain to a bioretention area. Each BMP will be sized differently, manage stormwater runoff and will need to be designed to be consistent with Section 3.
- Then obtain the required storage volume and surface area needed for each of the proposed BMP(s) from the appropriate heading below.
- Complete Table 4 Simplified Approach Worksheet.

For Rain Barrels/Cisterns:
Step 3A –Select the proposed impervious area value in Column 1 of Table 1 that is closest to, but not less than the determined value.

Step 3B – 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 1.

For Rain Gardens/Bioretention or Dry Well #1:
Step 3A – Select the proposed impervious area value in Column 1 of Table 2 that is closest to, but not less than the determined value.

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

Step 3C – Using the value from Column 2 determined above, and the depth (D) of the proposed BMP, simply determine the surface area needed from Column 3 of Table 2.

Note: The arrows under Column 3 in Table 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, and 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.

For Infiltration Trench or Dry Well #2:
Step 3A – Select the proposed impervious area value in Column 1 of Table 3 that is closest to, but not less than the determined value.

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

Step 3C – Using the value from Column 2 determined above, and the depth (D) of the proposed BMP, simply determine the surface area needed from Column 3 of Table 3.

Note: The arrows under Column 3 in Table 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, and 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 4 – Submit the final SWM Site Plan, Simplified Approach Worksheet, and signed and notarized "Simplified Approach Operation, Maintenance and Inspection Plan and Agreement" (a sample document is provided in the accompanying appendix) to the Municipality for review and approval prior to beginning construction. After the Municipality has signed the "Simplified Approach Operation, Maintenance and Inspection Plan and Agreement", record the Agreement at the County's Office of Recorder of Deeds. Construction can begin only after the Municipality has issued its approval of the proposed project to the applicant.

Table 1: Simplified Approach - Calculating Rain Barrel/Cistern Storage Volume for 1" Rainfall[1]

Column 1	Column 2	Column 3	
Proposed Impervious Area (square feet)	**Volume of Rain Barrel/Cistern[2] (cubic feet)**	**Volume of Rain Barrel/Cistern (gallons)**	
I	V_{RBcf}	V_{RBgal}	
Sum of all Proposed Impervious Areas	$(1*(1/12)*I)/0.75=V_{RBcf}$	$V_{RBcf} * 7.48=V_{RBgal}$	
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	**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	

[1]The typical volume of a rain barrel is between 50-200 gallons, so more than one rain barrel may be needed. Larger volumes may require a cistern.
[2]It is assumed that the rain barrel/cistern is 25% full prior to receiving runoff.

Table 2: Simplified Approach - Calculating Rain Garden/Bioretention and Dry Well #1 Storage Volume and Surface Area for 1 Inch Rainfall

Column 1	Column 2	Column 3							
Total Proposed Impervious Area (square feet)	**Volume of Rain Garden/Bioretention or Dry Well #1[1] (cubic feet)**	**Surface Area of Rain Garden/Bioretention or Dry Well #1** Acceptable Depths for Each BMP are indicated by the arrows below **(square feet)**							
		Area Required for a BMP with a Depth(D) of 0.5'	*Area Required for a BMP with a Depth(D) of 1.0'*	*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'*
		← **Rain Garden /Bioretention (0.5'-1.0')** →		← **Dry Well #1 (1.5'-4.0')** →					
I	V	*A(sf)*							
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

[1] It is assumed that the rain garden/bioretention or the dry well #1 are empty prior to receiving runoff (i.e. 0% full)

Table 3: Simplified Approach - Calculating Infiltration Trench and Dry Well #2 Storage Volume and Surface Area for 1 Inch of 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'*
						Infiltration Trench (2.0'-5.0')			
		Dry Well #2 (1.5'-4.0')							
I	V	*A(sf)*							
Sum of all Proposed Impervious Areas	$(1*(1/12)*I)/(0.4)^1=V$	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

[1] Assumes a percent void volume of 40%

Table-4: Simplified Approach Worksheet

Name of Property Owner(s):	Date:
Name of Applicant(s) [if different than Owner(s)]:	
Contact Phone #:	Email Address:
Address of Project:	
Description of Project:	
☐ Met with Municipal Engineer to discuss proposed project. [insert date of meeting]	
Distance from earth disturbance to nearest surface water feature (stream, pond, wetland, etc.) (if required by the Municipality, circle one): 50 feet or less	More than 50 feet
☐ **Step 1**: Attach Simplified SWM Site Plan (i.e. sketch plan), per Section 1, Step 1	
Step 2: Determine the Impervious Area to be Managed	
Total Proposed Impervious Area (square feet):	
Total Earth Disturbance (square feet):	
Step 3: Select the BMP(s) to be Used and Appropriate Sizing Criteria	
[redacted]	
[redacted]	
[redacted]	
☐ **Step 4**: Complete, Sign & have Operation, Maintenance and Inspection Plan and Agreement Notarized and Recorded at the County Recorder of Deeds (when signed by Municipality)	

Note: For additional BMPs, use additional sheet(s).

2. Definitions

These definitions apply only to this Simplified Approach to Stormwater Management for Small Projects Handbook. The definitions included in the Municipality's Stormwater Management Ordinance also apply.

Best Management Practice (BMP) – As defined in the Municipality's Stormwater Management Ordinance, but generally including activities, facilities, designs, measures or procedures used to manage stormwater impacts from land development and earth disturbance activities to meet stormwater quality, runoff control and groundwater recharge protection requirements. BMPs include, but are not limited to, a wide variety of practices and devices such as: infiltration facilities (dry wells and infiltration trenches), filter strips, low impact design, bioretention (rain gardens), permeable paving, grassed swales, and manufactured devices (cisterns and rain barrels). Structural stormwater BMPs are permanent appurtenances to the project site.

Geotextile - A fabric manufactured from synthetic fibers which provides a separation between different types of media (i.e., soil and stone), and is used to achieve specific objectives, including infiltration 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, recycling facilities, vehicle fueling stations, fleet storage areas, vehicle equipment and cleaning facilities, and vehicle service and maintenance facilities).

Impervious Surface - As defined in the Municipality's Stormwater Management Ordinance, but generally including any surface that prevents the infiltration of water into the ground. Impervious surfaces generally include, but are not limited to, streets, sidewalks, pavements, driveway areas, or roofs. The applicant should review the Municipality's Stormwater Management Ordinance or consult with the Municipal Engineer to confirm what components of the proposed project are considered "impervious surfaces". Decks, swimming pools, compacted soils or stone surfaces (such as for vehicle movement or parking), among other features, may be included in the Municipality's definition of "impervious surfaces".

Infiltration - Movement of surface water into the soil, where it is absorbed by plant roots, transpired or 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.

Percent Void Volume – The volume of void space, expressed as a percentage, of the total volume of the storage facility (void volume + volume of solid materials providing structural support for the storage facility).

Pervious Surface - Any area not defined as impervious surface.

Potable – A water supply that is either absent of contaminants or contains contaminant levels that are below a given threshold level that makes the water as suitable for drinking.

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.

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 Stormwater BMP Manual (December, 2006). Refer to the PA BMP Manual (latest version) which can be found on the PA Department of Environmental Protection's website.

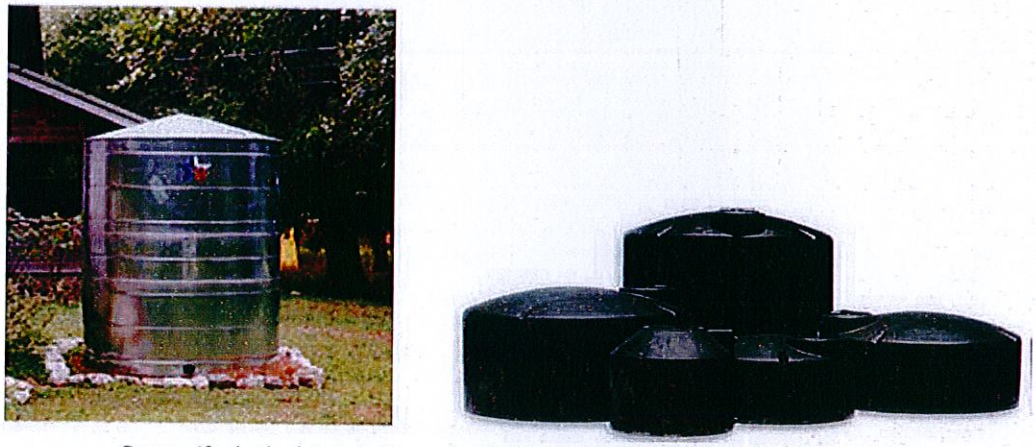
Rain Barrels/Cisterns

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 to 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 either on the surface or underground. Figures 1 and 2 show examples of rain barrels and cisterns, respectively, that could be used to manage stormwater from a project. 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 in the container 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 of the storage container with an overflow pipe to divert flow away from structures once the storage containers are filled.
- Use screens to filter debris, and covers (lids) placed over the containers to prevent insects and debris from entering the storage chamber.
- 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. The tables contained in this Handbook were developed to account for the 25% increase in the required storage of a rain barrel or a cistern.

