Beaverdam Branch Watershed Act 167 Stormwater Management Plan

Volume 1 Main Plan Document

May 2000

Prepared for the:
Blair County Planning Commission

CHESTER ENGINEERS

Beaverdam Branch Watershed
Act 167
Stormwater Management Plan

Volume 1
Main Plan Document

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Submitted to:
Blair County Planning Commission

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BEAVERDAM BRANCH WATERSHED
STORMWATER MANAGEMENT PLAN

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BEAVERDAM BRANCH WATERSHED STORMWATER MANAGEMENT PLAN SECTION I INTRODUCTION

BACKGROUND

General

Curbs, gutters, storm sewers, and other drainage systems have traditionally been designed to remove stormwater from developed properties as quickly as possible to minimize the possibility of flooding the properties served by the drainage systems. Little or no efforts were made to minimize increases in volumes and rates of runoff which resulted as land was converted from a permeable, vegetated state to an impervious, paved condition. Similarly, little consideration was given to the potential effects of accelerated runoff on downstream properties. Under this approach, progressive development in a watershed resulted in ever increasing stormwater runoff until damaging downstream problems developed. Problems attributable to inadequate control of stormwater runoff include flooding and accelerated erosion.

A significant change in the approach to stormwater management in Pennsylvania occurred with the passage of the Storm Water Management Act (Act 167) and its companion bill, the Flood Plain Management Act (Act 166). This legislation was passed by the Pennsylvania General Assembly on October 4, 1978 and requires a comprehensive approach to planning and managing excess stormwater runoff. Acts 166 and 167 were enacted in response to increasing problems caused by inadequately controlled stormwater runoff and the associated threats to public health and safety. The Storm Water Management Act established a program for managing accelerated runoff so that it does not lead to increased flooding, while the Flood Plain Act provides for the preservation and restoration of flood plains which function as natural stormwater storage areas.

PENNSYLVANIA STORM WATER MANAGEMENT ACT

The statement of legislative findings at the beginning of the Storm Water Management Act sums up the critical interrelationship between development, accelerated runoff, and floodplain management:

Inadequate management of accelerated runoff of storm water resulting from development throughout a watershed increases flood flows and velocities, contributes to erosion and sedimentation, overtaxes the carrying capacity of streams and storm sewers, greatly increases the cost of public facilities to carry and control storm water, undermines flood plain management and flood control efforts in downstream communities, reduces groundwater recharge, and threatens public health and safety.

A comprehensive program of storm water management, including reasonable regulation of development and activities causing accelerated runoff, is fundamental to the public health, safety and welfare and the environment.

The stated policy and purpose of the Storm Water Management Act is to:

1. encourage planning and management of stormwater 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 stormwater runoff regimes and natural course, current and cross section of water of the Commonwealth; to protect and conserve ground waters and ground water recharge areas
3. encourage local administration and management of stormwater 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 historical values of the environment

The general procedure established by the Act for achieving these goals includes

1. development of guidelines and regulations to be applied state wide
2. preparation of stormwater management plans for designated watersheds throughout the Commonwealth
3. implementation of the stormwater management plans
4. adherence to the plan requirements by individuals involved in land development activities

Act 167 establishes the following duties and responsibilities for individuals and various governmental agencies:

PERSONS ENGAGED IN LAND DEVELOPMENT: Act 167 states that any landowner and any person engaged in the alteration or development of land which may affect stormwater runoff characteristics must implement such measures consistent with the provisions of the applicable stormwater management plan as are reasonably necessary to prevent injury of health, safety or other property. Such measures must include such actions as are required:

1. to assure that the maximum rate of stormwater runoff is no greater after development than prior to development activities; or
2. to manage the quantity, velocity and direction of resulting stormwater runoff in a manner which otherwise adequately protects health and property from possible injury.

DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP): Act 167 assigns DEP the primary responsibility to carry out the policies and purposes of the Act. These responsibilities include providing guidelines for county stormwater management plans; designating watersheds for which stormwater management should be prepared; review and approval of the plans; providing technical assistance and model local ordinances; developing grants and reimbursement regulations governing the disbursement of grant moneys; and generally coordinating stormwater management activities state wide.

COUNTIES: Counties are required to prepare and adopt a watershed stormwater management plan for each designated watershed in their jurisdiction.

MUNICIPALITIES: Municipalities are required to adopt new or to amend existing regulations as necessary to comply with and implement the stormwater management plans.

In 1980, the DEP designated 353 watersheds for which plans are to be prepared. The number of designated watersheds now totals 356. Model ordinances were made available

in September 1981, followed by detailed stormwater management guidelines in June 1983. These guidelines and model ordinances were approved by the Pennsylvania General Assembly in June 1985 and now have the force of law. In May 1984, Act 167 was amended to authorize DEP to administer grants to municipalities and counties to pay 75% of the costs of preparing and administering stormwater management plans and regulations.

BEAVERDAM BRANCH WATERSHED PLAN DEVELOPMENT APPROACH

GENERAL PLANNING REQUIREMENTS AND APPROACH

The overall scope of work and general planning approach employed in the preparation of the Beaverdam Branch Watershed Stormwater Management Plan were defined to a large extent by specific planning requirements contained in Act 167 and Storm Water Management Guidelines and Model Ordinances developed by DEP. The basic requirements of the plan as outlined in these documents are that the plan shall:

1. contain such provisions as are reasonably necessary to manage storm water such that development or activities in each municipality within the watershed do not adversely affect health, safety and property in other municipalities within the watershed and in basins to which the watershed is tributary; and
2. consider and be consistent with other existing municipal, county, regional and state environmental and land use plans.

Specific and more detailed plan requirements were also defined in the Act. Beyond the general and specific plan requirements established by law and regulations, several additional considerations served as a guide to the development of the planning approach and scope employed during the preparation of this Beaverdam Branch Watershed Stormwater Management Plan. These additional planning considerations are as follows:

1. the development of the technical standards contained in the plan should accurately reflect local conditions
2. the development of the technical standards should employ accepted computational techniques familiar to the local planning agencies

3. the computational procedures employed should be reproducible and amenable to direct application when the plan is updated

4. the recommended stormwater management control standards and criteria should be attainable, clear, concise, broadly applicable and enforceable. The standards should clearly define performance requirements but allow sufficient latitude to permit creative stormwater control approaches

5. the recommended stormwater management controls and associated institutional framework should represent a reasonable and measured approach to effectively managing stormwater runoff. The plan should not produce unnecessary impediments to development nor excessive local government responsibilities

6. the recommended stormwater legal / institutional framework should be compatible with existing municipal and county financial, legal, technical and administrative capabilities

TECHNICAL APPROACH

The technical approach was designed to satisfy the above listed considerations by employing accepted hydrologic modeling techniques to define existing conditions and quantify stormwater control criteria necessary to comply with the intent of Act 167. The technical analysis utilized Procedure PSU-IV for Estimating Design Flood Peaks on Ungauged Pennsylvania Watersheds. This method was also employed to define hydrologic interactions throughout the study area to provide a basis for establishing stormwater runoff control criteria on a watershed wide basis. The PSU-IV was selected for use because it is recognized by DEP as an appropriate tool for watershed stormwater planning and provides quantitative results without the detailed input necessary for other techniques.

The data collection effort was designed to take fullest advantage of available data sources and current data analysis and management techniques to maximize the accuracy of the physical features data base necessary to model the watershed. Land cover information was obtained from a 7.5 minute quadrangle topographic maps prepared by the U.S. Geologic Survey.

Additional information, including obstruction sizes and capacities, stream characteristics, stormwater collection system locations, and descriptions of stormwater and flood control and flood protection facilities were obtained from mail surveys and reviewing available data sources.

LEGAL/INSTITUTIONAL APPROACH

This portion of the study deals with five interrelated issues:

1. the primary laws governing stormwater management in Pennsylvania
2. the institutional options for organizing an effective stormwater management effort in the watershed
3. institutional system initiatives and precedents established by previous watershed stormwater management planning efforts completed in the region
4. guidelines for incorporating stormwater provisions into stormwater management ordinances to implement the plan's technical recommendations
5. methods of fine-tuning stormwater control provisions to address issues encountered during the implementation of pilot stormwater management plans completed in the region

As part of the analysis, various laws were reviewed to determine specific areas of concern, requirements, duties, penalties and remedies, along with interrelationships with the other statutes. In addition to the laws related directly to stormwater management, common law relative to private and public nuisances and state and local municipal immunity statutes were reviewed, with attention to the remedies that provided for solutions to stormwater problems and issues.

This plan document includes proposals for ordinance provisions designed to implement the recommended technical measures. These ordinance standards are intended to provide a guide to the municipalities in enacting or amending their existing ordinances. These standards may not be appropriate for direct incorporation into an existing municipal ordinance. They do, however, indicate the types of provisions that are required and in which ordinances they properly belong. The municipalities should consult with their solicitors and the County Planning Office as they proceed with amending existing or enacting new ordinances for specific guidance as to how the key model ordinance provisions can be incorporated into their existing ordinance structure.

Finally, the institutional section outlines alternative organizational arrangements for developing and managing stormwater control facilities and for administering local ordinances. Since the stormwater management plans cannot be implemented effectively

on a piecemeal basis, a watershed-wide management approach and intergovernmental cooperation are required. Therefore, this study identifies several approaches that the municipalities, county, and state can take to implement a workable stormwater management system.

The nature of the optimal institutional system will be determined to a large extent by the roles and duties the system will be expected to fulfill. The system may be expected to perform a variety of duties, ranging from planning and regulation to construction, operation and maintenance, and financing. Consequently, this plan outlines the range of responsibilities associated with stormwater management, describes the capabilities, resources and legal authorities necessary to discharge those responsibilities, and discusses alternative institutional arrangements.

The selection of the recommended institutional framework will also depend upon the nature of the existing institutional system and the anticipated future roles and capabilities of each level of government. This plan, therefore, presents an overview of the existing system and a discussion of expectations relative to the future role of each level of government in stormwater management issues.

CONTENTS OF THE PLAN

The Beaverdam Branch Watershed Stormwater Management Plan report is presented in two volumes. Volume 1, the Plan Study Report, contains the plan text and describes the background and general characteristics of the study area, the method used for data collection, the analytical tools used, results of the analyses, and stormwater runoff control alternatives. Specific control requirements and management and regulatory responsibilities are identified as they relate to developers and local, county, and state agencies. Volume 2, the Executive Summary, contains a condensed overview of the plan development process and summarizes the findings and recommendations of the plan.

Copies of the materials and data developed during plan preparation and the Beaverdam Branch hydrologic model are on file at the Blair County Planning Commission.

BEAVERDAM BRANCH WATERSHED
STORMWATER MANAGEMENT PLAN
SECTION II
LEGAL FRAMEWORK FOR STORMWATER MANAGEMENT

GENERAL

An analysis of stormwater management would not be complete without a discussion of the law that created the stormwater management program, along with the other laws that relate to its implementation. This is particularly true in the case of the Storm Water Management Act (Act 167), where there are relatively few administrative regulations and little case law with which to interpret the Act's meaning and provisions.

The law as it relates to stormwater management is not widely understood by local officials, developers, and property owners. Pennsylvania's common law relating to drainage rights has developed over decades into a very complex system. As a result, it is not always easy to determine who has what rights and when. Many persons are still not aware of the extent to which Act 167 redefines prior common law. Further, many municipal officials, engineers, and developers are not well informed on other laws which relate to stormwater, development regulation, and governmental liabilities.

Besides the Storm Water Management Act, other laws that collectively provide the legal framework within which to implement a comprehensive stormwater management plan include the following:

- Dams Safety and Encroachments Act (Act 325-1978).
- Clean Streams Law (specifically, the erosion and sedimentation regulations adopted pursuant to the Law).
- Flood Plain Management Act (Act 166--1978).
- Municipalities Planning Code (Act 247, as amended).

As part of this stormwater management plan, each of these laws were reviewed to determine its scope, standards, duties, penalties and remedies, and enforcement responsibilities. The interrelationships between the five statutes and regulations were

also examined. Additionally, common law relative to private and public nuisances, municipal codes, and state and municipal immunity statutes was researched relative to the powers, duties, and remedies that are provided for stormwater related issues.

A general overview of these items is offered as a background to the discussion of the five statutes specifically impacting stormwater management. Key provisions of each of the five primary statutes are presented and the elements that are most pertinent to the watershed stormwater plan and management program are highlighted. A brief discussion of governmental immunities is included because it is helpful for the municipalities to understand their potential liabilities. The comments on these acts do not represent official legal opinions or constitute advice on any specific issue or case. This is especially true for Act 167 where there are presently no administrative regulations or case law to interpret the Act. This section is provided solely to assist in a general understanding of the legal framework for stormwater management.

COMMON LAW BACKGROUND

Stormwater law developed in the courts of the Commonwealth of Pennsylvania and across the United States in cases between private landowners. Common law rights, duties and responsibilities relative to drainage and flooding evolved from the resultant court decisions. In the common law, a basic distinction is drawn between waters in a watercourse and surface waters. A watercourse was defined as a channel with defined bed and banks. Watercourse law also included lakes, ponds, marshes and swamps. Surface water, on the other hand, was defined as diffused water running overland, to a defined channel or watercourse. Flood water which overflowed the banks of a watercourse and followed the course of the stream, was also held to be governed by the laws of watercourses. However, flood waters which entirely lost their connection with a watercourse, spreading out over the adjoining countryside and settling in low places, were governed by the law of surface waters.

Watercourse Law

Watercourse law is based on the rights and duties established among riparian property owners (owners of land along the banks of a river or lake). The fundamental principle of the riparian system is that each riparian owner has an equal right to make a reasonable use of the water of a stream subject to the equal rights for the other riparians to do likewise. A riparian right is reciprocal in that a riparian owner must exercise his rights in a reasonable manner and extent so as not to interfere unnecessarily with the corresponding rights of others.

As a general rule in most jurisdictions, a riparian owner does not have the right to construct an embankment or dike to protect his land from ordinary floods, if in so doing he causes damage to the lands of others. Expressed in slightly different terms, a riparian owner has the right to protect his land but only if he causes no damage to other riparian owners in exercising this right.

Surface Water Law

There are three basic doctrines which the courts have adopted regarding surface waters. These are the "common enemy rule", the "civil law rule", and the "reasonable use rule".

As originally conceived under the civil law rule, a landowner may do anything he pleases with surface waters regardless of the harm it might do to others. The upper land owner can divert or drain surface waters onto the lower land, and the lower landowner may put up a barrier even if it floods the upper property. Since the water must go somewhere, this concept would appear to inevitably result in contests of engineering where "might makes right". Therefore, some courts have modified the strict rule, resulting in a "modern common enemy rule". This rule gives landowners the right to obstruct or divert surface waters, but only when such obstruction or diversion is incidental to the ordinary use, improvement or protection of their land, and when it is done without malice or negligence.

The civil law rule granted the owner of upland property the right to drain surface waters onto lower property; imposed a duty upon the lower property owner to receive surface water from upland property; granted the owner of upland property an easement of natural flow over the lower property; and prohibited the owner of lower property from obstructing the natural flow of diffused surface water from upland properties. The key word is natural, meaning those waters which flowed from the land before alteration or development. A legal cause of action on the part of the lower property owner was deemed to have arisen when the upland property owner or another party interfered with natural conditions or caused water to be discharged in a greater quantity or in a different manner than would naturally occur.

The reasonable use rule is based on tort rather than on property law. In tort law, liability is based on negligence. A person can be held negligent if he has not acted like a "reasonably prudent man" in a given situation. The reasonable use rule recognizes common law in that use of one's property may occur in any reasonable manner which does not injure another person or their property. Common law considered the necessity

to alter drainage to make use of one's property, the reasonable manner of accomplishing alterations so as to avoid injury, the utility of the conduct, and the gravity of the injury to the other.

Pennsylvania jurisprudence has, at one time or another, applied all three of the doctrines in various cases. The Pennsylvania Storm Water Management Act of 1978 more specifically and directly assigns responsibilities for stormwater control. The Act imposes a duty on any landowner and person (including municipalities) engaged in the alteration or development of land which may affect stormwater runoff to implement measures to prevent injury to health, safety or property.

STORM WATER MANAGEMENT ACT (ACT 167-1978)

The two key sections of the Storm Water Management Act are Section 5, which sets up watershed stormwater planning programs, and Section 13, which establishes the basic standard to manage stormwater runoff to prevent harm to persons and property. A primary goal of the Act is to prevent future problems resulting from uncontrolled runoff, including flooding, erosion, sedimentation, landslides, and the pollution and debris often carried by storm runoff. A secondary goal is the elimination or correction of existing stormwater and flooding problems.

Watershed Stormwater Plans

As discussed in the preceding chapter, one of the Act's innovative features is the creation of a public stormwater planning, management, and control system at the watershed level. Plans are to be prepared for each watershed delineated by the Department of Environmental Protections (DEP). Counties must organize watershed advisory committees for each watershed. Each committee must be composed of representatives from the municipalities in the watershed. The committee is to advise the county during the planning process, and the plans are to be adopted by the county commissioners and approved by DEP, after public review and comment. The completed plans must be consistent with local land use plans and state plans, such as regional water quality management plans, the state water plan and floodplain programs.