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

Figure 1: Rain Barrels



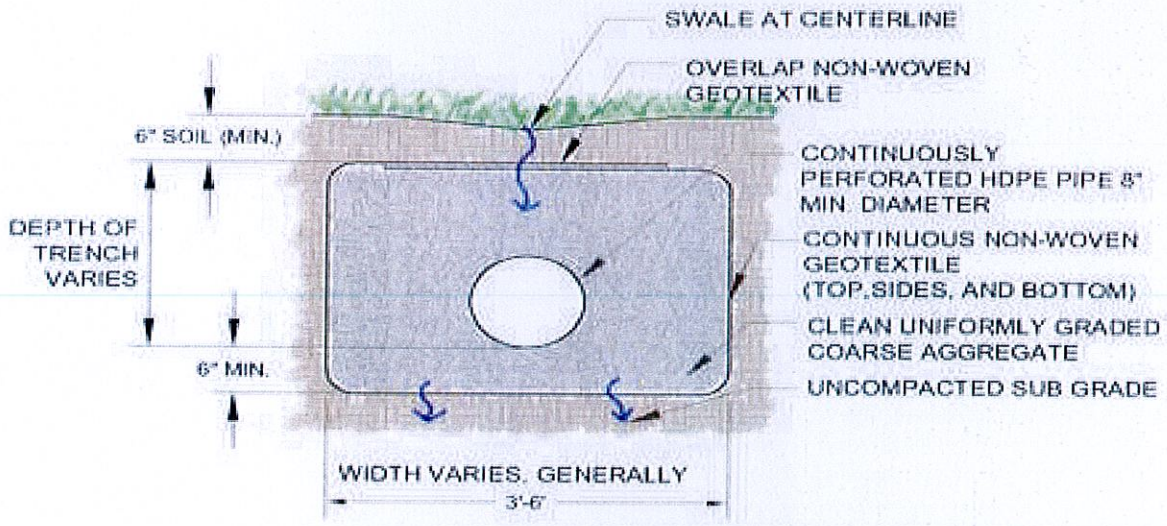
Source (for both pictures): Pennsylvania Stormwater BMP Manual (PADEP, 2006)

Figure 2: Cisterns

Infiltration Trench

An infiltration trench is a long, narrow, rock-filled trench, with or without a perforated pipe placed within the rock to distribute water evenly along the trench, 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 of the trench into the underlying soil matrix. Figure 3 shows a typical cross-section of an infiltration trench configuration. Infiltration trenches shall incorporate or make provisions for the following elements:

- These facilities should be located a minimum of ten (10) feet (or as otherwise required by the Municipality) from the building foundation to avoid foundation seepage problems, and are not recommended if their installation would create a risk of flooding other structures constructed at or below grade.
- Perforated pipe placed within the rock is to be set level.
- The width is limited to between **3 to 8 feet**, and the depth ranges from **2 to 5 feet**.
- Trench should be wrapped in nonwoven geotextile (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 soil is capable of infiltrating stormwater.
- It is recommended that there be a 2 foot clearance above the regularly occurring seasonal high water table, and have 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 stormwater Hotspots (refer to B.2 Definitions).
- 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 by heavy equipment during and after construction.
- Infiltration trenches should be constructed after all earth disturbance associated with a given project or site is stabilized to avoid clogging.
- The ratio of the drainage area which stormwater runoff is collected from to the area of the footprint (bottom area) of the infiltration portion of the facility should be as small as possible with a ratio of less than 5:1 preferred.



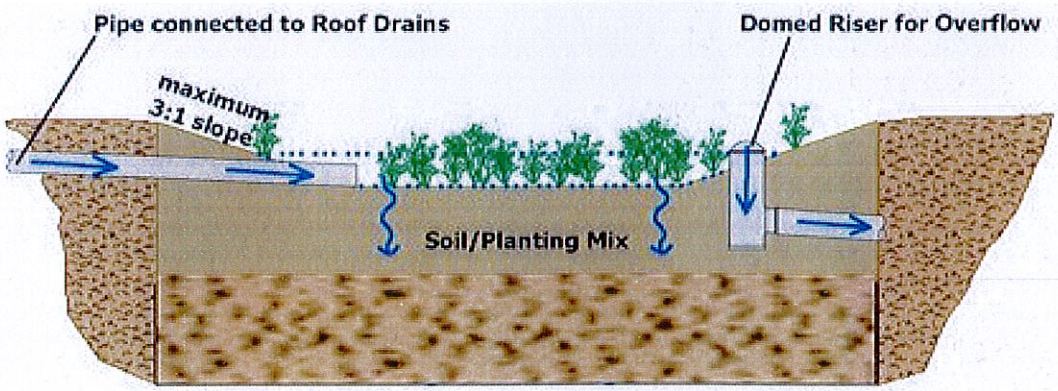
Source: Pennsylvania Stormwater BMP Manual (PADEP, 2006)

Figure 3: Cross-Section of Typical Infiltration Trench

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/planting mix below the surface where plants can use the water to grow. Bioretention improves water quality, with the vegetation planted in the facility filtering the water, and the root systems encouraging or promoting infiltration. Figure 4 shows a cross-section of a typical rain garden. Key elements of a rain garden include:

- Recommended ponding depths not exceeding **1 foot**.
- Native vegetation that can tolerate dry and wet weather.
- An overflow area where, if the bioretention area were to overflow, the overflow would flow over pervious surfaces (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 infiltration areas, pervious areas, or connected storm systems designed to receive the excess runoff.
- For most areas, slopes should be limited to 3:1, maximum; however, where space is limited, 2:1 side slopes may be acceptable with approval from the municipal engineer.
- The soil/planting mix depth should not be less than 1.5 feet deep and typically consist of a mixture of topsoil, sand and compost (i.e. mulch). The topsoil, sand and compost should be uniformly mixed by volume in a 50%, 30%, 20% mixture, respectively.



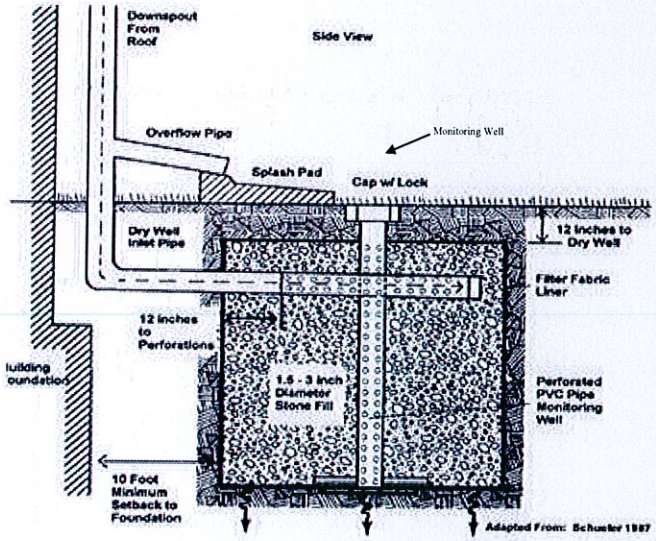
Source: Pennsylvania Stormwater BMP Manual (PADEP, 2006)

Figure 4: Cross-Section of Typical Rain Garden/Bioretention Area

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 5 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 (or as otherwise required by the Municipality) from the building foundation to avoid foundation seepage problems, and are not recommended if their installation would create a risk of flooding other structures constructed at or below grade.
- Dry well should be constructed after all earth disturbance associated with a given project or site is 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.
- For Dry Well #2 designs, the depth of dry well should be between **1.5 feet to 4 feet**. Gravel fill should consist of uniformly graded stone with an average diameter of between one and one half and two (1.5 –2.0) inches with the gravel fill wrapped in a nonwoven geotextile to separate the stone fill from the surrounding soil.
- At least 1 foot of soil must 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 overflow the facility and flow into a connected infiltration area, pervious area, or other connected storm sewer designed to receive the excess runoff.
- Every dry well must have at least one monitoring well to assist in the inspection of the dry well to determine how much water is retained within the well during dry weather periods.
- Infiltration testing is recommended to ensure the underlying soil is capable of infiltrating the needed volume of stormwater.



Source (for picture on left): http://www.seagrant.sunysb.edu/pages/BMPsForMarinas.htm
Source (for picture on right): http://www.copelandconcreteinc.net/1800652.html

Figure 5: Typical Dry Well Configuration filled with Stone Fill (DRY WELL #2) (Left) and Structural Prefabricated Chamber (DRY WELL #1) (Right)

4. Example

Simplified Approach to Stormwater Management for a Residential Garage and Driveway addition

Joe Homeowner wants to build a 400 square foot two car garage, and a 540 square foot (30′ long x 18′ wide) impervious driveway that is graded so that the stormwater runoff drains to the grassy area along one edge of the driveway. (An annotated copy of Table 1 is provided below as Table 5 and an annotated copy of Table 3 is provided below as Table 6, and outlines the steps of this example) and a completed Table 4 is provided as Table 7.

STEP 1 – Make a sketch of the site plan as shown in Figure 6.

STEP 2 - Determine the total area of all proposed 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	30 ft. x 18 ft.	=	540 sq. ft.
Total Proposed Impervious Surface			**940 sq. ft.**
Total Proposed Earth Disturbance Area			**2,500 sq. ft. (estimated)**

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 project.

STEP 3 – Select the BMP(s) to be Used and Appropriate Sizing Criteria

Select a BMP or combination of BMPs from Section 3 to be used to satisfy the volume requirement. Determine the length, width, depth and other requirements for the BMPs in Section 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 6 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.

<u>BMP #1 (Rain Barrel/Cistern) – Steps 3A and 3B</u>

STEP 3A - Select the proposed 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 1:
The value in Column 1 that is closest to but is not less than 200 is 200.

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

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 value in Column 3 for the same row 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. Depending on the size of the rain barrel(s), a combination of rain barrels could be used in succession as shown in Figure 1, or a cistern could be used.

BMP #2 (Infiltration Trench) - Steps 3A through 3C

STEP 3A - Select the proposed impervious area value for BMP #2, the infiltration trench, using Column 1 in Table 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 3B - Determine the volume that BMP #2, the infiltration trench must be to satisfy the volume requirements using Column 2 in Table 6:

The volume of the infiltration trench to be used as BMP #2, assuming a percent void volume of 40%, is determined by finding the value Column 2 that is in the same row as 750 square feet from Column 1 as described in Step 2. Therefore, the volume of BMP #2 must be 156 cubic feet.

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

Joe Homeowner would like to place the infiltration trench along the edge of the driveway 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 3, is 3 feet. Therefore, the area of the infiltration trench is:

20 feet * 3 feet = 60 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:

BMP #1: Rain barrel(s) that provides for at least 166 gallons, and
BMP #2: A 20′ long x 3′ wide x 3′ deep infiltration trench

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

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

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

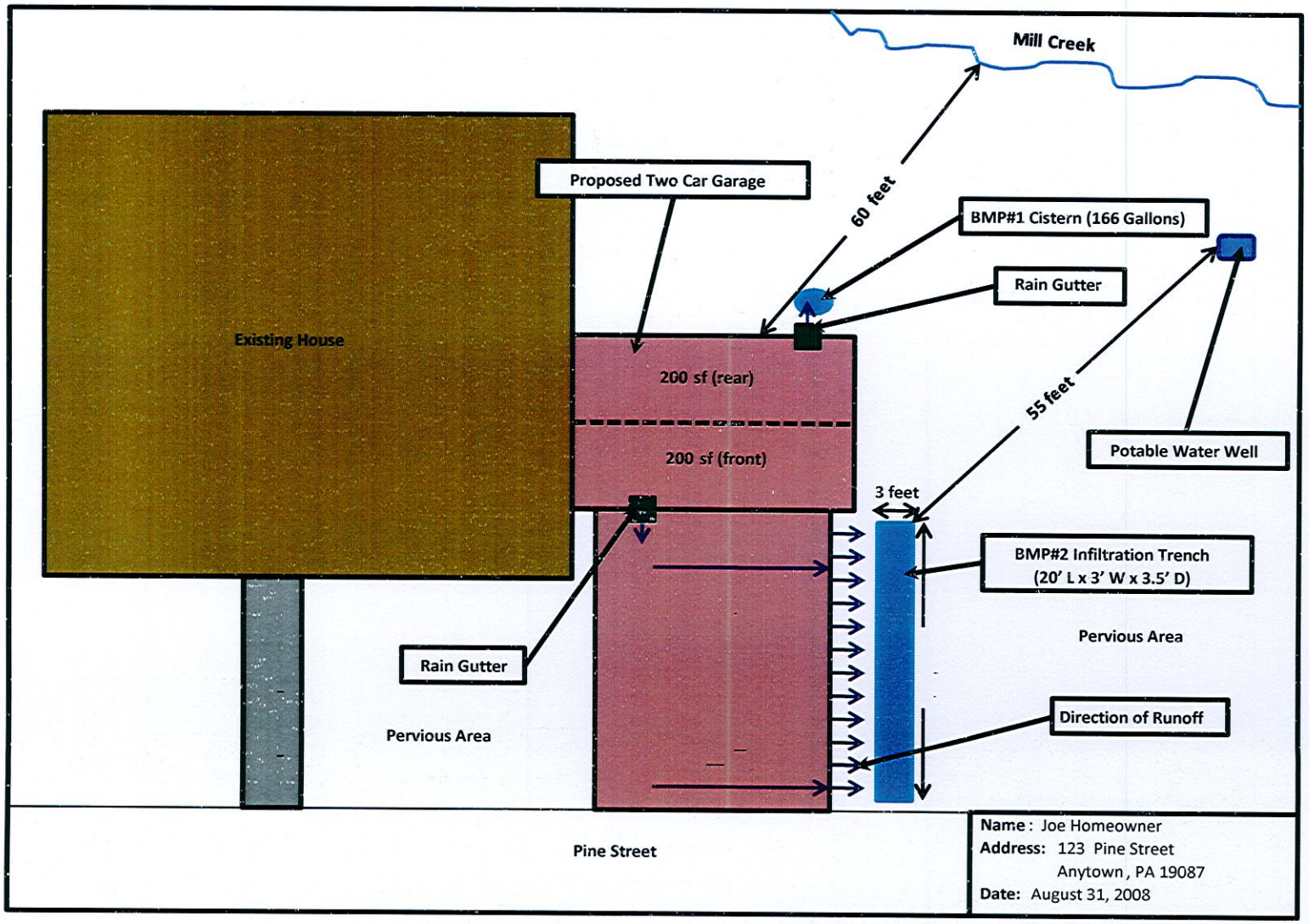


Figure 6: Example of Simplified Stormwater Management Site Plan for Joe Homeowner (revised 10/28/13)

Table 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[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'*
		Dry Well #2 (1.5'-4.0')				Infiltration Trench (2.0'-5.0')			
I	V	*A(sf)*							
Sum of all Proposed Impervious Areas	$(1*(1/12)*I)/(0.4)^1=V$	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
Step 3A 750	Step 3B 156	104	78		Step 3C 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

[1] Assumes a percent void volume of 40%

Table 7: Simplified Approach Worksheet – Example for *Joe Homeowner*

Name of Property Owner(s): **Joe Homeowner**					Date: **8/26/12**
Name of Applicant(s) [if different than Owner(s)]: **N/A**					
Contact Phone #: **610-555-1234** Email Address: **joe@homeowner.com**					
Address of Project: **123 Pine St., Anytown, PA 19355**					
Description of Project: **Add a 2-car garage and driveway**					
☐ Met with Municipal Engineer to discuss proposed project. [date of meeting 6/1/12]					
Distance from earth disturbance to nearest surface water feature (stream, pond, wetland, etc.) (if required by the Municipality, circle one): 50 feet or less More than 50 feet					
[x] **Step 1**: Attach Simplified SWM Site Plan (i.e. sketch plan), per Section .1, Step 1					
Step 2: Determine the Impervious Area to be Managed					
	Total Proposed Impervious Area (square feet): **940 sq. feet**				
	Total Earth Disturbance (square feet): **~ 2,500 sq. feet**				
Step 3: Select the BMP(s) to be Used and Appropriate Sizing Criteria					
	Rain Barrel or Cistern				
	Proposed Impervious Surface from Column 1 in Table 1	Volume from Column 3 in Table 1			
	200 sq. feet	**166 gallons**			
	Rain Garden/Bioretention or Dry Well #1				
	Proposed Impervious Surface from Column 1 in Table 2	Volume of BMP from Column 2 in Table 2	Area Dimensions of BMP - Column 3 in Table 2	Depth of BMP from Column 3 in Table 2	Types of Materials to be Used
	N/A				
	Infiltration Trench or Dry Well #2				
	Proposed Impervious Surface from Column 1 in Table 3	Volume of BMP from Column 2 in Table 3	Area Dimensions of BMP - Column 3 in Table 3	Depth of BMP from Column 3 in Table 3	Types of Materials to be Used
	740 sq. feet	**156 cubic feet**	**20 ft by 3 ft**	**3 ft**	**Infiltration trench, uniformly graded aggregate, 8" HDPE pipe, geotextile, grass planted on top.**
[x] **Step 4**: Complete, Sign & have Operation, Maintenance and Inspection Agreement Notarized and Recorded at the County Recorder of Deeds (when signed by the Municipality)					

Note: For additional BMPs, use additional sheet(s).