After the adoption and approval of a watershed stormwater management plan, the location, design and construction of stormwater management systems, obstructions, flood control projects, subdivisions, major land developments, highways, transportation facilities, facilities for the provision of public utilities, and facilities owned and financed in whole or in part by the Commonwealth (including PennDOT) must be conducted in a manner consistent with the plan (Section 11). This provision gives the stormwater plan a

definite legal status. Unlike municipal comprehensive plans, which are only advisory documents, watershed stormwater plans are legally binding. In addition, each municipality in the watershed must adopt the land use and development ordinances within six months of the approval of the watershed stormwater management plan to implement the plan (Section 11). These regulations must be consistent with the plan, as well as standards of the Storm Water Management Act. Failure to adopt and implement the necessary ordinances may result in the state withholding money from its General Fund for which the municipality might be eligible.

Basic Standard for Stormwater Management

The basic premise of the Act is that persons whose activities generate additional runoff, increase its velocity, or change the direction of its flow should be responsible for controlling and managing the runoff so that their activities will not cause harm to other persons or property, either now or in the future. The policy is that Pennsylvania's legal system will no longer condone those who negligently disregard the impact of runoff from their activities or allow them to shift the burden of runoff management to the public and downstream property owners.

Section 13 of Act 167 defines the legal duties of developers and others engaged in the alteration of land by setting performance standards for runoff management. This section of the Act became effective immediately upon the signing of the Act (October 4, 1978). These new standards essentially replace prior common law rules. However, common law rules still apply to all development and land alteration that occurred prior to October 4, 1978. Section 13 states that:

Any landowner and any person engaged in the alteration or development of land which may affect stormwater runoff characteristics shall implement such measures consistent with the provisions of the applicable watershed stormwater plan as are reasonably necessary to prevent injury to health, safety or other property. Such measures shall include such actions as are required:

1. to assure that the maximum rate of stormwater runoff is no greater after development than prior to development activities; or
2. to manage the quantity, velocity and direction of resulting stormwater runoff in a manner which otherwise adequately protects health and property from possible injury.

Act 167 defines persons as individuals, private corporations, municipalities, counties, school districts, public utilities, sewer and water authorities, and state agencies. For example, when public agencies build storm sewers, roads, buildings, or utility lines, they must implement runoff control measures that comply with Section 13 standards. Section 13 is a comprehensive standard for stormwater control with the primary stormwater management measure of requiring reasonable actions to prevent harm or injury to health and property. This general duty is contained in the language which precedes Sections 13(1) and 13(2). Thus, the proverbial "bottom line" for stormwater management is to not cause harm. Section 13 then prescribes two alternatives [Section 13(1) and 13(2)] for meeting this basic objective.

When Section 13 is read in conjunction with other portions of Act 167, it becomes apparent that the intent of the Act is to protect all persons and property downstream of the site being altered, not only the persons or property immediately adjacent to the site. In other words, Section 13 is not spatially limited and applies not only as the runoff leaves the site, but as far as its impact can be reasonably determined.

Section 2 of the Act states that the Legislature found that inadequate management of runoff has adverse impacts on downstream communities and that reasonable regulation of activities causing runoff is fundamental to the public welfare. Section 3 indicates that the Act was intended to manage runoff at the watershed level. Further, Section 5(c)(1) requires that watershed plans contain provisions to manage stormwater so that an activity in one municipality does not have adverse effects on persons or property in another municipality in the watershed to which the activity is tributary. Therefore, it is clear that the stormwater plans and management activities must consider the watershed impact of land alteration activities and runoff controls must be designed to prevent reasonably foreseeable harm, from the boundary of the site and downstream to the base of the watershed.

The Section 13(1) standard does not contain any limiting language from which it could be implied that no increase in maximum rate means only at a development's property line. Likewise, Section 13(2) contains no language to suggest that its "do not cause harm" standard applies only to neighboring or nearby property. The term "runoff characteristics" is not spatially limited since Section 13(2) indicates that runoff characteristics include at least direction, volume, and velocity. Changes in any of these characteristics will affect a stream all the way to its mouth. Downstream from the

generator, these runoff changes may result in an increase in peak rate, harm to persons or property, or both.

Section 13(1)

Section 13(1) requires that land alterations not cause an increase in the "maximum rate" of stormwater runoff. In other words, the maximum (peak) rate of runoff after development, for any level storm, may not be higher than the peak rate which would have been generated from the site before development. By referring to rate rather than volume, Section 13(1) implies that total volume of runoff generated may increase, but any increased volume must be retained and discharged over time so that the pre-development maximum rate of flow will not be exceeded. This is an important point because a standard that did not permit any increase in volume could only be met at locations where additional runoff could be permanently stored or recharged on-site. Obviously, this would limit the use of many sites.

It is not clear whether no increase in the "maximum rate" of runoff applies to the site as a whole or to any point on the site from which runoff was discharged before development. Since the purpose of Section 13 is to prevent harm from changes in runoff characteristics and runoff characteristics include direction, it would seem that the no increase in peak rate standard should apply to each pre-development discharge point. This interpretation seems necessary to control runoff from large developments in a manner which can achieve the purpose of the Act. Peak rate of discharge from the site as a whole could be used where runoff is discharged to a storm sewer or public retention system.

Section 13(1) basically states that development cannot increase the maximum rate of runoff at any point, from the boundary of the site to the bottom of the watershed. Also, development may not cause an increase in maximum rate of flow in any other watershed to which its location is tributary. The cutoff point for purposes of Section 13(1) seems to turn on the foreseeability of harm. Where it is reasonably possible for the developer to foresee that a higher peak rate will result because of the activities, then the duty imposed by Section 13(1) applies.

Section 13(2)

One of the purposes of Section 13(2) is to make the statutory drainage standard more flexible. Section 13(2) permits changes in runoff characteristics provided they do not cause harm. For example, Section 13(2) permits increased rates of runoff to be discharged into storm sewer systems, when the storm sewers can handle increased volumes and velocities without, in turn, causing harm. However, the Act does not define harm, thresholds of acceptable levels of potential harm, or address issues relating to how the potential for harm is to be assessed. It appears that the burden of establishing no harm is assumed by the developer. Practical problems associated with proving such a negative hypothesis (i.e. establishing that an action will not produce harm or increase the potential for harm throughout a watershed) is a major concern in developing means of generally incorporating Section 13(2) into watershed plans.

Violations, Penalties, Remedies

Section 15 of the Storm Water Management Act makes any violation of any provision of the Act or of the watershed stormwater plan a public nuisance. A public nuisance is defined as being a nuisance by its very existence. Therefore, it is not necessary to wait and see if damage results from the public nuisance. An aggrieved person, affected municipality, county, or the DEP can institute suits at equity to restrain or abate a violation of a law and sue for damages caused by a violation of this Act.

The state is not subject to penalty provisions and municipalities, county and state agencies are protected to a large extent from private damage suits by governmental immunity statutes. The rights and remedies created by the Act are in addition to rights and remedies which existed prior to the Act's passage. For example, private persons can still sue for private nuisances.

DAMS SAFETY AND ENCROACHMENTS ACT (ACT 325-1978)

Act 325 replaces several older state statutes dealing with dams safety, water obstructions and encroachments. This Act is the primary source of regulation for dams, existing and new obstructions, encroachments, fill in floodplains, culverts, bridges, retaining walls, and storm sewer outfalls in a stream or a 100-year floodplain. In some cases, retention/detention facilities may qualify as dams under the definition of the Act, requiring a permit from the DEP. The Act requires permits for the construction, or alteration or abandonment of dams, obstructions and encroachments. The owners of

existing obstructions or encroachments are also required to obtain permits. Permits are issued by the DEP pursuant to the Act and regulations (25 Pa. Code Chapter 105).

By addressing both new and existing structures, the Dams Safety and Encroachments Act is quite broad in its coverage. It also requires permittee's and owners of obstructions to inspect, maintain, and repair their structures. For example, owners of culverts must inspect them annually and remove silt and debris if the carrying capacity is reduced by 10 percent or more (Regulations, Section 105.171). If conditions change such that the design of an obstruction or encroachment no longer conforms to the performance standards in the Act or regulations, the permittee or owner has a duty to make such alterations as are necessary to achieve compliance.

DEP is the prime agency responsible for administering the Act. It must adopt regulations to implement the Act and is the permit issuing agency. The regulation [Section 105.14(b)(9)] requires the DEP to consider the project's consistency with state and local floodplain and stormwater management programs when reviewing permits. Thus, the standards and provisions of the Storm Water Management Act and stormwater plans appear to be applicable to obstructions and encroachments. It is important to note that once the watershed stormwater plan is approved, the DEP should consider local comments relative to consistency with the applicable watershed stormwater management plan when reviewing permit applications. Also, municipalities should not issue local building permits until necessary obstruction permits are obtained.

Violations of the Act are treated as a public nuisance. Therefore, municipalities can sue to enjoin or abate the nuisance, or can make necessary repairs and assess costs against the property. A private person also can sue on a private nuisance. As the prime enforcement agent, the DEP can issue orders to permittees and landowners to correct a violation of the Act or of an issued permit. Failure to comply can expose the violator to civil and criminal penalties. This provision includes municipalities and counties when they are the permittee for a structure.

If the DEP does not sue to correct the violation of the Act, any "affected municipality" may sue in the name of the Commonwealth. An affected municipality includes one where the violation occurs or where damage or harm results. The only limitation on these suits is that the municipality must give the State Attorney General 30 days notice of the municipality's intention to act.

CLEAN STREAMS LAW (EROSION/SEDIMENTATION REGULATIONS)

Pennsylvania's Clean Streams Law was enacted in 1937 for the purpose of regulating discharges of sewage and industrial wastes. Since its original enactment, its scope and duties have expanded substantially. In 1972, DEP determined that sediment constitutes a water pollutant under the provisions of the law and promulgated regulations for the control of erosion and sedimentation (E&S) caused by earth moving activities (25 Pa. Code, Chapter 102).

The general requirement of the E&S regulations is that earth-moving activities (including excavations, land development, mineral extraction or any other activity that disturbs the surface of the land) be conducted in a manner to prevent accelerated erosion and resulting sedimentation of streams and other watercourses, such as culverts. Persons engaged in earth moving activities must prepare E&S control plans for the site. These plans must be available on the site at all times, and sites 25 acres or larger must obtain an E&S permit prior to commencing any activity. As with obstructions and floodplain permits, local building permits should not be approved prior to issuance of an E&S permit.

The erosion plans must consider all factors which might contribute to increased erosion during and after land disturbance activities. Plans should include both temporary and permanent control measures, as well as a maintenance program for all control facilities. Since many of these temporary facilities can also serve as permanent stormwater runoff control structures, it is important that E&S and stormwater management controls be designed and reviewed as a package.

The adequate enforcement of erosion control plans is critical if stormwater management facilities are to function as designed. If culverts, storm sewers, detention ponds, or other facilities are filled with silt, they cannot function properly to control stormwater flows. As is discussed in subsequent sections of this Plan, problems of localized flooding often are caused by structures filled with sediment and debris. Implementing adequate erosion controls will reduce the amount and cost of maintaining structures.

Since the Clean Streams Law antedates the Storm Water Management Act, it does not specially mention the Storm Water Act. However, it can be assumed that E&S controls should be consistent with the Storm Water Act, and certainly an approved watershed stormwater plan. Since E&S controls could affect stormwater runoff management for the site, they would have to comply with Act 167 standards. Also, the Dams Safety and

Encroachments Act requires that obstruction permits comply with the Clean Streams Law including the erosion regulations, which in turn must be consistent with stormwater management programs.

The DEP has major administrative and regulatory responsibilities for implementing the Clean Streams Law, and may issue enforcement orders to establish compliance with the law. Failure to comply with an order is a nuisance and exposes the violator to abatement actions as well as civil and criminal penalties. The DEP or an affected municipality may sue to abate or restrain anyone who is in violation of the law. A municipality can act in the name of the Commonwealth after due notice to the Attorney General. It is important to note that both private parties and municipalities may be subject to abatement actions. For example, the DEP or a neighboring municipality may sue a municipal violator to compel action. When performing proprietary functions (e.g., constructing a road or sewer), a municipality or authority must comply with the same regulations as private individuals.

FLOOD PLAIN MANAGEMENT ACT (ACT 166 - 1978)

The Flood Plain Management Act requires municipalities with floodplain areas to participate in the National Flood Insurance Program, and to adopt floodplain management regulations that control new development in accordance with the minimum requirements established by the Federal Insurance Administration. Municipalities participating in the National Flood Insurance Program must require building permits for all construction and development occurring within identified floodplain areas. Such permits are not to be issued until all other required federal and state permits have been received by the applicant. Thus, municipalities should not issue building permits for development within floodplain areas unless the applicant has obtained all necessary obstruction and E&S permits. In addition, building permits should not be issued unless the proposed activity complies with the stormwater management regulations which have been adopted by the municipality.

Through this interrelated permitting process, the Flood Plain Management Act encompasses a comprehensive control of all activities in floodplains. It assures that there is compatibility among the actions governed by the different laws. As noted earlier, preservation of natural floodplains and comprehensive floodplain management are key parts of an effective overall stormwater management program. Natural flood areas should be maintained as part of the watershed's natural stormwater control system. Similarly, effective future stormwater management will preserve floodplains and assure that properties not now subject to flooding do not become so in the future.

MUNICIPALITIES PLANNING CODE (ACT 247, AS AMENDED)

The Municipalities Planning Code (MPC) is related to stormwater management because of the authority it grants to municipalities and counties. The MPC enables communities to prepare comprehensive land use plans and capital facilities programs. It also empowers them to prepare and adopt zoning, subdivision and land development, planned residential development, and official map ordinances. The various municipal codes (borough, township, etc.) authorize communities to adopt building/housing codes pursuant to their health, safety, and general welfare powers. These are the major planning and regulatory mechanisms that municipalities will use to implement the watershed plans. Section 11 of the Storm Water Management Act specifically requires municipalities to adopt "...such ordinances..., including zoning, subdivision and development, building code, and erosion and sedimentation ordinances..." to regulate development activity consistent with the watershed plan and Act 167. The reference to these ordinances in Section 11 implies that municipalities are supposed to utilize the land use and development authority granted by the MPC.

It is necessary to understand that various ordinances - zoning, subdivision and land development, and building - regulate different and distinct aspects or parts of the land use and development process. It is not possible to adopt one type of ordinance and simply include the items and controls covered by the other types of regulations. A community cannot regulate land usage in a subdivision and land development ordinance because the regulation of land use is a zoning power. Similarly, building code regulations such as structural standards for building construction cannot be contained in a subdivision and land development ordinance. Therefore, a comprehensive development regulation system requires, in most cases (especially urbanized / urban areas), the utilization of all three types of ordinances: zoning, subdivision/land development and a building code.

Applicable stormwater controls should be included in the proper ordinance whenever stormwater is being regulated for a land use or development activity that falls within the scope of one of the enabling authorities contained in the Planning Code (i.e., zoning, subdivision/land development, planned residential development) or under the building code's powers in the municipal codes. For example, if the activity being regulated is a subdivision, then the relative stormwater provisions belong in the subdivision ordinance. If a community utilizes a separate, single purpose stormwater ordinance, the ordinance should be clearly referenced into the appropriate sections of the municipality's zoning, subdivisions/land development and building codes. Also, the preamble of a separate stormwater ordinance should indicate that it is being adopted pursuant to the Municipalities Planning Code, Storm Water Management Act, and applicable sections of the municipal code. Under either approach, when a development activity is within the

scope of the MPC, then the municipality should be sure to follow the various plan review processes and other administrative procedures in the MPC, including the procedures for enacting and amending zoning and subdivision regulations.

The inclusion of specific procedural requirements in the MPC clearly demonstrates the Legislature's concern that all development applications be given a fair and timely review. Since most stormwater management activities will relate to zoning, subdivision/land development or building code requirements, the stormwater reviews would adhere to the procedures required by the respective ordinances.

GOVERNMENTAL TORT IMMUNITY

Municipal immunity is becoming a concern to local communities and officials who have adopted and are implementing stormwater management regulations. Pennsylvania and municipal immunity statutes have also been the subject of recent changes and litigation. This section discusses governmental tort immunity and identifies the laws specifically dealing with federal, state, municipal, and public official immunity. The discussion summarizes the basic scope of the laws, with some analysis of the relationship of the new (1979) Subdivision Torts Claims Act to stormwater management issues in local municipalities. Municipal officials, of course, will have to be guided by the advice of their solicitors on potential liabilities as specific cases or situations arise.

Federal and State Immunity

In common law there were three distinct levels of governmental tort immunity: sovereign immunity, political subdivision immunity, and public official immunity. Sovereign immunity was part of the common law from its very beginnings and became part of the law of this country and the Commonwealth of Pennsylvania when the common law of England was adopted after our county's independence was achieved. The concept behind the doctrine was that the king was sovereign and could be sued only if he consented. In fact, the rule of law came to be that "the king could do no wrong". After independence, the federal and state governments became sovereign and invested themselves with the king's immunity.

The U.S. Congress, by statute, has dramatically limited the doctrine of sovereign immunity as applied to the federal government. The Federal Tort claims Act (Title 28 U.S.C. 1346, 2671 et. seq.) provides, subject to certain enumerated exceptions, that the federal government can be held liable to the same extent as a private individual for the negligent acts or omissions of its employees.

With respect to the state sovereign immunity, the trend among states is to abolish or severely limit the doctrine by statute or case law. The belief is that the doctrine is unfair and not suited to the times. The Pennsylvania courts grudgingly applied the sovereign immunity doctrine, while pointing out its unjust results and strongly suggesting the need for legislation to reform the law. The Pennsylvania Supreme Court finally abolished the doctrine in Maybe vs. Pennsylvania Department of Highways, 479 Pa. 384 (1978). This case was decided in mid-July, 1978. Before the end of September of that year, the Legislature had recreated sovereign immunity by statute (42 Pa. C.S.A. 58521 et. seq). This new statute does provide for some very limited specifically enumerated exceptions to state sovereign immunity. Most of the exceptions go to negligent failure to adequately enforce state statutes and regulations. The statute also limits the amounts which can be recovered in suits brought under the exceptions. It is important to note that state immunity extends to state agencies, such as PennDOT and DEP.

Municipal Immunity

The second level of government tort immunity which developed as common law was applied to political subdivisions (i.e., municipalities, counties, municipal authorities, municipal agencies, commissions and departments, including planning commissions and zoning hearing boards). The historical basis of the doctrine was that local governments were the agents of the king. A substantial number of states have abolished municipal immunity by statute of judicial decision. The Pennsylvania Supreme Court first limited the doctrine by holding that it only applied to torts arising out of governmental function (i.e., those activities which are typically performed by government; e.g., police, fire, regulatory, etc.) and not to torts arising out of a municipality's proprietary activities (i.e., activities that could be done by private corporations, such as owning and operating utilities).

In 1973, the court abolished the municipal immunity doctrine in Ayala vs. Philadelphia of Public Education, 453 Pa. 584. The court's rationale was that compensating the victims of negligent public employees should be properly regarded as a cost of the administration of government and should be distributed by taxes to the public which benefits from that government. This decision exposed political subdivisions to unlimited liability, the same degree of liability to which private persons and corporations have always been exposed, for negligent acts or omissions and those of their employees and agents. This was the situation until 1978, when the Pennsylvania Legislature enacted the Political Subdivision Tort Claims Act. Since the effective date of this legislation (January 24, 1979), the doctrine of municipal immunity, with certain statutory exceptions, has been resurrected in

Pennsylvania. The provisions of this Act have been amended and recodified as 42 Pa. C.S. 38501 et. seq..

The Tort Claims Act applies to municipalities, municipal authorities, and counties. The purpose of the statute is to limit the liability of political subdivisions for the torts of their agencies, appointed and elected officials, and their employees. Under the Act, a municipality is not liable for damages caused by the negligence of an officer, employee, or agent unless all three of the following preconditions are met:

- Damages would be recoverable under common law or a statute, if the defendant was not a municipality.
- the injury was caused by the negligence of the municipality or its officers, employees, or agents operating within the scope of his or her office or employments.
- the negligent acts or omissions by a local agency or its officer or employer fall within eight specified categories of activity. The specified categories are:
    - operation of a motor vehicle
    - care, custody, and control of personal property of others
    - care, custody, and control of real property in the possession of the local agency
    - dangerous condition of trees, traffic signs, lights, or other traffic controls under care, custody, or control of the local agency
    - dangerous condition of stream, sewer, water, gas, or electric systems owned by the local agency
    - dangerous condition of streets owned by the local agency
    - dangerous condition of sidewalks within the right-of-way of streets owned by the local agency
    - care, custody and control of animals within the possession of the local agency, [Note: The numbers used here correspond to the numbering of these categories under Section 8542(b)].
    - The final four categories above are further conditioned by the requirement that a plaintiff must prove that the local agency had actual notice or could reasonably be charged with notice of the dangerous condition at a sufficient time prior to the event to have taken measures to protect against the danger.

The Torts Claims Act limits municipal liability to eight specific areas of activity. If an activity does not fit into any of the eight categories, then it appears that the municipality is not subject to any liability. For example, a municipality does not seem to be liable for damage caused by stormwater runoff from a development constructed according to subdivision plans negligently approved by municipal officials or employees. Under the Torts Claims Act, failure to use reasonable care (i.e., negligence) in the plan review and ordinance enforcement process does not fit into any of the eight categories. Therefore, even though there was negligence on the part of the official in performing the duty prescribed in the subdivision regulations and harm may have resulted, the Act appears to prevent the injured party from recovering damages against the municipality. After the Ayala case and before the effective date of the Tort Claims Act, the case law in Pennsylvania would have imposed liability on the municipality in this situation.

The Political Subdivisions Tort Claims Act probably would be held to be controlling with respect to suits of injured parties (e.g., those injured by runoff that would not have occurred but for the negligent enforcement of a municipal ordinance), although the other acts (e.g., Storm Water Management) appear to create municipal liability. Both acts should be read together. Since the Tort Claims Act is directly applicable, unless the court finds a clear express Legislative intent to impose liability, the Tort Claims Act would control. An affected municipality or aggrieved person could take action under Section 15(c) of the Storm Water Management Act to enjoin a municipality from taking an action, such as a negligent plan approval, because such action was a violation of the Act. Similarly, an aggrieved party may be able to force the municipality or official to enforce liability. If "streets" includes culverts and bridges supporting them, as it would seem it should, any culvert or bridge which does not meet the requirements of the Obstructions Act (which incorporates the Storm Water Management Act standards) could expose the municipality to action for damages. For example, damages which result from backwater flooding due to failure to clean culverts or undersized culverts under a municipal street might be recoverable.

The Torts Claims Act only protects municipalities and their officials from <u>private</u> suits. It does not protect them from enforcement orders issued by a state agency or from any criminal penalties provided by a state statute. Both the Obstructions Act and Clean Streams Law provide for DEP enforcement orders and criminal penalties for violations of the statutes.

Official Immunity

The final area of tort immunity is that immunity given to public officials, employees, and agents themselves. Sections 8545 and 8546 of Title 42 Pa. C.S. generally codify the common law rule with respect to official immunity. These sections provide that an elected and appointed officer, employee, or agent when carrying out official duties and acting within the scope of his or her employment, is liable for damages caused by his or her negligence only to the same extent as is the governmental unit (i.e., provisions of Paragraph 8542 of the Tort Claims Act are applied to public officials). This coverage does not extend to independent contractors under contract with the governmental unit, where the unit has no right of control. This could be the case for many consulting engineers.

In one respect, official immunity is broader than municipal immunity since the official may assert certain defenses. These include those available to employees at common law, good faith, and that the action was discretionary. There is no liability for discretionary as opposed to ministerial acts. Thus, most actions of members of the governing body of a municipality would be immune. In another respect, however, officials may be held totally liable. Title 42 Pa. C.S. Paragraph 8550 provides that when the conduct of the official constitutes a willful criminal act or involves actual malice or actual fraud, the immunity statute does not apply. Thus, if an official intentionally fails to enforce a regulation, he or she may be held personally liable to the extent of all of their private assets for any damage that their act causes. However, as noted above, the municipality is not liable.

BEAVERDAM BRANCH WATERSHED
STORMWATER MANAGEMENT PLAN
SECTION III
WATERSHED CHARACTERISTICS

GENERAL DESCRIPTION

The designated Beaverdam Branch watershed is located in Blair County in south-central Pennsylvania. The watershed encompasses the west-central part of the county, encompassing a total area of approximately 88 square miles. Small portions of the watershed lie outside of Blair County in Cambria County (Gallitzin Township and Tunnelhill Borough). A general watershed map is presented as Plate III-1 located in the map pocket at the rear of this report.

POLITICAL FEATURES

A total of eleven municipalities are situated in whole or in part within this watershed. These municipalities are listed in Table III-1.

Table III-1
Watershed Municipalities

Allegheny Township	Hollidaysburg Borough
Altoona City	Gallitzin Township
Blair Township	Juniata Township
Duncansville Borough	Logan Township
Frankstown Township	Tunnelhill Borough
Freedom Township	

NATURAL FEATURES

TOPOGRAPHY

The topography of the Beaverdam Branch watershed is properly described as mountainous. The western portion of the watershed is comprised of a long precipitous ridge of soil and rock known as the Allegheny Front. In the east, the watershed is confined by the southern extremities of Brush Mountain. The southern boundary is composed of Catfish Ridge, a series of hills extending from Hollidaysburg Borough westward until they merge with the Allegheny Front. Contained within these boundaries is a portion of the Logan Valley which extends into the northern areas of Blair County.

GEOLOGY

The majority of the Beaverdam Branch watershed is in the Appalachian Plateau physiographic province. The Appalachian Plateau has high, rounded ridges and stream-dissected valleys. Rocks of Pennsylvanian and Mississippian age are the youngest in the county and outcrop in the watershed. They are composed primarily of a cyclic sequence of shale, siltstone, sandstone, and some limestone and coal.

Regional uplift and compression from the southeast during the Permian period caused a regional northwest dip of bedding in the watershed. Erosion over the course of 200 million years has severely reduced the mountains to their present topography. Deposits of limestone, sandstone, shale, clay, and coal provide most of the mineral resources in the watershed.

SOILS

Soils in the Beaverdam Branch watershed can be divided into four broad groups based on association with a specific parent material. These groups are soils formed in material derived from shale, sandstone, limestone, and alluvial material. The predominant soil associations in the Beaverdam Branch watershed include the following:

- Laidig-Hazleton-Clymer Association
- Leck Kill-Meckesville-Albrights Association
- Berks-Brinkerton-Weikert Association
- Basher-Monongahela-Purdy Association
- Morrison Association

In addition, soils can be further categorized by hydrologic groups which are determined by a soil's infiltration rate. Many factors influence infiltration rate, including physical composition, chemical composition, dominant slope, and depth of soil profile. The Soil Conservation Service (S.C.S.) has defined groups of soils having similar hydrologic properties which directly influence the volume and rate of stormwater runoff. These hydrologic soil groups are defined as follows.

Group A: Soils having a high infiltration rate, even when thoroughly wetted, and consisting of deep, well to excessively drained sands or gravels.

Group B: Soils having a moderate rate of infiltration when wetted and consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse texture.

Group C: Soils having a slow rate of infiltration when thoroughly wetted, consisting chiefly of soils with a layer that impedes movement of water or soils with moderately fine to fine texture.

Group D: Soils having a very slow rate of infiltration rate when wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material.

As the soil descriptions imply, runoff potentials increase from a minimum for Group A soils to a maximum for Group D soils. Soils along the Allegheny Front were formed by the weathering of structures formed by uplift. These soils have substrata of sandstone, limestone, and shale and are characterized by slow and very slow infiltration rates. Therefore, they fall in between the Band C hydrologic classes.

For the purposes of classifying soil types for stormwater management, this investigation identified two additional classifications: water bodies and urban land. Water bodies represent areas covered by water, a condition which results in direct runoff of precipitation. Urban land consists of land which is so altered by earth moving or so obscured by buildings or other structures that the original soils cannot be identified. In some places, cuts have removed all or nearly all the natural soil horizons. In other places, fills have buried the original soils. Urban soils are generally assigned Group C hydrologic characteristic reflecting the characteristics of the predominant natural soils in the area.

A map illustrating the distribution of soil groups throughout the watershed is provided in Plate III-2. The distribution of soil groups throughout the watershed was determined based upon soil series information mapped on the S.C.S. soil survey for Blair County.

CLIMATE

The study area is dominated by atmospheric flow patterns common to the humid continental regions lying in the North Temperate Zone. Most weather systems that influence the area originate either in Western Canada or the Central Plains of the United States and are steered eastward by the prevailing westerly flow aloft.

Climatic data are available from the Weather Bureau station at Altoona. The average annual temperature is about 49.9 degrees Fahrenheit. The mean annual freeze-free period is about 169 days. The summer mean temperature is about 71 degrees Fahrenheit and the winter mean is about 28 degrees Fahrenheit.

PRECIPITATION

Long term precipitation data is available from the Martinsburg weather station. Normal annual precipitation at this station totals 36.24 inches and is well distributed throughout the year. Maximum precipitation occurs during the month of June (3.82 inches) while the minimum month in terms of precipitation is January (2.26 inches). The annual snowfall in the winter months exceeds 36 inches, with heavy snow sometimes experienced in February and March. Snow is produced as polar air masses travel south, meeting moisture carried up the Ohio Valley from the Gulf of Mexico or from the Mid-Atlantic coast.

HYDROLOGY

The Beaverdam Branch watershed is drained by the Beaverdam Branch of the Juniata River and its seven major tributaries. Blair Gap Run, which is fed by Dry Run, Blair Run, and Adams Run originates in the heavily forested regions of the Allegheny Front. As the stream approaches its junction with the Beaverdam Branch, it receives runoff from agricultural areas and the urbanized area of Duncansville.

Gillans Run also originates in the dense forests of the Allegheny Front, above the Duncansville Reservoir. As Gillans Run flows toward the Beaverdam Branch, it drains the principally urbanized Maple Hollow area. Agricultural land use predominates as the stream merges with Blair Gap Run near Duncansville.

Spencer Run begins in and drains the sparsely populated upland portions of the Carson Valley in the Allegheny Front.

Sugar Run originates in the eastern slopes of the Allegheny Mountains near Gallitzin in Cambria County. Little development has taken place in this watershed and dense forests are the predominant land cover.

Burgoon Run, with its Glenwhite Run, Kittanning Run and Scotch Gap Run tributaries, provide a portion of the water supply for the City of Altoona and its suburbs via three reservoirs situated in the upper reaches of the watershed. It flows eastward from the Allegheny Mountains, through Logan Township and into the City of Altoona. Land cover within the area drained by Burgoon Run ranges from virgin forests to dense urban land use. The upper reaches of the Burgoon Run are affected by surface mining activities.

Mill Run also flows in a easterly direction into Altoona. Water from Mill Run is impounded in two reservoirs used for water supply and flood control purposes. Runoff from the heavily urbanized areas of Calvert Hills, Westmont and South Altoona contribute water to Mill Run. It is relevant to this study that combined sewers capture portions of the runoff from the urbanized area for transport to the Altoona wastewater treatment facilities.

Brush Run begins in the area of Altoona's East End. As the stream flows southward to its junction with the Beaverdam Branch, it receives runoff from the wooded western slopes of Brush Mountain and the suburban areas of Lakemont, Sylvan Hills and Hollidaysburg.

These major tributaries combine at various points in the watershed to produce the Beaverdam Branch which then flows to its mouth on the Frankstown Branch of the Juniata River.

There are a number of dams / reservoirs within the watershed which may have an impact upon wet weather stream flows and, consequently, watershed storm water management standards and criteria. The Pennsylvania Department of Environmental Resources' Bulletin No. 5 Dams, Reservoirs and Natural Lakes lists the following dams / Reservoirs within the watershed:

- Blair Gap Dam, located on Blair Gap Run, with a drainage area of 3.0 square miles.
- Plain Nine Dam, located on Blair Gap Run, with a drainage area of 12.5 square miles.

- Lake Altoona Dam, located on Burgoon Run, with a drainage area of 11.2 square miles.
- Kittanning Point Dam, located on Burgoon Run, with a drainage area of 8.5 square miles.
- Lower Dam, located on Burgoon Run, with a drainage area of 9.0 square miles.
- Lakemont Park Dam, located on Brush Run, with a drainage area of 4.8 square miles.
- Storage Dam, located on Mill Run, with a drainage area of 7.0 square miles.
- Unnamed Dam, located on Gillans Run, with a drainage area of 1.4 square miles.
- Unnamed Dam, located on Baker Run, with a drainage area of 0. 5 square miles.
- Mill Run Reservoir, located on Mill Run, with a drainage area of 4.3 square miles.
- Blair Run Dam, located on Blair Run, with a drainage area of 7.3 square miles.
- Unnamed Dam, located on Kittanning Run, with a drainage area of 0.4 square miles.

FLOOD HAZARD / STORMWATER PROBLEM AREAS

Delineated Flood Prone Areas

Stream reaches which are identified as prone to flooding under 100 year flood conditions in Flood Insurance Studies published by the U.S. Department of Housing and Urban Development are illustrated on Plate III-3 (located in the map pocket appended to this report).

Reported Stormwater Problem Areas

The delineated flood prone areas established by flood insurance studies relate primarily to stream flooding during major storm events. As such, they do not provide information concerning more localized flooding problems or stormwater problems separate from stream flooding such as street flooding, soil erosion or stormwater pollution instances. Each of the municipalities in the watershed was contacted to solicit information relative to stormwater conditions which are perceived locally to be problems. In many cases, these problems may be somewhat localized, and related to local drainage limitations apart from stream flooding and may occur at a high frequency. Also, information relative to stormwater problems in addition to flooding (i.e., accelerated erosion, sedimentation and water pollution) was requested.

Data obtained through these efforts were supplemented by a review of Flood Insurance Studies conducted in the watershed to produce the listing of identified stormwater problem areas that is presented in Table III-2. The predominant type of stormwater related problem reported by the municipalities is flooding. 65% of the individual problems were reported as flooding problems and an additional 30% of the problems were described as a combination of flooding accompanied by stream bank erosion and sedimentation. The remaining approximately 5% of the reported problems were attributed specifically to soil erosion and sedimentation.

Suggested solutions were offered for several of the reported problem areas. The suggested solutions include structural approaches such as constructing new or increasing the capacity of existing storm sewers, increasing the capacity of culverts, and constructing stormwater detention facilities. Also included are such remedial actions as stream dredging for the removal of accumulated silt, the clearing of debris from trash racks, culvert and bridge openings and the removal of obstructions from the stream bed. Efforts to clear the stream channel is the predominant type of solution (24%) identified. Improvements to existing storm sewer systems were offered as a solution to existing problems in roughly 18% of the cases. Providing erosion protection, increasing stream channel capacity, and employing runoff detention basins are identified as potential solutions to a much lesser extent. All of the suggested solutions offered restore or increase hydraulic capacities. It is important to note that the ultimate success of any of these efforts will require that the incremental increases in hydraulic capacity not be offset by future increases in stormwater runoff. The nature of the problems currently encountered in the watershed and the types of solutions increase the importance of effective stormwater management in the watershed.