5. Simplified Approach Operation, Maintenance and Inspection Plan and Agreement

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 accompanying sample "Simplified Approach Operation, Maintenance and Inspection Plan and Agreement" (see accompanying appendix) 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 "Simplified Approach Operation, Maintenance and Inspection Plan and Agreement" must be signed, notarized and submitted to the Municipality. Following the signature by the Municipality, the property owner must have the Agreement recorded at the County Recorder of Deeds, so that the Agreement will be applicable to future property owners.

Appendix A.3

Simplified Approach – Stormwater Best Management Practices Operation, Maintenance, and Inspection Plan and Agreement

SAMPLE AGREEMENT

A.3 Simplified Approach - Stormwater Best Management Practices Operation, Maintenance, and Inspection Plan and Agreement

SAMPLE AGREEMENT

It is the Landowner's responsibility to properly maintain BMPs. It is also the Landowner'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 inspection and maintenance required for each type of BMP, the responsibilities of the Landowner, and the rights of the Municipality in regards to inspection and enforcement of the maintenance requirements.

The Operation, Maintenance and Inspection Plan and Agreement must be signed, notarized and submitted to the Municipality. Following approval and signature by the Municipality, the Landowner must have the Agreement recorded at the Chester County Office of the Recorder of Deeds, so that the Agreement will be applicable to future landowners.

SIMPLIFIED APPROACH
STORMWATER BEST MANAGEMENT PRACTICES
OPERATION, MAINTENANCE, AND INSPECTION PLAN AND AGREEMENT

THIS AGREEMENT, made and entered into this _____ day of _____, 20___, by and between _____, (hereinafter the "Landowner"), and _____(City, Borough, Township), Chester County, Pennsylvania, (hereinafter "Municipality").

WITNESSETH

WHEREAS, the Landowner is the owner of certain real property by virtue of a deed of conveyance recorded in the land records of Chester County, Pennsylvania, at Deed Book _____ and Page _____, (hereinafter "Property"); and

WHEREAS, the Landowner recognizes that the stormwater management best management practices or BMPs (hereinafter referred to as "BMP" or "BMP(s)") located on the Property at

_____

_____ (address of Property where BMP is located) must be inspected and maintained; and

WHEREAS, the Municipality and the Landowner, for itself and for its administrators, executors, successors, heirs, 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 BMP(s) be constructed and maintained on the Property; and

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

BMP – "Best Management Practice;" activities, facilities, designs, measures or procedures used to manage stormwater impacts from land development, to protect and maintain water quality and ground water recharge and to otherwise meet the purposes of the Municipality's Stormwater Management Ordinance, including, but not limited to infiltration trenches, dry wells, bioretention, rain gardens, permeable paving, rain barrels and cisterns, etc. The BMP(s) are permanent appurtenances to the Property; and

Conveyance -- As specifically identified in the Simplified Stormwater Management Site Plan (herein after "Plan"), a man-made, existing or proposed facility, structure 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, and like facilities or features. The conveyances identified in the Plan are permanent appurtenances to the Property; and

WHEREAS, the Municipality requires that the BMP(s) and conveyances as shown on Plan and in accordance with the sizing calculations found on the Simplified Method Worksheet (herein after "Worksheet") be constructed by the Landowner; the BMP(s) shall further be maintained by the Landowner, its administrators, executors, successors, heirs, and assigns in accordance with the associated operation and maintenance requirements included herein. The Plan and Worksheet are attached hereto and incorporated herein together as Exhibit "A" hereto; and

WHEREAS, the Municipality requires that stormwater management BMP(s) be constructed and adequately inspected, operated and maintained by the Landowner, its administrators, executors, successors, heirs, and assigns, in accordance with the following maintenance requirements:

NOTE TO EDITOR:
Retain the type of BMP(s) from the following list that applies to this Property and delete any of the following BMP(s) listed below that do not apply. You may also add a BMP not listed and provide its maintenance requirement, if needed.

1. Infiltration Trenches

a. At least twice a year and after significant rainfall events the Landowner is to inspect the infiltration trench and remove any accumulated debris, sediment and invasive vegetation.

b. Vegetation along the surface of an infiltration trench is to be maintained in good condition, and any bare spots are to be revegetated as soon as possible.

c. Vehicles are not to be parked or driven on an infiltration trench, and care is to be taken to avoid excessive compaction by mowers.

d. Any debris, such as leaves blocking flow from reaching an infiltration trench, is to be routinely removed.

2. **Bioretention/Rain Garden**

a. Any debris, such as leaves blocking flow from reaching a bioretention/rain garden, is to be routinely removed.

b. Pruning and weeding are required as needed including removal of invasive species, especially while vegetation is being established for a bioretention/rain garden.

c. Mulch cover is to be maintained in a bioretention/rain garden, re-spread and replaced as needed to prevent erosion, reduce weed growth and assist with plant survival, without restricting the infiltration of stormwater.

d. At least twice a year the Landowner is to inspect the bioretention/rain garden for sediment buildup, ground cover and vegetative conditions and make any repairs as needed.

e. Watering is required as needed, including during periods of extended dry weather and drought.

f. Trees and shrubs in a bioretention/rain garden are to be inspected at least twice per year by the Landowner to evaluate their health. If they are in poor health they are to be replaced.

3. **Dry Wells**

a. Dry wells are to be inspected by the landowner at least four (4) 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 or recycling sites and in compliance with local, state, and federal waste regulations.

b. For dry wells, gutters are to be regularly cleaned out and ensure that proper connections are maintained to facilitate the effectiveness of the dry well.

c. The filter screen for downspouts or roof gutters which intercepts roof runoff and conveys it to the dry well must be cleaned and replaced as necessary.

d. Dry wells that are damaged are to be fixed or replaced within two (2) weeks of being damaged.

e. If an intermediate sump box exists in conjunction with a dry well, it must be cleaned out at least once per year.

4. **Rain Barrels and Cisterns**

a. Rain Barrels and Cisterns are to be cleared of debris routinely at least every three (3) months and after significant storms to allow stormwater from gutters to enter them.

b. Gutters that directly convey rain water to dry wells, rain barrels, and cisterns are to be routinely cleared of trash and debris at least every three (3) months and after significant rainfall events.

c. Rain Barrels and cisterns should be routinely emptied to allow for storage of additional rain water.

d. Overflow outlets from rain barrels and cisterns must be kept free and clear of debris.

e. Rain Barrels and cisterns that are damaged are to be fixed or replaced within two (2) 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, intending to be legally bound hereby, agree as follows:

1. The foregoing recitals to this Agreement are incorporated as terms of this Agreement and obligations of the Landowner as if fully set forth in the body of this Agreement.

2. The Landowner shall construct the BMP(s) in accordance with the specifications identified in the Plan and Worksheet.

3. The Landowner shall inspect, 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 inspection and maintenance requirements outlined in this Agreement.

4. The Landowner hereby grants permission to the Municipality, its authorized agents and employees, to enter upon the Property from the public right-of-way or roadway, at reasonable times and upon presentation of proper identification, to inspect the BMP(s) whenever it deems necessary for compliance with this Agreement and the Municipality's Stormwater Ordinance. Whenever possible, the Municipality shall notify the Landowner prior to entering the Property.

5. The Landowner acknowledges that, per the Municipality's Stormwater Ordinance, it is unlawful, without written approval of the Municipality, to:

a. Modify, remove, fill, landscape, alter or impair the effectiveness of any BMP or conveyance that is constructed as part of the Plan;
b. Place any structure, fill, landscaping, additional vegetation, yard waste, brush cuttings, or other waste or debris into a BMP or conveyance that would limit or alter the functioning of the BMP or conveyance;
c. Allow the BMP or conveyance to exist in a condition which does not conform to the Plan or this Agreement; and
d. Dispose of, discharge, place or otherwise allow pollutants including, but not limited to, deicers, pool additives, household chemicals and automotive fluids to directly or indirectly enter any BMP or conveyance.

6. In the event the Landowner fails to operate and maintain the BMP(s) as shown on the Plan in good working order acceptable to the Municipality the Landowner shall be in violation of this Agreement and the Landowner agrees that the Municipality or its representatives may, in addition to and not in derogation or diminution of any remedies available to it under the Stormwater Ordinance or other statutes, codes, rules or regulations, or this Agreement, enter upon the Property and take whatever action is deemed necessary to maintain said BMP(s). 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.

7. In the event the Municipality, pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner shall reimburse the Municipality for all expenses (direct and indirect) incurred within [_____] days of delivery of an invoice from the Municipality. Failure of the Landowner to make prompt payment to the Municipality may result in enforcement proceedings, which may include the filing of a lien against the Property, which filing is expressly authorized by the Landowner.

NOTE TO EDITOR: Municipality must insert appropriate number of days. Municipality may, at its option, delete the language requiring Landowner to reimburse the Municipality.

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

9. The Landowner, its executors, administrators, assigns, heirs, and other successors in interests, hereby release and shall release the Municipality, its employees, agents and designated representatives from all damages, accidents, casualties, occurrences or claims which might arise or be asserted against the Municipality and/or its said employees, agents or representatives, arising out of the construction, presence, existence, or maintenance of the BMP(s) either by the Landowner or Municipality. In the event that a claim is asserted or threatened against the Municipality, its employees, agents or designated representatives, the Municipality shall notify the Landowner and the Landowner shall defend, at his own expense, any claim, suit, action or proceeding, or threatened claim, suit, action or proceeding against the Municipality or, at the request of the Municipality, pay the cost, including attorneys' fees, of defense of the same undertaken on behalf of the Municipality. If any judgment or claims against the Municipality, its employees, agents or designated representatives shall be allowed, the Landowner shall pay all damages, judgments or claims and any costs and expenses incurred by the Municipality, including attorneys fees, regarding said damages, judgment or claims.

10. The Municipality may enforce this Agreement in accordance with its Stormwater Ordinance, at law or in equity, against the Landowner for breach of this Agreement. Remedies may include fines, penalties, damages or such equitable relief as the parties may agree upon or as may be determined by a Court of competent jurisdiction. Recovery by the Municipality shall include its reasonable attorneys fees and costs incurred in seeking relief under this Agreement.

11. Failure or delay in enforcing any provision of this Agreement shall not constitute a waiver by the Municipality of its rights of enforcement hereunder.

12. The Landowner shall inform future buyers of the Property about the function of, operation, inspection and maintenance requirements of the BMP(s) 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.

13. This Agreement shall inure to the benefit of and be binding upon, the Municipality and the Landowner, as well as their heirs, administrators, executors, assigns and successors in interest.

This Agreement shall be recorded at the Office of the Recorder of Deeds of the County of Chester, Pennsylvania, and shall constitute a covenant running with the Property and/or equitable servitude, in perpetuity.

ATTEST:

WITNESS the following signatures and seals:

(SEAL) For the Municipality:

_____

(SEAL) For the Landowner:

_____

ATTEST:

_____ (City, Borough, Township)

County of Chester, Pennsylvania

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

GIVEN UNDER MY HAND THIS _____ day of _____, 20__.

_____ _____

NOTARY PUBLIC **(SEAL)**

ORDINANCE APPENDIX B

SITE DESIGN PROCESS

NATURAL HYDROLOGY SITE DESIGN PROCESS

INTRODUCTION

Section 304 identifies a natural hydrology site design process that strives to minimize disturbances to land, site hydrology, and natural resources, and maintain the natural hydrologic regime, drainage patterns and flow conditions of a site to the maximum extent practicable. This appendix is intended to build on that process by providing additional information for achieving site designs that best maintain pre-construction stormwater runoff conditions, protect site amenities, and preserve natural resources. This appendix describes the following components of the natural hydrology site design process:

- Design Principles and Techniques;
- Design Process;
- Design Practices; and
- References.

Some common drainage design approaches for land development radically alter natural hydrologic conditions by constructing collection and conveyance systems that are designed to remove runoff from a site as quickly as possible and capture it in a detention basin. This approach has often led to the degradation of water quality, reduced groundwater recharge, and increased volumes of runoff, as well as the expenditure of additional resources for detaining and managing increased volumes of concentrated runoff at some downstream location.

The natural hydrology site design process encourages land development site designs that minimize post-development runoff rates and volumes, and that minimize needs for artificial conveyance and storage facilities. This process strives to incorporate the desired land development into the natural hydrologic landscape in a manner that maintains and utilizes existing site hydrology features and functions to minimize generation of new stormwater. This avoids cumulative environmental impacts often associated with land development, and reducing the need for and size of constructed stormwater facilities. This approach minimizes the disturbance of land area, natural features and site hydrology; preserves significant concentrations of open space, woodlands, and corridors of environmentally sensitive features; and incorporates landscape-based BMPs and low impact development techniques to minimize the utilization of more intrusive structural stormwater facilities.

With this design process, the primary goals of a land development project can be achieved while minimizing the negative environmental impacts and avoiding management costs associated with unnecessary stormwater runoff. The fundamental principle of this design process is that site hydrology features are considered "up front" in the land development design process and are prioritized as integral aspects to be maintained and utilized within the site design, rather than being first sacrificed for space needed for traditional site layout or for construction of more intrusive stormwater facilities.

Natural hydrology site design is not a new approach but rather a holistic process that combines certain principles of Low Impact Development, Conservation Design, and Sustainable Design, and focuses on reducing unnecessary alterations to the natural patterns and functions of existing on-site hydrologic features. These natural hydrologic features tend to perform their "hydrologic function" (i.e., infiltration, evapotranspiration, flow attenuation, pollutant removal, etc.) very efficiently and sometimes have the hydrologic capacity to perform that function on increased runoff loadings from the built environment. However, care must be taken to adequately characterize the capacity of their hydrologic function and avoid overwhelming the feature with excessive runoff loadings, thus causing unintended impairments that are completely counter-productive to the purpose of natural hydrology site design.

Preserving natural hydrologic conditions requires careful site design considerations. Natural hydrology site design should serve as the foundation of the overall site design approach, and when applied in conjunction with the design professional's overall land development goals and desired outcomes, can help shape the overall vision and conceptual layout of the land development project.

Site design practices include preserving natural drainage features, minimizing impervious surface area, reducing the hydraulic connectivity of impervious surfaces, and protecting natural depression storage. Applying this site design process helps maintain site hydrology and manage stormwater by: minimizing the generation of stormwater runoff (achieved by designing to the land, considering site drainage patterns and infiltration characteristics, reducing grading and compaction, and considering scale and placement of buildings); managing stormwater as close to the point of generation as possible (by disconnecting impervious surfaces and distributing storm flows to landscaped-based BMPs); providing open and vegetated channel conveyance (as needed to treat water quality, reduce velocity and infiltrate); and managing remaining conveyed stormwater in common open space (as needed to disperse low velocity storm flows, treat water quality, infiltrate, and release). A well-designed site will contain a mix of all those features.

DESIGN PRINCIPLES AND TECHNIQUES

Natural hydrology site design involves identifying and prioritizing natural resources and natural and man-made hydrologic features, and incorporating such features into the overall site design to take advantage of their efficiencies of hydrologic performance, their cost efficiencies of reducing the need for or size of constructed stormwater facilities, and their aesthetic amenities. The five Design Principles to be achieved by this approach are as follows:

- Minimize land disturbance – both surface and subsurface.
- Minimize the cumulative area to be covered by impervious and compacted surfaces.
- Designing to the land, so that the layout of constructed and landscape features utilizes the natural topography and minimizes grading.
- Design the constructed stormwater management system to take advantage of the natural hydrologic landscape to achieve the required stormwater runoff control standards.
- Refine the site design and layout to optimize the cumulative benefits of the natural

hydrologic features, the constructed stormwater management system, and the land development components to achieve the minimum post-construction runoff volume, peak discharge rates and pollutant loads from the proposed land development site.

Techniques to be applied to achieve the design principles are presented in Table B.1.