Development in Flood Hazard Areas

Stream reaches identified as being prone to flooding under 100 year storm conditions in Flood Insurance Studies are identified previously in Plate III-3. Information obtained from the watershed municipalities through the municipal questionnaire provides an indication of the nature of development in areas affected by stormwater drainage problems. The municipalities were asked to indicate the types of properties affected by reported stormwater drainage problems and to estimated the approximate number of properties affected. Residential properties were identified as being affected by 48% of the problems for which the data was reported. Commercial properties were associated with 24% of the problems, agricultural or undeveloped in 16% of the cases, and industrial in 12% of the cases. Approximately 77% of the problems were reported to affect 10 or more properties and 23% were reported to affect less than 10 properties.

Table III-2
Summary of Reported Stormwater Problems

Municipality	Storm Water Problem	Suggested Solutions
Borough of Hollidaysburg	- Flooding and erosion along Minnie Ditch caused by. excessive storm water volume and velocity as well as obstructions in the channel and upstream development - Flooding and seepage of into basements in Gaysport neighborhood caused by excessive storm water volume and lack of proper grading and conveyance facilities. - Flooding of basements and surcharging of combined sewers in Gaysport neighborhood and stadium area caused by combined sewers.	Clean and align ditch and reopen Stowell Farm field ditch. Fill low lying areas, install curbs, construct storm sewers. Construct storm sewers remove inflow from sanitary sewers.
City of Altoona	- Flooding in the 40th Street area north of Pennsylvania Railroad tracks caused by excessive storm water volume and velocity as well as undersized storm sewers - Flooding in Eldorado section of city caused by excessive storm water volume and velocity as well as undersized storm sewers.	Storm sewer construction. Storm sewer construction.
Frankstown Township	- Flooding along Brush Run caused by excessive storm water volume. - Flooding along State Route 22 caused by excessive storm water volume.	
Blair Township	Flooding at various locations along Beaverdam Branch Localized flooding east of Duncansville Flooding on unnamed tributary to Beaverdam Branch	Widen, align channel, build levee Improved storm sewer system Widen and align channel
Freedom Township	- Flooding of the Juniata River and its tributaries caused by. excessive storm water volume	
Juniata Township	- Information not available or does not apply.	

Table III-2
Summary of Reported Stormwater Problems
(continued)

Municipality	Storm Water Problem	Suggested Solutions
Logan Township	-Erosion and sedimentation along Burgoon Run caused by excessive storm volume and bridge bridge obstruction.	
	-Flooding along lower Mill Run caused by excessive storm water volume, velocity, and creek constriction.	Widen and align creek in the vicinity of the problem areas.
	-Flooding along Brush Run caused by excessive storm water volume and velocity.	Construct dykes and widen and align the stream.
	-Flooding, erosion, and landslides along upper Mill Run caused by excessive storm water volume, velocity, and creek constriction.	Construct dykes, widen creek, and conduct scheduled cleaning.
Duncansville Borough	-Localized flooding along Gillans Run caused by inreased storm water volume and sediment deposition.	Dredge channel and institute upstream stormwater runoff control requirements.
	-Flooding along Blair Gap Run caused by increased storm water volume and sediment deposition:	Riprapping to control erosion.
	-Nuisance flooding occurs due to the entire area laying within the 100-year floodplain.	Installation of adequate storm sewers.
	-Significant erosion caused by drastic change in stream alignment.	Installation of riprap.

STREAM OBSTRUCTIONS

Stream obstructions are defined as structures or assembly of materials which may impede, retard or change flood flows. Typical obstructions include bridge crossings, culverts, piers, suspended pipelines, etc.. Information describing the dimensions, condition and flow capacity of 27 separate stream obstructions was assembled during the preparation of this plan. The approximate locations of these obstructions are illustrated in Plate III-4 (located in the map pocket appended to this report. This information was collected by field investigations and site visits to the obstruction locations.

The capacities of the obstructions were estimated based upon field measurements and the application of procedures outlined in the U.S. Department of Transportation's publication *Hydraulic Design of Highway Culverts*. The estimates of the capacities of the obstructions are indicated in Plate III-4. The capacities of the limiting obstructions in the vicinity of

reported problem areas were compared against estimated flood flow rates of various return frequencies in order to evaluate the extent to which culvert capacities affect existing problems. The results of this assessment are presented in Section IV of this report.

FLOOD CONTROL FACILITIES

Existing and Proposed Flood Protection Facilities

Eexisting and proposed flood protection facilities reported in the watershed are listed in Table III-3. The approximate locations of these facilities are illustrated in Plate III-5 (located in the map pocket accompanying this report). There are no regional flood control projects within the study area. The existing flood protection facilities are designed to provide localized flood protection and include stream channelization, stream bank protection, storm sewers and debris racks. The proposed facilities would also address localized flooding problems and include stream channel improvements, stream bank protection, and debris rack construction. Riprap alone is strictly speaking is not flood protection, however, it is included in this inventory as one type of stream improvement.

STORM SEWER SYSTEMS

Existing and Future Storm Sewer Systems

The approximate locations of areas served by storm and combined sewer systems are illustrated on Plate III-6. As one would expect, the areas served by piped stormwater collection systems largely correspond to the most densely developed areas of in the watershed.

The construction of storm sewers has been identified in the municipal questionnaires as a suggested solution to stormwater drainage problems Hollidaysburg and Altoona. While some storm sewer construction can be expected to occur in these and other currently developed areas in order to address localized stormwater drainage problems, most of the future storm sewer construction will occur as new areas of the watershed are developed. Therefore, future storm sewer system construction will occur as residential and commercial development progresses. The locations of such future storm sewer systems will correspond to the locations of future residential and commercial development.

Table III-3
Reported Existing Flood Control Facilities

Municipality	Flood Control Facilities
Borough of Hollidaysburg	- Earthen levee along Beaverdam Branch*
City of Altoona	- Channel excavation at 8th, Meadow, 9th, 10th, and 12th. Street Bridges along Brush Run*
Frankstown Township	- Stormwater ditch widening and riprap lining along Lower Brush Mountain Road* - Stormwater ditch riprap lining along Brush Oakes Drive.* - Stormwater ditch riprap lining in Hickory Hill area.* - Additional stormwater ditch widening and riprap lining along Lower Brush Mountain Road**
Freedom Township	- None.
Juniata Township	- Information not available or does not apply.
Logan Township	- Dredging and cleaning of Brush Run*
Duncansville Borough	- Installation of R-5 riprap along Blair Gap Run* - Installation of R-7 riprap along Blair Gap Run* - Channel excavation/widening*
Blair Township	- Levee bordering Legion Park* - Levee to the north of Fort Fetter*
* existing ** proposed	

Financing Storm Sewer Construction

Under current practice, storm sewer construction in currently developed areas is generally financed by the municipality in which the construction occurs. Usually, storm sewer construction in newly developing areas is financed privately by the land developer.

Amendments to the Pennsylvania Infrastructure Investment Authority (PENNVEST) make certain municipalities eligible to receive financial assistance from PENNVEST to construct stormwater management improvements. Eligible municipalities are those which are located within watersheds for which stormwater management plans have been approved by the Pennsylvania Department of Environmental Resources and which have enacted, or will enact, stormwater ordinances consistent with the approved plans. Examples of eligible stormwater projects include construction of detention / retention basins, upgrades of existing storm sewer systems and the installation of new storm sewer systems.

Municipalities considering the construction of such facilities should investigate the potential for the receipt of funding assistance through the PENNVEST program.

STORMWATER CONTROL FACILITIES

Existing and Future Stormwater Control Facilities

The survey of Beaverdam Branch watershed municipalities conducted during the preparation of this plan requested information relative to current and planned stormwater control facilities. Reported stormwater control facilities are listed in Table III-4. The approximate locations of these facilities are illustrated on Plate III-6. A total of 18 existing and five proposed stormwater control facilities were reported. Five municipalities reported either existing or proposed stormwater control facilities. Approximately 80 percent of the facilities reported control stormwater runoff by using detention / retention techniques. The majority of these facilities are stormwater basins or ponds. Stormwater control through the use of facilities to induce ground water infiltration was reported in two instances. Widespread use of stormwater control facilities is significant because it demonstrates that stormwater management requirements are being enforced in the watershed and indicates that the use stormwater control techniques is not foreign to developers in the area.

Table III-4
Reported Existing Stormwater Control Facilities

Municipality	Storm Water Control Facilities
Borough of Hollidaysburg	- Detention pond for Gateway Office Center. - Swale with controlled release to storm sewer in MacNeil subdivision. - Subsurface storage tank with controlled release to storm sewer for McLanahan Foundary. - Subsurface storage tank with controlled release to swale for Old Farme Office Center. - Swale with controlled release for James Industries factory. addition. - Roof-top storage and parking lot ponding for Hillcrest. Elderly Care Apartment Building - Seepage basin for Allegheny Lutheran Home parking lot.

Table III-4
Reported Existing Stormwater Control Facilities (Continued)

Municipality	Storm Water Control Facilities
	- Detention/retention basin for Anderson Electronics two new factory buildings.
City of Altoona	-Storage tank at Tuckahoe Park.
Frankstown Township	- Infiltration device in Sylvan East development. - Detention/retention pond in Elmview development. - Detention/retention pond in Las Villas development. - Detention/retention pond in Grappone development. - On-site downspout infiltration/retention devices for all new home construction.
Freedom Township	-None.
Juniata Township	-Information not available or does not apply.
Logan Township	-Lakemont Lake. -Storm sewers built along State Route 220. - Holding pond - Detention pond
Duncansville Borough	-Stormwater detention pond for Antique Depot property. -Two stormwater detention ponds for Pielmeier Subdivision.

PRESENT LAND USE

High density residential, commercial and industrial land use classes predominate in the extreme eastern portion of the watershed. In the remainder of the watershed, open space and agricultural land uses predominate.

Table III-5 contains 1990 U.S. Census population densities for each of the municipalities in the watershed. The data presented therein is indicative of the wide variation in development density in the watershed.

Table III-5
Municipality Population Densities

Municipality	Population Density (persons / sq. mi.)
Allegheny Township	239.7
Altoona City	5,294.0
Blair Township	3,952.0
Duncansville Borough	2,618.0
Frankstown Township	148.7
Freedom Township	148.7
Hollidaysburg Borough	2,343.3
Gallitzin Township (Cambria)	75.8
Juniata Township	42.0
Logan Township	265.7
Tunnelhill Borough	265.0

BEAVERDAM BRANCH WATERSHED STORMWATER MANAGEMENT PLAN SECTION IV WATERSHED TECHNICAL ANALYSIS - PEAK FLOW ESTIMATES

INTRODUCTION

The Act 167 regulations require that watershed stormwater management plans produce estimates of peak stream flow rates under a range of storm event conditions. This section contains a discussion of the procedure used to prepare these estimates for the Beaverdam Branch Watershed.

SELECTION OF METHODOLOGY

There are a number of hydrologic modeling techniques available for estimating stormwater runoff based upon ground cover and precipitation conditions. Procedure PSU-IV was selected for use in the Beaverdam Branch Watershed. PSU-IV was selected because it represents an efficient method of estimating runoff rates. This model allows adjustments for reservoirs, lakes, and urbanization, all of which are applicable to the Beaverdam Branch Watershed.

DATA COLLECTION

Input data requirements for PSU-IV include the following parameters:

A. Tributary Area (Subbasin) Physical Features
   1. Tributary land areas
   2. Geographic Location
   3. Percent Forestation
   4. Percent Urbanized

B. Tributary Area (Subbasin) Hydrologic Features
   1. Estimated Manning's coefficient
   2. Reservoir storage

DESCRIPTION OF THE METHODOLOGY

The PSU-IV procedure was developed by the Pennsylvania Department of Transportation and the Federal Highway Administration to estimate design flood peaks on ungauged Pennsylvania streams. PSU-IV estimates peak runoff rates for a watershed using the log Pearson equation:

$$Y_{Tr} = \hat{y} + K_y S_y$$

in which:

Y_{tr} = Logarithm (base 10) of the flood peak in cfs of the specified return period, Tr.

$\hat{y}$ = Mean value of the annual series of the log of the flood peak, approximately equivalent to the 2.33 flood peak.

K_y = Log Pearson III coefficient, a function of the return period, Tr, and the skew coefficient, G, of the log of the flood peak

S_y = Standard deviation of the log of the flood peak form the annual series of flood peaks.

The watershed to be modeled is located geographically to determine the appropriate flood region. The mean logarithm of annual maximum flood peaks, $\hat{y}$, is computed using the following equation:

$$\hat{y} = 2.60 + 0.85\log A - 0.44\log FOR$$

in which:

A = Drainage area in square miles.

FOR = Percentage of drainage area covered by forests, measured as green area on 7.5 minute USGS topographic map.

Regional standard deviation and skew coefficient values are taken from plates at the corresponding watershed centroid location. Flood peaks of the desired return periods are then computed using the log Pearson equation presented above. Adjustments are then made to the flood peaks for watershed urbanization and reservoir, lake or swamp storage effects. A watershed is defined as urbanized if a significant amount of the drainage area is impervious and/or a significant amount of channel improvement has taken place. Flood peak reduction by reservoir, lake or swamp storage is evaluated if the total flood storage volume available, including 2 feet of surcharge on the reservoir, lake, or swamp area, is equivalent to at least 0.02 feet of runoff from the total drainage area. The PSU-IV procedure allows for the determination of confidence limits and safety factors.

PEAK FLOW ESTIMATES

Existing Conditions

The PSU-IV procedure was used to determine the flood peak for the entire Beaverdam Branch Watershed and for subareas that were reported as problem areas by municipalities within the study area. The raw results of the PSU-IV procedure were adjusted to calibrate to the 100-year peak discharge reported at in the Federal Flood Insurance Study for at the Route 36 bridge. The results of this analysis are presented in Table IV-1. The locations of the points for which peak discharge rates were calculated are presented in Plate IV-1. Rates were determined for 2, 5, 10, 25, 50, and 100-year floods. The flood peaks were compared to capacities of obstructions in the applicable subareas to determine if the obstructions contribute to flooding. None of the modeled subareas appear to have obstructions that would limit flood peaks for any of the return periods. This correlates with the responses to the municipal questionnaires in which the most prevalent cause of reported problems was a general lack of stream capacity and typically not a limiting capacity of specific obstructions.

Table IV-1
Peak Discharge Estimates - Existing Conditions

Subarea	Return Year and Discharge in Cubic Feet per Second						Limiting Obstructions
	2	5	10	25	50	100	
Entire Study Area	2,750	4,627	6,186	8,659	10,764	13,317	None (Min. = 196,800 cfs)
A	439	739	987	1,366	1,698	2,076	None (Min. = 2,600 cfs)
B	1,925	2,606	3,159	3,989	4,750	5,604	None (Min. = 9,800 cfs)
C	472	726	933	1,218	1,470	1,716	None (Min. = 5,000 cfs)
D	270	429	559	756	928	1,122	None (Min. = 3,200 cfs)

Future Conditions

Peak flow estimates under potential future development conditions where developed using the PSU-IV procedure as described above. The peak flow estimates are based upon an overall ten percent increase in the total amount of developed area. This estimate was produced based upon an review of historical rates of urbanization as evidenced by successive updates of U.S.G.S. topographic maps as well as dicussions with Blair County

Planning Commission staff. The projected future peak flow rates under these conditions for the same areas presented in Table IV-1 are provided in Table IV-2. As is indicated by the data contained in Table IV-2, without appropriate controls, increases in land development will increase peak stream flow rates and increase the potential for flooding. This points to the advisability of instituting stormwater management controls for the purpose of avoiding increases in stream flows as land development progresses.

Table IV-2
Peak Discharge Estimates - Future Conditions

Subarea	Return Year and Discharge in Cubic Feet per Second					
	2	5	10	25	50	100
Entire Study Area	2,829	4,762	6,367	8,912	11,079	13,707
A	440	740	990	1,370	1,703	2,082
B	1,937	2,629	3,194	4,036	4,796	5,661
C	474	729	936	1,222	1,475	1,721
D	270	429	561	758	930	1,124

BEAVERDAM BRANCH WATERSHED STORMWATER MANAGEMENT PLAN

SECTION V

DEVELOPMENT OF WATERSHED TECHNICAL STANDARDS AND CRITERIA

INTRODUCTION

As was discussed previously in Section I, the basic standard for stormwater management as established by Act 167 is that those involved in activities which can generate additional stormwater runoff, increase its velocity, or change the direction of its flow must be responsible for controlling and managing the runoff so that these changes will not cause harm to other persons or property throughout the watershed. This mandate requires comprehensive stormwater planning at a watershed level and the development of standards and criteria for managing stormwater to prevent adverse impacts, both at a particular site and anywhere downstream where the potential for harm can reasonably be identified.

Specifically, the primary prerequisite for effective stormwater management in the watershed is the development of standards which specify allowable stormwater discharges from land development activities. Standards must also be developed which address issues associated with the control of velocity, direction, and quality, if appropriate. The standards must be accompanied by associated criteria which serve as the basis for the evaluation and design of stormwater controls that are necessary to comply with those standards.

CONTROL STORM CHARACTERISTICS CRITERIA

A key element in the development of this stormwater management study is the definition of the characteristics of the rainfall events against which the developed control standards must be applied. Specifically, the rainfall events which the stormwater control measures must adequately handle need to be defined. The objective of the analyses discussed in the following paragraphs was to describe characteristics of storm events which will serve as the basis for the evaluation and design of effective control measures in the Beaverdam Branch Watershed.

The critical rainfall event characteristics are as follows:

1. An identified duration or length of the particular rainfall event.
2. An identified rainfall intensity or distribution or pattern of precipitation falling over the duration of the event.
3. An identified frequency of occurrence or the expected time interval between occurrences of the given precipitation event.
4. An identified volume or total amount of rainfall that can be expected for the particular event.

Storm Distribution

The Soil Conservation Service (SCS) Type II rainfall distribution has been selected for application to the development of control standards and the design of actions to be taken to satisfy those standards. The SCS Type II rainfall distribution is a synthetic rainfall distribution pattern which includes maximum rainfall intensities for selected storm return frequencies arranged in a sequence that is critical for producing peak runoff. Since the SCS Type II storm distribution is supported by significant research activity, is widely used in stormwater runoff calculations throughout the area, and its use is incorporated directly in the frequently employed SCS stormwater runoff computational procedures, it was selected as the control storm distribution for use in the Beaverdam Branch watershed.

Storm Duration

A 24-hour design storm has been selected as the storm duration criteria for use in the Beaverdam Branch watershed. Experience has shown that the 24-hour duration generally approximates the most damaging design storm conditions for watersheds located throughout Pennsylvania. An additional supporting consideration in the selection of the storm duration for use in the Beaverdam Branch Watershed is the fact that the popular Soil Conservation Service Technical Release 55 Urban Hydrology for Small Watersheds procedure for estimating runoff and peak discharges is based upon a 24-hour storm duration. This procedure is extensively used within the region and nationally in the production of stormwater control plans for proposed land development. Adoption of a storm duration criteria other than 24 hours would effectively preclude the use of this most popular computational procedure.

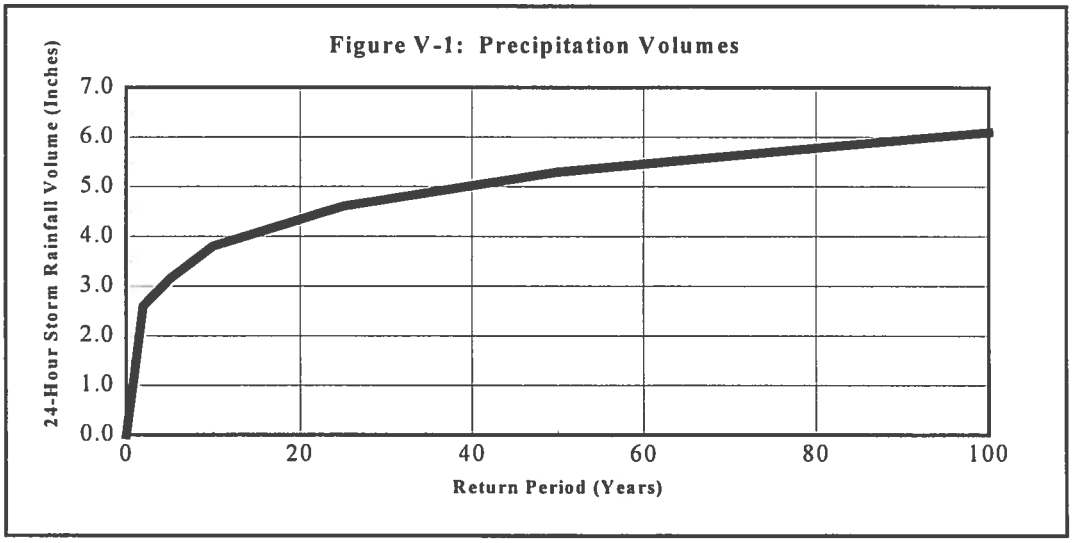
It is recognized that the use of shorter durations will be appropriate and permissible in the design of stormwater collection facilities. However, the selection and application of

controls to the discharge of runoff from developing sites will be based upon the 24-hour storm duration criteria

Storm Return Frequencies and Precipitation Volumes

General

Storm return frequency refers to the average interval in years over which a storm event of a given precipitation volume can be expected to recur. For example, reference to a "10-year" storm with an associated 3.75 inch 24 hour duration storm volume indicates that a storm producing 3.75 inches of rainfall over a 24 hour period on the average can be expected to occur approximately every ten years. Another way to consider this storm is that, on the average, a storm producing 3.75 inches of rainfall over a 24 hour period has approximately a ten (10) percent chance of occurring in any given year. Storm duration and volumes for return frequencies ranging from 2-years to 100-years were presented previously in Section IV of this report (Table IV-2). This data is presented graphically below in Figure V-1. As is indicated in Figure V-1, precipitation amounts increase with increasing return periods reflecting the obvious fact that the larger the rainfall event the more infrequent the occurrence.



The Pennsylvania Department of Environmental Protection's "Storm Water Management Guidelines" describe design frequencies as the peak rates of discharge for which the components of drainage systems are designed. Reoccurrence intervals used for design typically range from 2 to 100 years.

Individual drainage system components are generally assigned design storm frequencies based upon an evaluation of such factors as the size of the area drained and the potential for damage produced as a result of inadequate drainage as characterized by the size of the affected area, the nature and characteristics of land use in the affected area (i.e., residential, commercial, industrial uses). Components of the initial drainage system such as storm sewers and inlet structures generally are designed for relatively high frequency events ranging upwards to the 10-year storms. Major drainage system components are generally designed for less frequent, larger storms such as the 25-year and 50-year events. Flood protection projects typically are designed to accommodate conditions produced by the 100-year storm events.

Design frequency criteria for the construction of conveyance facilities such as storm sewers, pipes, culverts, bridge openings and spillways are contained in a number of regulations and design manuals, including: regulations produced relative to the Pennsylvania Dams Safety and Encroachments Act, and the Pennsylvania Flood Plain Management Act; Pennsylvania Department of Transportation design criteria; Pennsylvania Soil and Erosion Control Manual; and the Water Pollution Control Federation Manual of Practice No. 9: Design and Construction of Sanitary and Storm Sewers. These references provide ample guidance under the law and standard engineering practice to permit municipalities to establish local requirements for traditional stormwater facilities design commensurate with local conditions. There are, however, no state level criteria for stormwater discharges as they relate to total discharge volumes and rates from new land development. Moreover, unlike the generally site specific conduit construction criteria, site runoff criteria must be established based upon watershed wide considerations. Consequently, this watershed plan presents specific criteria relative to storm frequencies to be used in controlling total stormwater discharge volumes and rates from new site development.

Upper and Lower Storm Frequency Criteria Limits

For this study the design storm frequency criteria were selected to respond to watershed conditions and to meet the objective of Act 167 to minimize stormwater damage now and in the future. The following example serves to illustrate the design storm frequency criteria selection rationale. The following table contains pre-development and post-development peak rates of discharge for a hypothetical development.

Table V-1
Hypothetical Storm Discharge Rates Under Various Return Frequency Conditions

Condition	Design Storm		
	2 - Year	10 -Year	100 - Year
Pre-development	50 cfs	75 cfs	100 cfs
Post-development	100 cfs	150 cfs	200 cfs

Two conclusions may be drawn for the data presented in this table:

1. If the design storm frequency criteria require that only the 100-year event be used as a point of control, the post-development discharge for the 2- and 10-year storms will be passed uncontrolled through a stormwater management facility potentially causing downstream harm..

2. If the criteria require that only the 2-year event be applied, damage may result from increased runoff during the less frequent storm conditions.

If the stormwater conveyance system from this hypothetical development site to the river were capable of accommodating flows generated under 100-year return frequency storm conditions, controlling discharges under simply a 100-year storm frequency criteria would be acceptable. However, information obtained from local municipal questionnaires and data produced through an analysis of existing obstruction capacities identified a number of locations where flooding occurs as frequently as once per year. The municipal questionnaires identified a number of locations within the watershed at which flooding occurs on average at least once per year. In addition, it is generally accepted that the bankfull capacity of natural stream channels approximates the mean annual flood. As a result, flows in excess of the mean annual flood frequently produce localized flooding. Consequently, the mean annual (2-year) event has been selected as the lower limit design storm frequency criteria.

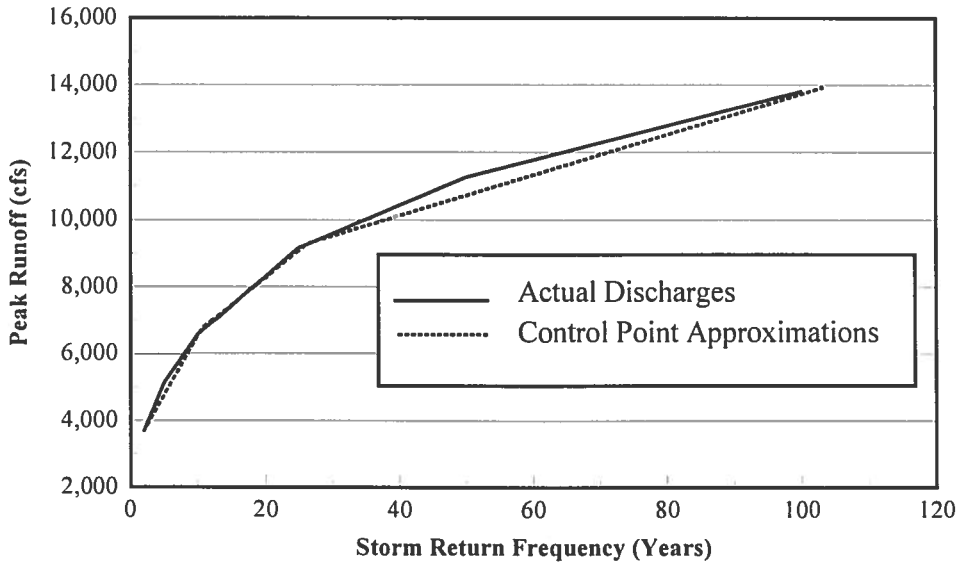
The 100-year frequency storm was selected for use in the watershed because the control of the 100-year frequency runoff would serve to preserve the 100-year flood plain and floodway boundaries as defined in the flood insurance studies completed in the watershed. These boundaries provide the basis for on-going flood plain management in the area. Permitting increased runoff at the 100-year return frequency conditions would result in an expansion of the flood zones and substantially increase the potential for damage.

Intermediate Frequency Criteria

In setting the upper and lower limits for the return frequency storms to be controlled, it is assumed that the runoff produced by all of the intermediate storm events will also be controlled. In other words, the stormwater control facilities would regulate discharges such that the post-development discharges would match the pre-development discharges at the 3-year, 4-year, 5-year frequency storms and so on through the 100-year frequency event. It would clearly be impractical to design for such a multitude of conditions and cumbersome to review management plans produced on such a basis.

Intermediate return frequency events were selected as reasonable points at which to verify that the runoff control system performance will generally parallel pre-development conditions between the 2- and 100-year limits. The selected check points and the manner in which they approximate actual runoff rates at various return frequencies are illustrated in Figure V-2.

Figure V-2: Illustration of Intermediate Control Points



The following storm frequency check points have been selected for inclusion in the stormwater management criteria:

1. 2-year frequency storm;
2. 10-year frequency storm;
3. 25-year frequency storm; and
4. 100-year frequency storm.

The rationale for the selection of the upper and lower check points was described previously. The reasons for selecting the 10-year and 25-year frequency storm intermediate check points are as follows:

1. The use of these two intermediate points are effective in producing a curve of runoff rate verses storm return frequency which reasonably closely approximates the observed modeled relationship between the two variables.
2. The 10-year and 25-year events are the most frequently referenced recommended design storms for a wide range of stormwater drainage facilities.

Precipitation Volumes

Precipitation volumes to be used in the design and evaluation of stormwater control measures in the Beaverdam Branch Watershed are presented in Table V-2.

Table V-2
Design Rainfall Volumes
(24 - Hour Storm Durations)

Return Period	Volume (Inches)
2 - year	2.6
10 - year	3.8
25 - year	4.6
100 - year	6.1

RUNOFF CONTROL STANDARD

General Approach

The basis for the establishment of runoff control standards is contained in the Storm Water Management Act. The statement of legislative findings contained in the Act (Section 2 of the Act) presents the following findings:

> "(1) Inadequate management of accelerated runoff of storm water resulting from development throughout a watershed increases flood flows and velocities, contributes to erosion and sedimentation, overtaxes the carrying capacity of streams and storm sewers, greatly increases the cost of public facilities to carry and control storm water, undermines flood plain management and flood control efforts in downstream communities, reduces ground water recharge, and threatens public health and safety.
>
> (2) A comprehensive program of storm water management, including reasonable regulation of development and activities causing accelerated runoff, is fundamental to the public health, safety and welfare and the protection of the people of the Commonwealth, their resources and the environment."

Section 13 of the Act defines the duty of persons engaged in the development of land as follows:

> "Any landowner and any person engaged in the alteration or development of land which may affect storm water runoff characteristics shall implement such measures consistent with the provisions of the applicable storm water plan as are reasonably necessary to prevent injury to health, safety or other property. Such measures shall include such actions as are required:
>
> (1) to assure that the maximum rate of storm water runoff is no greater after development than prior to development activities; or
>
> (2) to manage the quantity, velocity and direction of resulting storm water runoff in a manner which otherwise

adequately protects health and property from possible injury."

Runoff Control Standard

Runoff Quantity Standard

The runoff control standard recommended to be applied to new land development activities in the Beaverdam Branch Watershed is as follows:

There shall be no increase in the peak rate of stormwater runoff discharge from land subdivision, land development, and land alteration activities following completion of the activity (post-development conditions) over the rate that would have occurred from the land prior to the activity (pre-development conditions).

This control standard is intended produce the result that land development or alteration activities will not increase the peak rate of stormwater discharges from the site. In this manner, adjacent and downstream properties are afforded protection from the runoff effects of the developer and the developer is presented with the reasonable expectation that he/she does not increase peak stormwater discharges from the site above those that existed prior to the start of his/her activities.

Runoff Quality Standard

The suggested runoff quality standard takes the form of a requirement that the developer apply identified best management practices for the improvement of runoff quality in the design of his stormwater management facilities. The use of best management practices for the purpose of reducing stormwater runoff pollution is very worthwhile and is encouraged. However, the following best management runoff water quality standard is provided as a recommendation, not as a mandatory standard:

Stormwater detention / retention basins shall be designed so that the outlet of the basin shall, in addition to meeting the runoff water quantity standard, discharge the 1 year, 24 hour storm over a 24 hour period. Or, as an alternative, the water quality control objectives may

be achieved through a combination of best management practices, including, but not limited to detention / retention basins, vegetation filter strips, and buffers designed in consultation with the municipal engineer.

The application of this best management practices standard will result in the provision of features in the design of the stormwater control system that will result in improvements to the quality of the water discharged from the development site and serve to protect downstream water quality.

Application of the Runoff Quantity Control Standard

The runoff control standard functions as a performance standard; that is, it defines an end result which is to be attained. Under this performance standard based approach, the individual developer can select and design those drainage control measures that are most appropriate to the site as long as control standard is met. The following procedure should be used as a test in specific cases to determine whether the post-development not to exceed pre-development peak discharge rate controls will be satisfied.

1. Compute the pre-development and post-development runoff for the specific site using an approved method for the 2, 10, 25 and 100 year storms, using no stormwater management techniques. If the post-development peak rate is less than or equal to the pre-development rate, the requirements of Act 167 and this plan have been met. If the post-development runoff rate exceeds the pre-development rate, proceed to Step 2.

2. Apply on-site stormwater management techniques to increase infiltration and reduce impervious surfaces. Recompute the post-development runoff rate for the 2, 10, 25 and 100 year storms; and if the resulting post-development rate is less than or equal to the pre-development rate, the requirements of this plan have been met. Otherwise, design stormwater detention or retention facilities as required to limit peak discharges to no more than the calculated pre-development rates to satisfy the runoff quantity standard and to attenuate the discharge of the 1 year, 24 hour storm over a 24 hour period to satisfy the runoff quality standard.

It should be noted that stormwater storage can be provided on or off site. The possibility for regional or off-site facilities is an option which can be considered as a means to more efficiently provide the needed facilities, in terms of both cost and land requirement

considerations. In many areas, the best solution may be for several development sites to share a joint facility.

Municipalities may also benefit from this approach. They may maximize development in prime development areas by providing regional or distributed storage through the use of natural or artificial lakes, flood plains and steep sloped valleys which are unsuitable for development. However, where off site storage is to be used, the developer must ensure that no flooding or harm will be caused by runoff between the new development and the off site storage area. This may require the protection of the stream channel or the construction of a storm sewer to convey runoff to the storage site.

Application of the Runoff Water Quality Standard

The runoff water quality standard calls for the utilization of recognized best management practices for the improvement of runoff water quality. The standard specifically identifies the use of extended detention ponds as a preferred best management practice. However, the potential for the application of other best management practices is recognized. The evaluation and application of alternative best management practices must be made in consultation with the municipal engineer and should consider the following specific factors:

- total contributing area
- permeability and infiltration rate of soils
- slope and depth to bedrock
- seasonal high water table
- proximity to buildings and wells
- erodibility of soils
- land availability and topography
- peak discharge and required volume control
- streambank erosion
- efficiency of BMPs to improve water quality
- volume of runoff effectively treated
- nature of pollutants being removed
- maintenance requirements
- recreational value
- enhancement of aesthetics and property values
-

Section VI of this plan contains descriptions of various runoff water quality best management practices. This information can be used to assist in the identification and evaluation of water quality control alternatives.