DESIGN PROCESS

The first step in applying natural hydrology site design is to identify, delineate and assess the functions of all existing natural resources and natural and man-made hydrologic features that: are located within the project site; will receive discharge from the project site; or, may be impacted by runoff or disturbance from the proposed land development project. This includes:

- Streams, waterways, springs, wetlands, vernal pools, and water bodies;
- Drainage patterns, conveyances and discharge points;
- Natural infiltration areas and patterns;
- Areas of natural vegetation that provide significant evapotranspiration, pollutant removal, bank stabilization, flow attenuation, or riparian buffer functions;
- Floodplains; and
- Other features that contribute to the overall hydrologic function and value of the site and its receiving streams.

Once this inventory and assessment are completed, these identified resources and features are then prioritized for their ability to provide hydrologic function and performance for managing runoff from the proposed site improvements. Specifically, they should be prioritized as follows:

- Those to be incorporated into the site design in a manner that provides for their protection from any disturbance or impact from the proposed land development;
- Those to be protected from further disturbance or impact and for which the proposed land development will provide improvement to existing conditions;
- Those that can be incorporated into and utilized as components of the overall site design in a manner that protects or improves their existing conditions while utilizing their hydrologic function (e.g., for infiltration, evapotranspiration, or reducing pollutant loads, runoff volume or peak discharge rates, etc.) to reduce the need for or size of constructed BMPs; and
- Those that may be considered for alteration, disturbance or removal.

These prioritizations are then applied as the basis on which to begin the site design lay-out, grading, construction, and permanent ground cover designs to achieve the five (5) Design Principles outlined above. The following section describes just a few of the many design practices, methods and techniques that are available to achieve the landowner's desired land development goals and the desired environmental efficiencies intended by natural hydrology site design.

Table B.1 – Site Design Process Principles and Techniques

Minimize land disturbance – both surface and subsurface.	• Maintain the natural soil structure and vegetative cover that are often critical components of maintaining the hydrologic functions of natural infiltration, bioretention, flow attenuation, evapotranspiration, and pollutant removal. • Protect, or improve, natural resources to reduce the needs for environmental mitigation, future environmental restoration, and cumulative flow and water quality impacts of unnecessary disturbances within the watershed system. • Minimize the disturbance of natural surface and groundwater drainage features and patterns, discharge points and flow characteristics, natural infiltration and evapotranspiration patterns and characteristics, natural stream channel stability, and floodplain conveyance, etc.
Minimize the cumulative area to be covered by impervious and compacted surfaces.	• Minimize the size of individual impervious surfaces. • Separate large impervious surfaces into smaller components. • Disconnect runoff from one impervious surface to another. • Avoid unnecessary impervious surfaces. • Utilize porous materials where suited in lieu of impervious materials.
Designing to the land, so that the layout of constructed and landscape features utilizes the natural topography and minimizes grading.	• Prioritize on-site hydrologic features (i.e., for protection, improvement, utilization, or alteration) and natural site drainage patterns and infiltration characteristics and consider them for the cornerstones of the conceptual site design. • Reduce grading and compaction by applying selective grading design methods to provide final grading patterns tthat preserve existing topography where it most benefits natural hydrologic functions and where needed; this results in graded areas that evenly distribute runoff and minimize concentrated runoff flows. • Consider the scale and placement of buildings and other infrastructure to minimize impact to natural hydrologic features. • Incorporate unique natural, scenic, and historic site features into the configuration of the development, and ensure flexibility in development design to meet community needs for complimentary and aesthetically pleasing development, such as can be achieved through Conservation Design and Sustainable Design approaches.

Design the constructed stormwater management system to take advantage of the natural hydrologic landscape to achieve the required stormwater runoff control standards.	• Incorporate natural hydrologic features that have been selected for their available capacity and function into the overall system of site runoff controls.
	• Incorporate Low Impact Development (or similar) BMPs and distribute storm flows to:
	  o Reduce runoff;
	  o Manage stormwater at or as close to the point of generation as possible;
	  o Disconnect discharges from streets and municipal storm sewer systems; and
	  o Select and design BMPs to give first priority to nonstructural and vegetation (landscape-based) BMPs, second priority to surface structural BMPs, third priority to subsurface structural BMPs, and design subsurface BMPs as shallow as possible.
	• Provide open channel conveyance, as needed, to:
	  o Treat water quality;
	  o Reduce runoff velocity; and
	  o Promote infiltratation and evapotranspiration of runoff.
	• Manage remaining conveyed stormwater from small storms in common open space areas to achieve multiple objectives:
	  o Disperse storm flows and reduce velocity;
	  o Treat water quality; and
	  o Promote infiltrate and evapotranspiration of runoff.
	• Provide for appropriate conveyance to retention or detention storage facilities as needed for flows from large storm events.
	• Maintain open space functions consistent with common area uses (passive recreation, on-site sewage management, scenic vistas, etc).

Refine the site design and layout to optimize the cumulative benefits of the natural hydrologic features, the constructed stormwater management system, and the land development components to achieve the minimum post-construction runoff volume, peak discharge rates and pollutant loads from the proposed land development site.	Apply site design techniques and practices as appropriate based on: • Conservation Design principles and practices. • Sustainable Design principles and practices. • Low Impact Development Design principles and practices.

DESIGN PRACTICES

Numerous practices and strategies can be considered where their aim is to sustain and utilize the benefits of existing site hydrology and minimize the generation of new stormwater runoff. Following are brief descriptions of various practices that can be used to achieve the principles of the natural hydrology site design process.

Site Layout Practices

The following site layout practices are but a few of the methods by which the natural hydrology site design process described above can be implemented. Such practices are less functions of regimented codes and procedures than about understanding and recognizing the benefits and values that existing resources can contribute to the desired outcomes of the land development project. In some circumstances, communication among design engineers, land planning and environmental professionals, knowledgeable developers, community representatives, and regulatory authorities is also beneficial to combine their collective understanding and perspectives to create effective planning efforts.

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. Unfortunately, some common land development practices encourage just the opposite pattern -- streets and adjacent storm sewers typically are located in the natural headwater valleys and swales, thereby replacing natural drainage functions with an 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. Designing developments to fit site topography retains much of the natural drainage function. In addition, designing with the land minimizes the amount of site grading, reduces the amount of compaction that can alter site infiltration characteristics, and can result in cost savings to the developer.

Protecting Natural Depression Storage Areas. Depressional storage areas have no surface outlet, or drain very slowly following a storm event. They can be commonly seen as ponded areas in fields during the wet season or after large runoff events. Some development practices eliminate these depressions by filling or draining, thereby eliminating 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 to assist in reducing runoff volumes and reducing runoff rates. Designing around the depression, or incorporating its storage as additional capacity in required detention facilities, treats this area as a site amenity rather than a detriment.

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. In many instances, municipalities have the ability to reduce impervious cover by providing incentives or opportunities in their zoning and subdivision/ land development ordinances to reduce road width, reduce or modify cul-de-sac dimensions, reduce or modify curbing requirements, and reduce or modify sidewalk requirements.

Disconnecting Impervious Surfaces. Impervious surfaces are significantly less of a problem if they are not directly connected to an impervious conveyance system (such as storm sewer). Two basic ways to reduce hydraulic connectivity are routing roof runoff over lawns and reducing the use of storm sewers. Site grading should promote increasing travel time of stormwater runoff from these sources, and should help reduce concentration of runoff to a single point within the project site.

Routing Roof Runoff Over Lawns. Roof runoff can be easily routed over lawns in most site designs. The practice discourages direct connections of downspouts to "driveway-to-street-to-storm sewers" or parking lots. The practice also discourages sloping driveways and parking lots to the street. Crowning the driveway, to run off to the lawn, uses the lawn as a filter strip.

Reducing Street Widths. Street widths can be reduced by either eliminating on-street parking and/or by reducing roadway widths. Designers should select the narrowest practical street width for the design conditions (speed, curvature, etc.). Narrower neighborhood streets should be considered and encouraged under select conditions. Reduced street widths also can lower maintenance needs and costs.

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 as an alternative to reduced sidewalks, where appropriate.

Reducing Building Setbacks. Reducing building setbacks (from streets) reduces the size of impervious areas of driveways and entry walks and is most readily accomplished along low-traffic streets where traffic noise is not a problem.

***Constructing Compact Developments or Conservation Design*:** Low impact cluster or compact development can reduce the amount of impervious area for a given number of lots. Savings result from reduced street length, which also contributes to a reduction in development and long-term maintenance costs. Reduced site disturbance and preservation of open space help buffer sensitive natural areas and retain more of a site's natural hydrology. Development can be designed so that areas of high infiltration soils are reserved as stormwater infiltration areas. Construction activity can be focused onto les -sensitive areas without affecting the gross density of development.