PERMISSIBLE RUNOFF COMPUTATION TECHNIQUES

GENERAL

A number of techniques and methods have been developed and are used to estimate rates and volumes of runoff from land. Runoff computation techniques permissible for use in

developing runoff control plans pursuant to the requirements of this Plan have been identified. It is recommended that municipalities require land developers to limit the computation techniques employed to one or more of those listed. The list of permissible techniques includes a cross section of the most commonly used computation methods entailing a range of approaches, levels of effort and required access to computer facilities. The list affords developers the opportunity to select from a number of techniques. At the same time, the number of techniques which the local reviewing engineer must be familiar with is kept to a manageable number. In addition, the use of inapplicable, unproven or inaccurate techniques is prohibited.

PERMISSIBLE RUNOFF COMPUTATION TECHNIQUES

The recommended permissible runoff computation techniques are as follows.

METHOD	METHOD DEVELOPED BY	APPLICABILITY
TR-55 (or commerical package based on TR-55)	USDA NRCS	Applicable for land development plans within limitations described in TR-55.
TR-20 (or commercial package based on TR-20)	USDA NRCS	Applicable where use of full hydroloby computer model is desirable or necessary.
HEC-1	U.S. Army Corps of Engineers	Applicable where use of full hydroloby computer model is desirable or necessary.
PSRM	Penn State University	Applicable where use of full hydroloby computer model is desirable or necessary.
Rational Method (or commercial computer package based on Rational Method)	Emil Kuichling	For sites less than 200 acres, or as approved by the Municipality and Municipal Engineer.
Other methods	Varies	Other computation methodologies approved by the municipality and municipal engineer.

Engineers involved in the preparation of stormwater control plans and reviewers of such plans should review the pertinent information relative to the use and applicability of each of these methods. It is important that the assumptions implicit and explicit in each of the techniques be understood and that the techniques are properly applied.

BEAVERDAM BRANCH WATERSHED
STORMWATER MANAGEMENT PLAN

SECTION VI
STORMWATER MANAGEMENT TECHNIQUES

INTRODUCTION

One of the key features of the Stormwater Management Act 167 is its mandate to implement comprehensive stormwater runoff control practices. The Act requires stormwater planning at the watershed level in such a manner that adverse impacts of storm runoff are prevented, both at a particular site and at every potential flood prone location downstream from the watershed. Therefore, any stormwater management technique must consider runoff impacts on the watershed.

Studies in recent years have identified a number of methods of reducing the impact of development on storm peaks. Many management practices indicate the ingenuity of the planning, engineering and regulatory agencies. In particular, the publications of Soil Conservation Service (SCS) of Department of Agriculture (USDA), U.S. Environmental Protection Agency (EPA) and American Public Works Association (APWA) are quite comprehensive and aid in expanding some of the management practices reported in this section.

The present-day emphasis on detention or reduction of urban runoff within the contributing source area represents a remarkable shift in runoff control strategy that has occurred only rather recently . This trend toward on-site runoff abatement includes control measures that either reduce the runoff directly at the source or delay the arrival of runoff contributions at some critical points downstream. Attesting to the strength of this trend is the large and growing number of publications describing various on-site control measures. Notable contributions in this regard include those by Poertner on stormwater detention practices; Becker et al. on rooftop storage; Aron et al. on general runoff abatement measures including infiltration trench design; Montgomery County Soil Conservation District on storage detention ponds; ASCE, The Urban Land Institute, and the National Association of Homebuilders]on residential runoff abatement measures; and

Field and Field and Lager for comprehensive reviews of structural and nonstructural measures.

Methods applicable to almost all watersheds are based on the principles of velocity reduction, infiltration enhancement, detention and retention storage, etc. However, site-specific conditions in a given watershed may lead to the development of innovative control measures. All the methods are designed to control sediment, pollution and stormwater within the watershed. Although the design of stormwater control facilities is usually completed by engineers and landscape architects, key policy questions should first be answered by local officials. Preferences of local residents concerning level of protection, aesthetics, maintenance responsibilities, and cost allocation should be assessed by local officials, not professionals. After community stormwater management policies have been established, detailed design or design review of particular controls and measures can be carried out [Clinton River Watershed Council, 1984]. Where practical, control measures should be designed to exploit the beneficial uses of the stormwater such as recreational and aesthetic benefits and recharge of underground aquifers. In many cases this can be the decisive factor in approval of a new land development. The intent of this chapter is to review the existing storm water management techniques and make recommendations on their applicability, from many different perspectives such as suitability for the study watershed, cost, effectiveness, advantages, disadvantages and maintenance etc.

CONCEPT OF STORMWATER MANAGEMENT

Early stormwater management efforts concentrated on transporting the runoff as quickly as possible from a storm location, by routing it through storm sewer systems. As the urban development increased in the watershed, such a flood control effort resulted in the worst flooding conditions downstream, due to increased total flow, peak flow rate, stream velocity, and flow depth. Land development causes an increase in the rate of runoff from the site, resulting in an increased peak flow rate. Changing a natural channel to a concrete-lined ditch or a storm sewer system increases the velocity and reduces the travel time to downstream locations. A reduction in the travel time may cause the peak flow rate from one watershed to contribute to, or, in the worst case, to coincide with the peak flow rate of some other watershed(s). This again results in an increased peak flow rate. Detaining the storm water and releasing the maximum rate over a longer period of time may also induce the same adverse effect.

It is now recognized that, due to above mentioned problems the most logical and effective approach to control the storm runoff is to maintain the natural runoff flow characteristics. This can be accomplished in general by maximizing natural infiltration processes, reducing impervious surfaces, preserving floodplains, and controlling storm runoff in the watershed. There are numerous, technically acceptable techniques which have varying degrees of applicability in the study area, depending on the site and watershed characteristics. Some of the most widely used ones will be described here, along with a brief discussion of their key features, advantages and disadvantages, and typical costs. It will be up to each individual developer to select the techniques that are most appropriate to the project and site. It is most likely that, in most situations, a combination of on-site controls will be the most appropriate and least costly stormwater management system. Nevertheless, some alternatives must be carefully analyzed. For example, when several detention basins are used, their interaction must be considered, since a combination of the timing of their releases could aggravate downstream flooding rather than alleviating it. Also, the efficiency and costs of many of management alternatives vary from one location to another. Many of the alternatives, such as on site storage basins, erosion control, and flow reduction alternatives, may be feasible only for areas of new development [Kibler, 1982].

To determine the most appropriate set of techniques for a particular site, several factors should be evaluated:

1. Soil characteristics (i.e. soil permeability, erodibility)
2. Topography
3. Subsurface conditions
4. Drainage patterns (i.e. proximity to stream flooding problems)
5. Proposed land uses
6. Costs
7. General advantages and disadvantages of each technique.

STORMWATER RUNOFF PROBLEMS

FLOODING

During high intensity, or long duration storms the existing infiltration capacity of soils may be exceeded and surface storage filled to capacity. Once this happens, runoff occurs in the form of overland and channel flow. During some high runoff and relatively infrequent storm events, if the existing watercourses have insufficient capacity to convey surface flows, they get flooded. Natural floodplains provide some benefits by serving as reservoirs, natural recharge basins, collectors of pollutants, wildlife habitats etc. As floodplain or upstream areas are developed, this natural beneficial phenomenon, becomes a disaster due to its increased frequency and magnitude. Thus, new developments potentially create flood problems and potential downstream damages.

There are many ways to reduce the impact of new development on flooding. Some general concepts to consider in determining which solutions are applicable to a study area are listed below:

1. Limit development of floodplains and prohibit development in floodways
2. Increase infiltration
3. Reduce runoff rates
4. Store precipitation and runoff where it falls and release it slowly
5. Keep water confined in adequate pipes or channels
6. Protect areas subject to flood damages
7. Build flood control measures
8 Limit erosion and sediment transport

EROSION AND SEDIMENTATION

When raindrops hit bare soil, the cumulative effect is the splashing of the hundreds of tons of soil into the air. Some particles are washed into streams or downstream areas unless the velocity is very low or the soil is protected by some means. This phenomenon is called erosion. The runoff from new land developments can result in erosion both on-

site and off-site. Once soil erosion begins, the soil particles transported by runoff and water currents begin to settle down in downstream drainage ways. This is called sedimentation. Sedimentation may result in blockages of natural watercourses, plugging of culverts and storm sewers, smothering of vegetation, filling of reservoirs, etc. Sedimentation occurs at increased rates during and following land development because graded areas are left in an unprotected state. Data collected by Brandt [1972] shows that erosion rates on land undergoing development can be 2,000 times larger than the erosion rate of forested lands.

Erosion problems in the Beaverdam Branch Watershed are particularly significant in areas downstream of large developments. Unless properly collected and transported, runoff in large developments can collect on the surface and run through downstream property. This ultimately can lead to loss of property and threats of damage to residential, commercial, and industrial properties.

General concepts to be followed for minimizing erosion and sedimentation include the following:

1. Protect the soil surface to withstand effects of rainfall and runoff
2. Limit soil erosion through site management practices
3. Store rainfall and runoff where it originates and release it slowly
4. Catch sediment before it enters natural drainage channels

Activities specifically appropriate to drainage in the vicinity of the shore line bluff areas include:

1. Collection of surface runoff in properly designed stormwater collection and conveyance systems.
2. Conveyance of surface water runoff to the base of the bluffs thorough outfalls equipped with energy dissipation devices.

POLLUTANT TRANSPORT

Runoff from developed areas contains more pollutants than from natural watersheds. These pollutants include heavy metals, BOD, and high concentrations of suspended solids. Heavy metals and BOD generally increase as the area is developed and reach a plateau when the development has stabilized. The impacts of these pollutants depend on the existing quality and use of the receiving waters. If the newly developed area drains into a supply reservoir, an increase in the amount of pollutants could be very significant. In other cases, the impacts may be difficult to determine and are often long-term, subtle, and persuasive rather than immediate.

ON-SITE STORMWATER FLOW MANAGEMENT

Many methods are available to alleviate the impact of urbanization on the quantities and rates of stormwater runoff. Maryland Interim Watershed Management Policy [APWA, 1981] states, "When engineering a site for stormwater management, two overall concepts must be considered: 1) the perviousness of the system should be maintained or enhanced, and 2) the rate of runoff should be slowed. Land development methods which tend to reduce the volume of runoff are preferred over methods which tend to increase the volume of runoff." Many of the steps taken to reduce flooding also have significant effects in reducing erosion, sedimentation, and stream pollution and may reduce the need for capital-intensive storm sewer systems.

All things considered, the most advantageous means of controlling stormwater runoff from new developments is by minimizing the amount of increased runoff volumes produced. If it were possible to complete the new development in a manner such that there would be no change in either the volume or peak rate of discharge after development, there would be essentially no stormwater related impacts. While it is recognized that, in most cases, it may not be possible to accomplish the goal of making both post-development runoff volumes and peak rates of runoff match pre-development conditions, reasonable efforts should be made to minimize increases in total runoff volumes prior to the design of supplemental controls designed to control peak discharge rates.

It is recommended that land developers be encouraged to take reasonable and applicable steps to incorporate features into their developments which will serve to minimize increases in stormwater runoff volumes.

RUNOFF VOLUME REDUCTION MEASURES

Following are brief descriptions of measures which may be taken to limit increases in total runoff volumes resulting from new developments. The applicability of these measures is highly site specific and dependent upon the nature of the development. However, it is recommended that the potential application of these techniques be seriously considered early in the design of land development activities.

Limit the Amount of Land Disturbed

The added volume of runoff produced as a result of the development of "virgin" land is directly related to the amount of land cover changed from its natural state to a more impervious condition (usually paved). Consequently, increases in runoff volumes can be minimized to the extent that land cover disturbances can be minimized. Individuals involved in land development activities, should, therefore, be encouraged to optimize their development activities from the standpoint of accomplishing the basic objectives of the development while minimizing the amount of paved areas used and natural areas disturbed.

Utilize Terraces, Contoured Landscapes, Runoff Spreaders, Diversions and Grassed or Rock-Lined Waterways

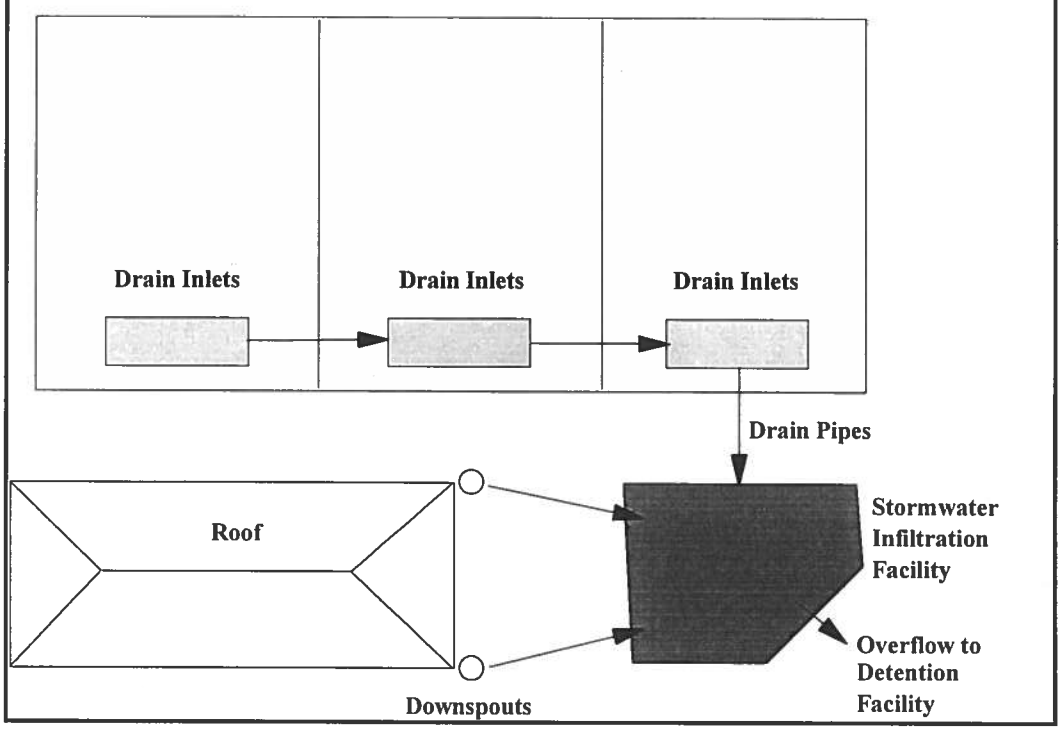
These measures increase the time of concentration by increasing length of overland flow, and thus lowering the flood peak. They provide the additional benefit of reducing total runoff through infiltration if the site has well-drained soils. Runoff spreaders spread runoff or direct it into a system of terraces. Terraces are more suitable for reducing erosion from agricultural and non-urban areas and conserving soil moisture. They reduce effective slope length and avoid runoff concentration. About 90% of the soil that is moved is deposited in the terrace channels. In contouring, crop rows follow field contours to prevent erosion and runoff. Contouring can reduce average soil loss by 50% on moderate slopes and less on steep slopes. There are no soil or climatic limitations on practicing contouring, but it is not feasible on very irregular topography. Grassed waterways or swales stabilize vegetation on drainage channels. For velocities of up to eigth feet per second, runoff is reduced by grass channels, if correctly graded and

stabilized. Detailed design information for this category of alternatives can be obtained from the Soil Conservation Service's Engineering Field Manual for Conservation Practices.

Use of Infiltration Devices

Infiltration devices are used to reduce flood peaks by releasing all or part of the stored runoff into the ground water. The infiltrated water may appear a short distance downstream as surface water at a later time. However, the runoff hydrograph at the outlet point should be much lower and drawn out in time than that from runoff delay techniques [Aron, 1975]. An example application of infiltration storage techniques is provided in Figure VI-1.

Figure VI-1
Example Application of Roof and Parking Lot Infiltration Facility

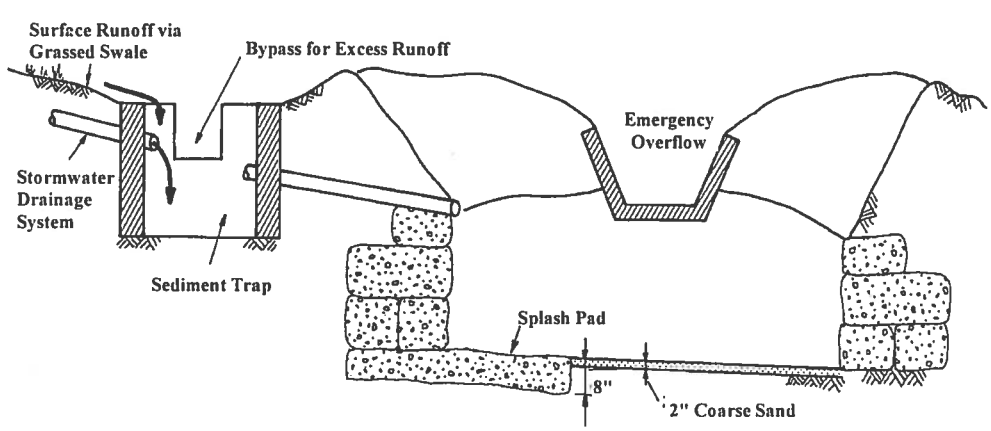


Soils comprised of sands and/or silty sands have high infiltration capacities, and therefore are well suited for infiltration storage. Soils comprised of fine silts and clays have low infiltration capacities and, therefore, are not suitable for constructing infiltration devices over them. Deep soil sampling should be performed to assess the feasibility of water loading the various geological strata for purposes of stormwater disposal. Percolation tests, pumping tests, and soil sampling should provide useful data about the depth, size, and location where subsurface storage is practical. In the Beaverdam Branch Watershed, a number of the soils have properties which can limit the applicability of infiltration storage. Therefore, this alternative should be used with caution. If this method is proposed as the primary means to reduce runoff for large development sites or for sites located in landslide-prone soil locations, a soil engineer's report should be obtained. Moreover, infiltration systems should not be used where there is a reasonable probability the runoff may be contaminated (e.g. industrial sites, commercial parking lots, etc.). The following techniques for stormwater control are based on the principle of encouraging infiltration to ground water.

Seepage or Recharge Basins

Figure VI-2 shows a typical design of a seepage or recharge basin. In this method, runoff is collected in various storm drainage systems and then passed into large excavations called seepage or recharge basins designed to allow a large percentage of annual rainfall to recharge an underlying aquifer. In addition to reducing runoff volumes, this method offers to put the stormwater to beneficial use by allowing a large percentage of runoff to recharge an aquifer.

Figure VI-2
Seepage or Recharge

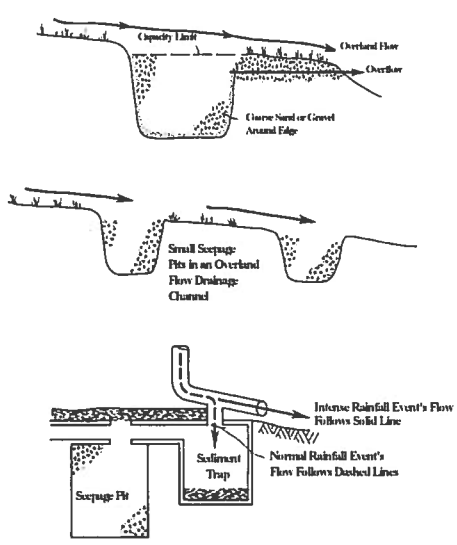


Generally, the infiltration basins must be located in aquifer recharge areas, but they may be used whenever the water table is more than 48" below the ground surface. If they are used as the only means of stormwater control, their size must be sufficient to store the area's maximum design rainfall from all paved areas. However, seepage or recharge basins are economically more feasible if designed to recharge a limited amount of the runoff that is produced by rainfall events and to overflow relatively early during intense rainfall events. Control of this overflow may require the use of additional stormwater management facilities. As indicted above, when seepage basins are used there is a need to consider the impacts of the type and quality of runoff being infiltrated; e.g., water quality impacts on ground water, and possibility of the pit being sealed by salts in the water. Seepage basins should not be used where there is a significant potential for pollution of the ground water. In order to maintain good infiltration rates, the bottom of the basin should be kept silt free by using a sediment trap. In addition, an emergency overflow structure is required to bypass excess runoff.

Seepage Pits or Dry Wells

Seepage pits are small excavations designed to overflow during intense storms, but reduce flood peaks by encouraging infiltration to ground water. They can be effectively used at sites where soil permeability is over 0.15 ft/day and water table is more than 48" below the bottom of the pit. There are two important design considerations associated with seepage pits: (1) the minimum size (which depends on porosity of the soil and design storm) should be sufficient to

Figure VI-3
Seepage Pits

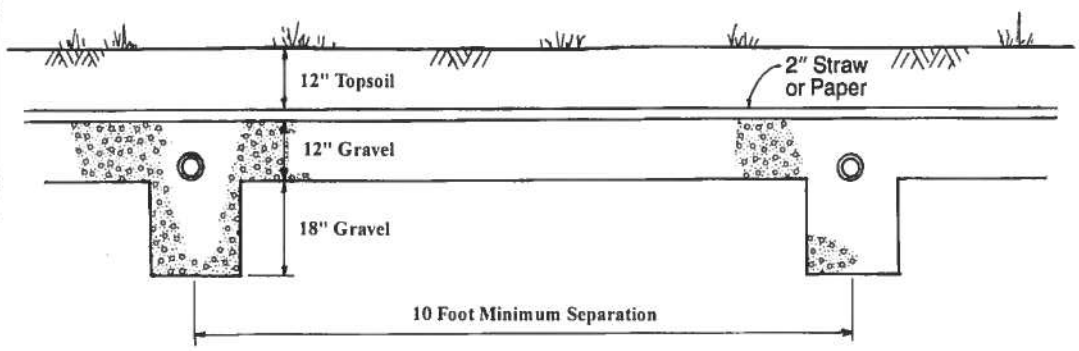


maintain predevelopment infiltration rate; (2) the side area should be at least two times larger than the bottom area. Figure VI-3 shows three seepage pit designs each with an alternative overflow mechanism.

Seepage Beds or Ditches

Seepage beds dispose of runoff by infiltration into the soil through a system of perforated pipes laid in ditches. They are not suitable for sites with water tables less than 48" deep and extremely low permeability. A typical design of a seepage bed is shown in Figure VI-4.

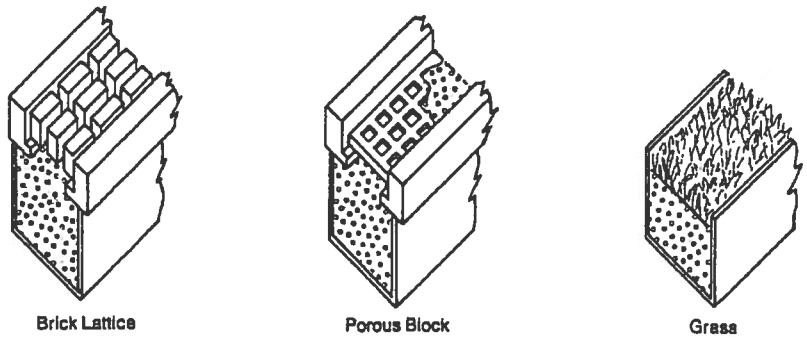
Figure VI-4
Seepage Bed



Dutch Drains

Dutch drains are employed in residential developments. They are simply ditches either filled entirely with gravel or covered with top soil and seeded. Very wide drains are usually covered with brick lattice or porous block as shown in Figure VI-5. The drains may either be located directly under the roof eaves along the length of a building, or runoff can be routed from downspouts to the dutch drain.

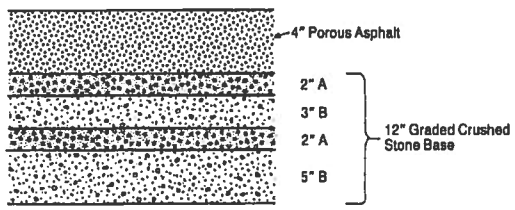
Figure VI-5
Dutch Drains



If dutch drains are the only means of stormwater disposal in a development, they should be able to drain the area's design rainfall alone and would be impractally large. More often, dutch drains are combined with other control alternatives for partial stormwater management using dutch drains.

Porous Pavement

Figure VI-6
Typical Cross Section of Porous Pavement



Porous pavement is a special asphalt mixture designed to pass water at a high rate to a specially prepared subbase. The special subbase is thicker than a normal gravel subbase and is composed of coarse graded stone supplying large void spaces to store infiltrated runoff. Figure VI-6 shows a typical porous pavement cross-section. The base aggregate is designed to have about 40% voids ratio. Regardless of design traffic number (DTN), a minimum surface thickness of 4" should be provided. Also, the combined surface and base thickness should not be less than anticipated frost penetration. Porous pavements have shown very positive results in regard to permeabilities, wear resistance and freezing - thawing effects.

However, the main problem with porous pavements is that of pore clogging by muddy tires.

PEAK DISCHARGE CONTROL DEVICES

Peak discharge control devices are those which control peak discharges rates by either lengthening the runoff path of the storm water or storing it and releasing it at a controlled rate. The runoff delay may vary between 15 to 30 minutes for very small areas to several hours for drainage basins of larger extent. A common goal of delay devices is, however, the disposal of all stored water before a second storm might hit. The stored water must be allowed to release at a flow rate that is designed not to cause harm.

Delay of runoff is accomplished by two basic principles of detention and retention. Detention is defined as detaining a large portion of the runoff from a storm, for a time period approximately equal to the natural runoff duration. Retention, on the other hand, is defined as holding of runoff for some time period longer than the natural runoff period. There are following alternatives available based on the principle of runoff delay. There are a number of on-site locations for temporary storage of precipitation and runoff are generally considered:

1. Storage in ponds and lakes
2. Rooftop storage
3. Underground storage
4. Parking lot storage
5. Blue-green storage
6. Multiple use storage areas

In planning on-site storage methods, one should consider existing physical, social and economic limitations of the area. What may be a good solution at one site, may be inappropriate at another.

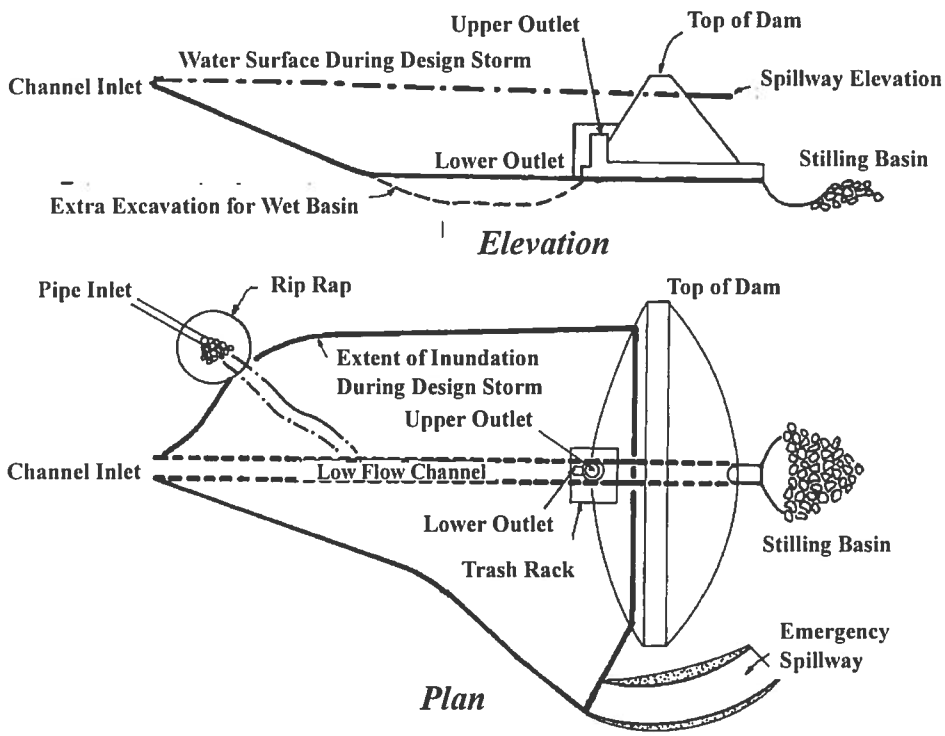
Detention and Retention Basins

Detention and retention basins take a variety of forms. Some are wet (filled with water all of the time) and some are dry (filled with water only during storms). Some basins are designed as a continuation of a stream or river (on-stream basins) while others are separate from the river (off-site basins). Off-stream basins are usually connected to the water course by pipes or swales.

Dry Ponds

Figure VI-7 shows a typical detention basin design. As the name implies, dry ponds are designed to be normally dry with the ability store a portion of the stormwater during a storm event and then release the stored volume slowly and safely. Typically they, are used in areas where runoff volume has been increased and it is desirable to reduce the runoff rate.

Figure VI-7
Typical Detention Basin Design



Retention basins are used when extreme limits on downstream flow rate or velocity are required. The outflow rate will be relatively low and extended over a longer period of time as compared to the outflow period of detention basin. This requires large amounts of storage for detaining stormwater for periods greater than 24 hours. One detention basin can be designed to control the stormwater from 2, 10, 25 and 100-year design storm events, by constructing multi-stage outlet structures. The outlet flow discharge rate from the basin will depend on the return period of the design storm.

Rooftop Detention

Rooftop detention utilizes the built-in structural capabilities of rooftops to store a certain amount of rainfall that falls on them. In many cases, existing roof structures require little modification to function as detention structures. On flat rooftops, drains must be designed with proper outlet capacities to control release rates to the design level. Overflow mechanisms should be provided to preclude danger from overloading.

Special considerations of roof water tightness may be necessary when water is to be detained for longer time periods or where frequent freezing and thawing are prevalent. Figure VI-8 illustrates several types of rooftop retention devices. On sloping roofs, the retention can be achieved by providing findams. Findams are actually about 4" high gravel ridges at 15 to 30 ft spacing as shown in Figure VI-9. Individual wedge-

Figure VI-8
Examples of Rooftop Detention Devices

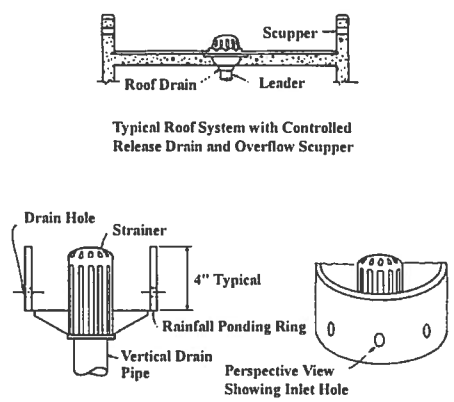
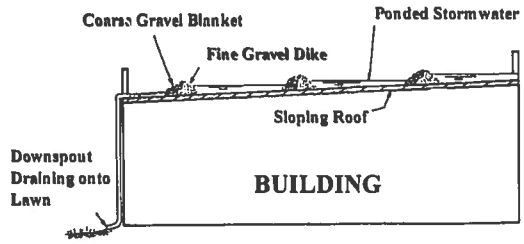


Figure VI-9
Roof Ponding With Gravel Dikes



shaped ponds would build up behind these "minidikes". Through laboratory studies it was found that a series of five dikes of 1/4 inch gravel placed on roofs of 1% slope will cut the peak runoff rate by 50% and extend the runoff time by about 30 minutes [Aron, 1975]. Finer gravel would naturally delay the runoff further. The effectiveness of the rooftop storage is a function of the actual area affected by such storage. It is most effective when used as an integral part of a larger stormwater runoff control plan. Detailed structural analyses of the structure should be completed to assure that the added roof load represented by stored water can be safely supported. Moreover, additional maintenance should be anticipated on roofs subject to leaf accumulation.

Wet Ponds

Permanent or wet ponds are detention/retention structures filled with water all the time with adequate detention capacity to store the design floods above normal ponds level. Overflow spillways must be provided to bypass or discharge flows into floodways on the peripheries of the ponds so that safe water-storage elevations are not exceeded nor banks breached.

For extremely large ponds, adequate design precautions should be taken to minimize possible shoreline erosion due to ice, wind, and wave action. Sediment accumulation and water pollution due to roadside accumulations of salts, copper, and asbestos from brake linings, grease, oil, and heavy metals are the disadvantages associated with wet ponds. Such deleterious material should be screened out from the drainage system by interception and disposition before it reaches stormwater storage ponds. In some locations, municipal, state, or federal safety standards regarding the depth and volume of water will have to be met. These ponds are unquestionably more aesthetically appealing than a typical dry detention basin. In addition, they can be designed to provide some recreational benefits.

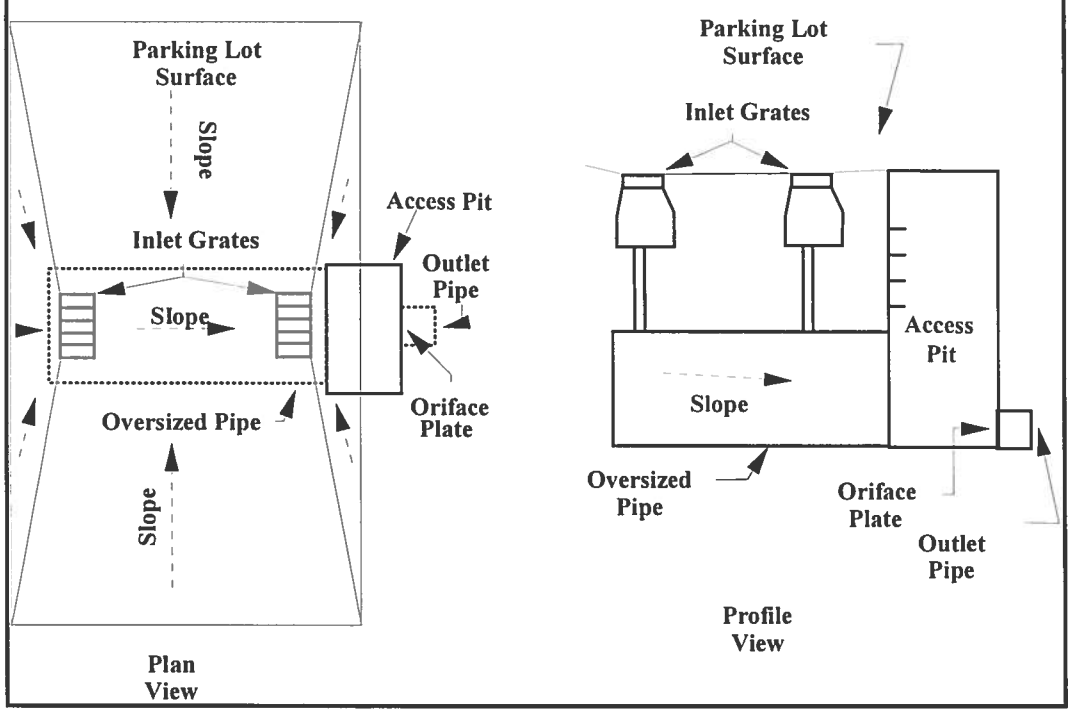
The main difficulty with wet ponds lies in the frequent unavailability of land. Dry ponds can be made rather inconspicuous as an integral part of the landscaping or as lawn areas for office buildings. For example, depressed front lawn areas can be designed to detain runoff from intense storms and to serve as buildings' green space in dry season. The outlet pipes allow the ponds to drain in 12 to 24 hours,

and a certain amount of water undoubtedly filters into the ground [Aron, 1975] - thus drying the areas and returning them to a suitable condition for dry weather uses.