Stormwater Best Management Practices

Stormwater best management practices (BMPs) are intended to supplement natural hydrology site design techniques where needed. Structural in nature, such practices include bioretention facilities, rain gardens, swales and other engineered stormwater BMPs. Listed here are techniques intended to help manage stormwater predominantly at or near the source, rather than traditional techniques that largely release runoff over an extended period of time to adjacent properties and streams. This list, in no way exhaustive, gives examples of a few of the most common practices.

Bioretention. This type of BMP combines open space with stormwater treatment. Soil and plants, rather than sand filters, treat and store runoff. Infiltration and evapotranspiration are achieved, often coupled with an underdrain to collect water not infiltrated or used in the root zone.

Rain Gardens. Typically rain gardens are shallow depression areas containing a mix of water tolerant native plant species. The intent is to capture runoff for storage and use in the root zone of plants. Intended largely as a way of managing stormwater through evapotranspiration (ET), rain gardens often function as infiltration facilities as well.

Reducing the Need for Storm Sewers. Increasing the use of natural or vegetated drainage swales can reduce the need for extending 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, who may expect runoff to disappear shortly after a rainfall event.

Using Permeable Paving Materials. These materials include permeable interlocking concrete paving blocks or porous bituminous concrete, among others. 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. Surfaces for which seal coats may be applied should refrain from using permeable paving materials.

SOURCES

Conservation Design for Stormwater Management, Delaware Department of Natural Resources and Environmental Control and the Brandywine Conservancy, September 1997.

Conservation Design: Techniques for Preserving Natural Hydrologic Functions, White Paper prepared for New Castle County, Delaware Drainage Code, John M. Gaadt, AICP, September 2007.

Growing Greener, Conservation by Design, a program of the Natural Lands Trust, www.natlands.org/.

Guidance on MS4 Ordinance Provisions, Document Number 392-0300-003, by the Pennsylvania Department of Environmental Protection.

Low Impact Development Center, http://www.lowimpactdevelopment.org/.

PA Department of Environmental Protection, Best Management Practices Manual, 2006.

ORDINANCE APPENDIX C

RUNOFF COEFFICIENTS AND CURVE NUMBERS

TABLE C-1. RUNOFF CURVE NUMBERS
Source: Table 2-2a, Table 2-2b, and Table 2-2c from U. S. Department of Agriculture, Natural Resources Conservation Service, June 1986, *Urban Hydrology for Small Watersheds, Technical Release No. 55 (TR-55)*, Second Edition.

TABLE C-2. RATIONAL RUNOFF COEFFICIENTS
Source: Table F.2 from Delaware County Planning Department, December 2011, *Crum Creek Watershed Act 167 Stormwater Management Plan*.

TABLE C-3. MANNING'S 'n' VALUES
Source: Table 3-1 from United States Army Corps of Engineers, January 2010, *HEC-RAS River Analysis System, Hydraulic Reference Manual*, Version 4.1.

TABLE C-1. RUNOFF CURVE NUMBERS
(3 pages)

Source: Table 2-2a, Table 2-2b, and Table 2-2c from U. S. Department of Agriculture, Natural Resources Conservation Service, June 1986, *Urban Hydrology for Small Watersheds, Technical Release No. 55 (TR-55)*, Second Edition.

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2]	Hydrologic condition [3]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

[1] Average runoff condition, and I_a=0.2S

[2] Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

[3] Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

Table 2-2c Runoff curve numbers for other agricultural lands [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4]	48	65	73
Woods—grass combination (orchard or tree farm). [5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.

2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

TABLE C-2. RATIONAL RUNOFF COEFFICIENTS
(1 page)

Source: Table F.2 from Delaware County Planning Department, December 2011, *Crum Creek Watershed Act 167 Stormwater Management Plan*.

TABLE F-2

RATIONAL RUNOFF COEFFICIENTS

		HYDROLOGIC SOIL GROUP			
LAND USE DESCRIPTION		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 condition: 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 C-3. MANNING'S 'n' VALUES
(3 pages)

Source: Table 3-1 from United States Army Corps of Engineers, January 2010, *HEC-RAS River Analysis System, Hydraulic Reference Manual*, Version 4.1.

Table 3-1 Manning's 'n' Values

Type of Channel and Description	Minimum	Normal	Maximum
A. *Natural Streams*			
1. **Main Channels**			
a. Clean, straight, full, no rifts or deep pools	0.025	0.030	0.033
b. Same as above, but more stones and weeds	0.030	0.035	0.040
c. Clean, winding, some pools and shoals	0.033	0.040	0.045
d. Same as above, but some weeds and stones	0.035	0.045	0.050
e. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
f. Same as "d" but more stones	0.045	0.050	0.060
g. Sluggish reaches, weedy. deep pools	0.050	0.070	0.080
h. Very weedy reaches, deep pools, or floodways with heavy stands of timber and brush	0.070	0.100	0.150
2. **Flood Plains**			
a. Pasture no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
2. Same as above, but heavy sprouts	0.050	0.060	0.080
3. Heavy stand of timber, few down trees, little undergrowth, flow below branches	0.080	0.100	0.120
4. Same as above, but with flow into branches	0.100	0.120	0.160
5. Dense willows, summer, straight	0.110	0.150	0.200
3. **Mountain Streams, no vegetation in channel, banks usually steep, with trees and brush on banks submerged**			
a. Bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
b. Bottom: cobbles with large boulders	0.040	0.050	0.070

Table 3-1 (Continued) Manning's 'n' Values

Type of Channel and Description	Minimum	Normal	Maximum
B. *Lined or Built-Up Channels*			
1. **Concrete**			
a. Trowel finish	0.011	0.013	0.015
b. Float Finish	0.013	0.015	0.016
c. Finished, with gravel bottom	0.015	0.017	0.020
d. Unfinished	0.014	0.017	0.020
e. Gunite, good section	0.016	0.019	0.023
f. Gunite, wavy section	0.018	0.022	0.025
g. On good excavated rock	0.017	0.020	
h. On irregular excavated rock	0.022	0.027	
2. **Concrete bottom float finished with sides of:**			
a. Dressed stone in mortar	0.015	0.017	0.020
b. Random stone in mortar	0.017	0.020	0.024
c. Cement rubble masonry, plastered	0.016	0.020	0.024
d. Cement rubble masonry	0.020	0.025	0.030
e. Dry rubble on riprap	0.020	0.030	0.035
3. **Gravel bottom with sides of:**			
a. Formed concrete	0.017	0.020	0.025
b. Random stone in mortar	0.020	0.023	0.026
c. Dry rubble or riprap	0.023	0.033	0.036
4. **Brick**			
a. Glazed	0.011	0.013	0.015
b. In cement mortar	0.012	0.015	0.018
5. **Metal**			
a. Smooth steel surfaces	0.011	0.012	0.014
b. Corrugated metal	0.021	0.025	0.030
6. **Asphalt**			
a. Smooth	0.013	0.013	
b. Rough	0.016	0.016	
7. **Vegetal lining**	0.030		0.500

Table 3-1 (Continued) Manning's 'n' Values

Type of Channel and Description	Minimum	Normal	Maximum
C. *Excavated or Dredged Channels*			
1. Earth, straight and uniform			
a. Clean, recently completed	0.016	0.018	0.020
b. Clean, after weathering	0.018	0.022	0.025
c. Gravel, uniform section, clean	0.022	0.025	0.030
d. With short grass, few weeds	0.022	0.027	0.033
2. Earth, winding and sluggish			
a. No vegetation	0.023	0.025	0.030
b. Grass, some weeds	0.025	0.030	0.033
c. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
d. Earth bottom and rubble side	0.028	0.030	0.035
e. Stony bottom and weedy banks	0.025	0.035	0.040
f. Cobble bottom and clean sides	0.030	0.040	0.050
3. Dragline-excavated or dredged			
a. No vegetation	0.025	0.028	0.033
b. Light brush on banks	0.035	0.050	0.060
4. Rock cuts			
a. Smooth and uniform	0.025	0.035	0.040
b. Jagged and irregular	0.035	0.040	0.050
5. Channels not maintained, weeds and brush			
a. Clean bottom, brush on sides	0.040	0.050	0.080
b. Same as above, highest stage of flow	0.045	0.070	0.110
c. Dense weeds, high as flow depth	0.050	0.080	0.120
d. Dense brush, high stage	0.080	0.100	0.140

Other sources that include pictures of selected streams as a guide to n value determination are available (Fasken, 1963; Barnes, 1967; and Hicks and Mason, 1991). In general, these references provide color photos with tables of calibrated n values for a range of flows.

Although there are many factors that affect the selection of the n value for the channel, some of the most important factors are the type and size of materials that compose the bed and banks of a channel, and the shape of the channel. Cowan (1956) developed a procedure for estimating the effects of these factors to determine the value of Manning's n of a channel. In Cowan's procedure, the value of n is computed by the following equation:

ORDINANCE APPENDIX D

WEST NILE VIRUS DESIGN 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 E

STORMWATER
BEST MANAGEMENT PRACTICES
AND CONVEYANCES
OPERATION AND MAINTENANCE AGREEMENT

SAMPLE AGREEMENT

NOTES TO EDITOR:

1) *This was written to serve as a sample agreement between the Municipality and the landowner who will be responsible for the inspection, operation and maintenance of stormwater BMPs and man-made Conveyances.*

2) *For all other situations, the language in this sample agreement will have to be adjusted.*

3) *User must complete the information needed on Page 1, and Sections 2, 5, and 8.*

REVISED
Chester County Water Resources Authority
February 19, 2013

STORMWATER BEST MANAGEMENT PRACTICES (BMPs) AND CONVEYANCES
OPERATION AND MAINTENANCE AGREEMENT

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

WITNESSETH

WHEREAS, the Landowner is the owner of certain real property by virtue of a deed of conveyance recorded in the land records of Chester County, Pennsylvania, at Deed Book _____ and Page _____, (hereinafter "Property"); and

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

WHEREAS, the stormwater Best Management Practices (herein after BMP(s)) And Conveyances Operations and Maintenance Plan approved by the Municipality (hereinafter referred to as the "O&M Plan") for the Property, which is attached hereto as Appendix A and made part hereof, provides for management of stormwater within the confines of the Property through the use of BMP(s) and conveyances; and

WHEREAS, the Municipality and the Landowner, for itself and its administrators, executors, successors, heirs, 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 stormwater BMP(s) and conveyances be constructed and maintained on the Property; and

WHEREAS, for the purposes of this agreement, the following definitions shall apply:
BMP – "Best Management Practice" –Those activities, facilities, designs, measures, or procedures as specifically identified in the O&M Plan, used to manage stormwater impacts from land development, to meet state water quality requirements, to promote groundwater recharge, and to otherwise meet the purposes of the Municipality's Stormwater Management Ordinance. BMPs may include, but are not limited to, a wide variety of practices and devices, from large-scale retention ponds and constructed wetlands to small-scale underground treatment systems, infiltration facilities, filter strips, low impact design, bioretention, wet ponds, permeable paving, grassed swales, riparian or forested buffers, sand filters, detention basins, manufactured devices, and operational and/or behavior-related practices that attempt to minimize the contact of pollutants with stormwater runoff. The BMPs indentified in the O&M Plan are permanent appurtenances to the Property; and

Conveyance – As specifically identified in the O&M Plan, a man-made, existing or proposed facility, structure 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 O&M Plan are permanent appurtenances to the Property; and

WHEREAS, the Municipality requires, through the implementation of the O&M Plan, that stormwater management BMPs and conveyances, as required by said O&M Plan and the Municipality's Stormwater Management Ordinance, be constructed and adequately inspected, operated and maintained by the Landowner, its administrators, executors, successors in interest, heirs, and assigns.

NOW, THEREFORE, in consideration of the foregoing promises, the mutual covenants contained herein, and the following terms and conditions, the parties hereto, intending to be legally bound hereby, agree as follows:

1. The foregoing recitals to this Agreement are incorporated as terms of this Agreement as if fully set forth in the body of this Agreement.

2. The Landowner shall construct the BMP(s) and conveyance(s) in accordance with the final design plans and specifications as approved by the Municipality _____(title of approved plans) _____(date).

3. The Landowner shall inspect, operate and maintain the BMP(s) and conveyance(s) as shown on the O&M Plan in good working order acceptable to the Municipality and in accordance with the specific inspection and maintenance requirements in the approved O&M Plan.

4. The Landowner hereby grants permission to the Municipality, its authorized agents and employees, to enter upon the Property from a public right-of-way or roadway, at reasonable times and upon presentation of proper identification, to inspect the BMP(s) and conveyance(s) whenever it deems necessary for compliance with this Agreement, the O&M Plan and the Municipality's Stormwater Management Ordinance. Whenever possible, the Municipality shall notify the Landowner prior to entering the Property.

5. The Municipality intends to inspect the BMP(s) and conveyance(s) at a minimum of once every [_____] years to determine if they continue to function as required.

6. The Landowner acknowledges that, per the Municipality's Stormwater Ordinance, it is unlawful, without written approval of the Municipality, to:

a. Modify, remove, fill, landscape, alter or impair the effectiveness of any BMP or conveyance that is constructed as part of the approved O&M Plan;
b. Place any structure, fill, landscaping, additional vegetation, yard waste, brush cuttings, or other waste or debris into a BMP or conveyance that would limit or alter the functioning of the BMP or conveyance;
c. Allow the BMP or conveyance to exist in a condition which does not conform to the approved O&M Plan or this Agreement; and
d. Dispose of, discharge, place or otherwise allow pollutants including, but not limited to, deicers, pool additives, household chemicals, and automotive fluids to directly or indirectly enter any BMP or conveyance.

7. In the event that the Landowner fails to operate and maintain the BMP(s) and conveyance(s) as shown on the O&M Plan in good working order acceptable to the Municipality, the Landowner shall be in violation of this Agreement, and the Landowner agrees that the Municipality or its representatives may, in addition to and not in derogation or diminution of any remedies available to it under the Stormwater Ordinance or other statutes, codes, rules or regulations, or this Agreement, enter upon the Property and take whatever action is deemed necessary to maintain said BMP(s) and conveyance(s). 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.

8. 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 [_____] days of delivery of an invoice from the Municipality. Failure of the Landowner to make prompt payment to the Municipality may result in enforcement proceedings, which may include the filing of a lien against the Property, which filing is expressly authorized by the Landowner.

9. The intent and purpose of this Agreement is to ensure the proper maintenance of the on-site BMP(s) and conveyance(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.

10. The Landowner, for itself and its executors, administrators, assigns, heirs, and other successors in interest, hereby releases and shall release the Municipality's employees, its agents and designated representatives from all damages, accidents, casualties, occurrences, or claims which might arise or be asserted against said employees, agents or representatives arising out of the construction, presence, existence, or maintenance of the BMP(s) and conveyance(s) either by the Landowner or Municipality. In the event that a claim is asserted or threatened against the Municipality, its employees, agents or designated representatives, the Municipality shall notify the Landowner, and the Landowner shall defend, at his own expense, any claim, suit, action or proceeding, or any threatened claim, suit, action or proceeding against the Municipality, or, at the request of the Municipality, pay the cost, including attorneys' fees, of defense of the same undertaken on behalf of the Municipality. If any judgment or claims against the Municipality's employees, agents or designated representatives shall be allowed, the Landowner shall pay all damages, judgments or claims and any costs and expenses incurred by the Municipality, including attorneys, regarding said damages, judgments or claims.

11. The Municipality may enforce this Agreement in accordance with its Stormwater Ordinance, at law or in equity, against the Landowner for breach of this Agreement. Remedies may include fines, penalties, damages or such equitable relief as the parties may agree upon or as may be determined by a Court of competent jurisdiction. Recovery by the Municipality shall include its reasonable attorney's fees and costs incurred in seeking relief under this Agreement.

12. Failure or delay in enforcing any provision of this Agreement shall not constitute a waiver by the Municipality of its rights of enforcement hereunder.

13. The Landowner shall inform future buyers of the Property about the function of, operation, inspection and maintenance requirements of the BMP(s) 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.

14. This Agreement shall inure to the benefit of and be binding upon, the Municipality and the Landowner, as well as their heirs, administrators, executors, assigns and successors in interest.

NOTE TO EDITOR:
Municipality may add the following:
15. Additional items or conditions, as required by the Municipality (per [redacted] of this Ordinance), as attached herein:

_____

This Agreement shall be recorded at the Office of the Recorder of Deeds of Chester County, Pennsylvania, and shall constitute a covenant running with the Property, in perpetuity.

ATTEST:

WITNESS the following signatures and seals:

(SEAL) For the Municipality:

_____

(SEAL) For the Landowner:

_____

ATTEST:

_____ (City, Borough, Township)

County of Chester, Pennsylvania

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

GIVEN UNDER MY HAND THIS _____ day of _____, 20__.

_____ _____

NOTARY PUBLIC **(SEAL)**