Underground Detention/Retention Tanks

This alternative involves the construction of underground holding tanks or large sized pipes as a means of providing controlled runoff from the site. In areas where land is expensive or surface topography is not suitable, these tanks can serve the same function as basins, while conserving land area. Outflow control devices may consist of small gravity pipes, or weirs. In some applications pumping may be required to discharge the stored runoff. This method can be quite expensive because of high material construction costs and possible pumping requirements; however, they may be appropriate in situations where land area is at a premium. An example general design of an underground stormwater detention facility is illustrated in Figure VI-10.

Figure VI-10
Underground Detention Facility



Parking Lot Detention

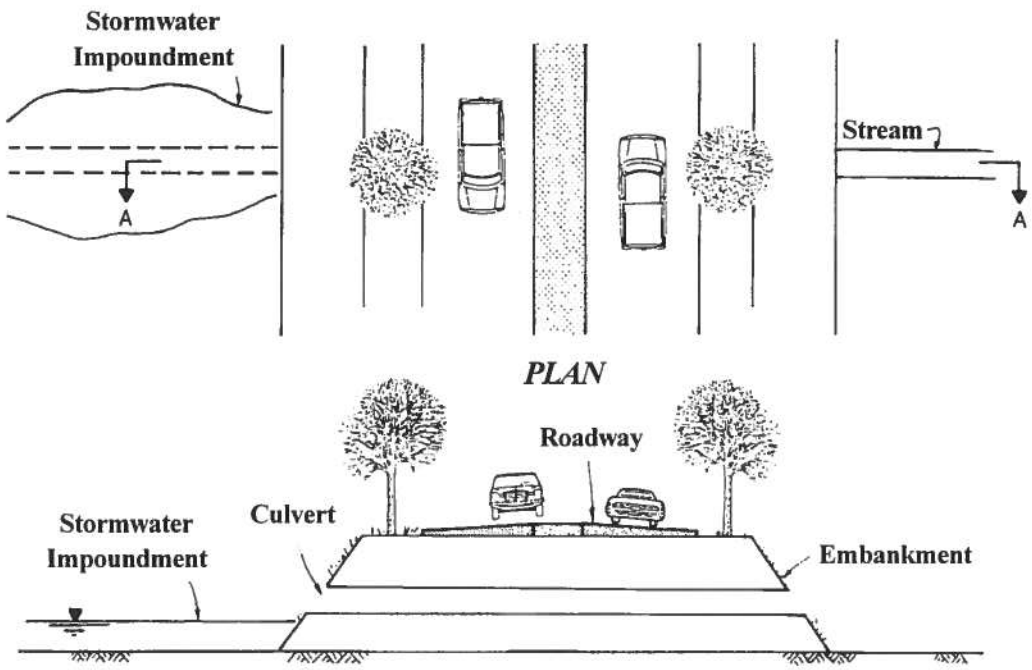
Parking lots cover a major portion of commercial developments and are, therefore, large contributors of stormwater runoff. Stormwater runoff can be detained on parking lot sites by shallow basins or swales. If properly designed, this measure can be quite effective. Initial construction costs for implementing these measures are only a small percentage above the construction cost of conventional parking lots. Arrangements of areas in a parking lot to accept ponding should be planned so that pedestrians are inconvenienced as little as possible. A 7" design depth is not unreasonable for parking locations in the remote areas of lots [APWA, 1981]. The facility should be designed to drain completely and avoid formation of ice.

Design considerations should recognize the possible use of porous asphalt, provided the subgrade has an adequate infiltration capability. Expansive and/or collapsing type soils may preclude this solution. An alternative to impervious paving of parking areas is the substitution of grassy strips. The ground surface of the planting strip is depressed and driving lanes are graded to direct the storm runoff into the depressions. The strips should be filled with pervious soil to allow a maximum of infiltration, and planted with a Fescue-type grass which is both resistant to occasional swamping and dry soil conditions. The strips should be oriented perpendicular to the parking lot slope and surrounded by broken curbs to protect them from being overrun by cars.

Blue-Green Storage

Incorporation of stormwater storage in urban drainage ways traversing roadways is a version of detention ponding that has been identified as the blue green concept. Topographical characteristics of many land areas adjacent to roadway embankments make them very much adaptable for use as detention facilities. This can be achieved by designing the culverts to pond where appropriate, as shown in Figure VI-11. Many drainage structures can be designed to operate in this fashion. Roadway embankments at control points should be stabilized and protected to minimize erosion effects of retained water. Any such culverts that are intentionally designed to store water, if they meet the criteria of Subsection 105.3 of Chapter 105 of the Department of Environmental Protection's regulations, are required to be constructed as a dam.

Figure VI-11
Road Embankment Stormwater Detention



Detention within Pedestrian Plazas and Malls

On-site detention in heavily congested areas can be incorporated effectively in the design of pedestrian plazas, malls, and other similar type developments. The ponding requirement can be accomplished at selected locations with very shallow depths (1 to 3 in) to avoid public inconvenience. Frequent maintenance and suitable discharge control devices designed to satisfy the architectural objectives of the land development are necessary in developments of this type.

Multiple Use Impoundment Areas

These areas utilize sites having primary functions other than runoff control. In new developments, such multiple use should be incorporated into the primary design. For example, open space and grassed areas provided in the land development to enhance the aesthetic appeal can also be used as stormwater detention facilities. This can be accomplished by providing stormwater release controls such as weirs, orifices, small diameter pipes, gates, etc.

A hard-surface basketball or tennis court can be designed to drain adjacent grassed or paved areas. The stormwater would collect in grass swales around the edge of the court, seep through a gravel drain to retain the sediment load, and discharge onto a porous asphalt surface. Some type of emergency drain should be provided. Positive drainage toward the control devices is essential to avoid the swampy conditions, weed growth and increased maintenance costs. For optimum operation of control structures, it is also essential to screen out the floating debris from the inlet stormwater.

RELATIVE ADVANTAGES AND DISADVANTAGES

Table VI-1 gives a brief summary of principal urban runoff abatement practices and their associated relative advantages and disadvantages. As was expressed previously, the runoff volume reduction measures which simultaneously reduce runoff peaks offer significant advantages from the perspective of both local and watershed wide effects. However, since there are limitations inherent in the volume reduction techniques, it is likely that an overall stormwater control plan will include a combination of applicable volume reduction features and peak discharge control features (i.e. detention and/or retention facilities).

Selection of the best combination of techniques to be used in a particular instance should be made by the developer in consultation, or at least with the concurrence, of the municipal reviewer.

Table VI-1
Advantages and Disadvantages of On-Site Control Methods

METHOD	ADVANTAGES	DISADVANTAGES
REDUCTION OF RUNOFF / INFILTRATION STORAGE		
Dutch Drains	- Reduces the total volume of runoff. - Reduces the peak runoff discharge rate. - Enhances the groundwater supply. - Provides additional water for vegetation in the area. - Reduces the size of down-slope stormwater control facilities.	- Looses efficiency if intensive storms follow in rapid succession. - Subject to clogging by sediment. - Limited to application for small sources of run-off only, i.e., roof drains, small parking lots, tennis courts. - Maintenance is difficult when the facility becomes clogged. - Limited application in poor infiltration soils.
Porous Pavement	- Reduces the total volume of runoff. - Reduces the peak runoff discharge rates. - Enhances the groundwater supply. - Provides additional water for vegetation in the area. - Reduces the size of down-slope stormwater control facilities. - Less costly than conventional pavements for most	- More prone to water stripping than conventional mixtures. - Subject to clogging by sediment. - Water freezing within the pores takes longer to thaw and limits infiltration. - Motor oil drippings and gasoline spillage may pollute groundwater. - Limited application in poor infiltration soils. - recent studies suggest

Table VI-1
Advantages and Disadvantages of On-Site Control Methods (continued)

METHOD	ADVANTAGES	DISADVANTAGES
Porous Pavement (continued)	applications. - Safety features - superior skid resistance and visibility of pavement markings. - Provides pavement drainage without contouring. - Prevents puddling on the surface.	that porous pavement's advantage will reduce with time.
Seepage/Recharge Basins	- Reduces the total volume of runoff. - Reduces the peak runoff discharge rates. - Enhances the groundwater supply. - Construction borrow pits often can be converted to a large seepage basin to serve multiple areas.	- Must be fenced and regularly maintained. - If porosity is greatly reduced, it may be necessary to bore seepage holes or pits in the base. - No filtering supplied by the topsoil. - Usefulness limited in poor infiltration soils.
Seepage Pits	- Reduces the total volume of runoff. - Reduces the peak runoff discharge rates. - Enhances the groundwater supply. - Provides additional water for vegetation in the area. - Reduces the size of down slope stormwater control facilities	- Looses efficiency if intensive storms follow in rapid succession. - Subject to clogging by sediment. - Maintenance is difficult when the facility becomes clogged. - Limited utility in poor soils.

Table VI-1
Advantages and Disadvantages of On-Site Control Methods (continued)

METHOD	ADVANTAGES	DISADVANTAGES
Seepage Beds/Ditches	- Reduces the total volume of runoff. - Reduces the peak runoff discharge rates. - Enhances groundwater supply. - Reduces the size of down-slope stormwater control facilities. - Distributes stormwater over a larger area than other infiltration techniques. - May be placed under paved areas if the bearing capacity of the paved area is not affected. - Safer than seepage or recharge basins.	- More expensive than other infiltration techniques. - Replacement of entire system if clogging by sediment should occur. - Maintenance of sediment traps must be frequent and consequently more expensive.
Terraces, Diversions, Runoff Spreaders, Grassed Waterways, and Contoured Land-scapes	- Increases the overland flow time, increasing the time of concentration and allowing for increased infiltration. - Vegetative swales are less expensive than curb and gutter systems.	- On poorly drained soils, these techniques may leave ground waterlogged for extended periods after storms. - vegetative channels may require more maintenance than curb and gutter systems. - Roadside swales become less feasible as the

Table VI-1
Advantages and Disadvantages of On-Site Control Methods (continued)

METHOD	ADVANTAGES	DISADVANTAGES
		number of driveway entrances requiring culverts increase
		culverts increase.
	DELAY OF RUNOFF	
Rooftop Retention	- No additional land requirements. - Not unsightly or a safety hazard. - May be adapted to existing structures.	- Leaks may cause damage to buildings and contents. - Stored runoff will greatly increase the load imposed on structural support. This increased construction expense may be greater than the savings resulting from reducing the size of downslope stormwater management facilities.
Parking Lot Detention	- Adaptable to both existing and proposed parking facilities. - Parking lot storage is usually easy to incorporate into parking lot design and construction.	- May cause an inconvenience to people. - Ponding areas are prone to icing, requiring more frequent maintenance.
Multiple Use Impoundment Areas	- Serves more than one purpose. Employing areas of grass, a certain amount of stormwater will infiltrate	- Difficult to maintain the porosity of multi-use areas.

Table VI-1
Advantages and Disadvantages of On-Site Control Methods (continued)

METHOD	ADVANTAGES	DISADVANTAGES
	and improve the quantity of water recharged by natural filtering processes. - If porous pavement is used on basketball or tennis courts, additional infiltration will be provided.	
Detention/Retention Basins	- Offers design flexibility for adapting to a variety of uses. - Construction of ponds is relatively simple. - May allow significant reduction in the size of downslope stormwater management facilities. - May have some recreational and aesthetic benefits if runoff is not carrying heavy sediment loads.	- Facilities that empty out completely can have an unsightly nature and be a detriment to the developments. - Difficulty in establishing a regular maintenance program. - In a residential development, it may be difficult to determine whose responsibility it is to pay for the maintenance program. - Consumes land area which could be used for other purposes.
Permanent Ponds	- Will provide both a reduction in peak runoff rates and a source of recreation in any residential area. - Only minor modifications may be required to adapt an existing	- Stormwater runoff having a high sediment or pollutant load should not be controlled in existing ponds because of its adverse impact on the natural conditions.

Table VI-1
Advantages and Disadvantages of On-Site Control Methods (continued)

METHOD	ADVANTAGES	DISADVANTAGES
	pond for use as a permanent stormwater management facility. - Wildlife habitat and wetlands may be preserved	
Underground Retention/ Detention Tanks	- Minimal interference with traffic or people. - Can be used in existing as well as newly developed areas. - Potential for using storm-water for nonpotable uses.	- Subsurface excavation could be extremely expen-sive depending upon the type and amount of rock encountered. - Access for maintenance may be difficult if proper design features are not provided.

STORMWATER QUALITY BEST MANAGEMENT PRACTICES

Urbanization and Stormwater Runoff

As has been discussed previously, land development typically creates impervious surfaces that reduce natural infiltration of rainfall and stormwater conveyance systems concentrate collected runoff with resulting increases in volume and velocity. Water quality degradation is also associated with land development as the increased volumes of runoff carry with it higher concentrations of pollutants from sources such as automobiles, law care products, materials discharged into storm sewers and sedimentation from erosion. Water quality effects in a typical moderately developed watershed include the following:

- Increased discharge of pollutants
- Increased sedimentation
- Increased levels of bacteria
- Introduction and/or increased loading of toxic substances
- Increased inputs of trash and debris
- Lower levels of dissolved oxygen
- Increased stream temperature
- Reduced biodiversity

In the past, stormwater runoff was not recognized as a major pollution contributor. However, nonpoint sources of pollution are now recognized as major contributors to the degradation of the nation's waters. Documentation about the negative impacts of land development on water quality is reported in a number of sources. Two examples include: The Nationwide Urban Runoff Program (NURP) and the State's reports written in response to the requirements of section 305(b) and section 319 of the Clean Water Act (North Virginia SWCD, 1994). The NURP report states that urban runoff and storm sewers are the second leading source of water quality impacts on lakes and estuaries, and the third leading source of water quality degradation in rivers in the United States (North Virginia SWCD, 1994). There are four major sources of nonpoint source pollutants.

- agriculture
- land development
- forestry operations
- mining sources

Non-urban sources of pollutants vary from agricultural sources including runoff from eroded croplands, overgrazed pastures, animal feedlots and dairies, salts from irrigation

practices, discharges from rural septic tanks, and nitrates from atmospheric deposition into water bodies. Forestry operations, if they involve improperly constructed logging roads and poorly managed tree harvesting, can lead to erosion. Mining sources include acid drainage from abandoned mines, mine tailing sites, and pollution from resource extraction activities, such as contamination from improperly sealed oil and gas wells.

Urban runoff often contains oily residues and other pollutants deposited on impervious surfaces such as streets and paved parking lots, in addition to sediment eroded from road and land development construction sites. Other sources include discharges from improperly maintained suburban septic tanks, leachate from landfills and hazardous waste sites, salts from road de-icing operations, and atmospheric deposition of contaminants produced by burning fossil fuels, such as coal.

The impact of higher levels of pollutants is felt by adjacent streams and on downstream receiving water bodies such as lakes, rivers, and estuaries (see Table VI-2). Government officials, planners, and designers should become familiar with these situations to identify the pollutants of greatest concern to the community and then choose the most appropriate measures to control the negative effects of the pollutants of concern.

Table VI-2
Pollutants - Their Source and Impact on the Environment

Pollutants	Source	Non-Point Source Impacts
Sediment	Grass & Leaf Cuttings Construction Logging Operations	When silt and suspended solids enter water bodies, they can reduce water depth, smother plants and aquatic organisms, and destroy fish habitat. Decomposition of organic material uses up dissolved oxygen, making it difficult for fish to breathe.
Nutrients	Nitrates in Sewage, Animal Wastes, Fertilizers, Phosphates from Detergents and Fertilizers	Excessive levels of nutrients over stimulate the growth of aquatic plants and cause algal blooms. Excessive plant growth clogs navigable waters, impairs recreational activities such as swimming and boating, and decreases plant and animal diversity. Nitrates in groundwater are a serious contaminant that can lead to water supply well closures.
Bacteria	Stormwater Runoff, Human and Animal Waste	Cause illnesses such as typhoid and dysentery. Presence of indicator bacteria such as fecal coliforms suggest the possibility of the presence of more dangerous organisms.
Hydrocarbons	Stormwater Runoff, Service Stations	Toxicity contributes to the decline of aquatic organisms. They accumulate in organisms and pose a health threat to humans who eat them.

Table VI-2
Pollutants - Their Source and Impact on the Environment
(continued)

Trace Metals	Automobiles, Roofing Materials and Pipes	Toxic to aquatic organisms, a contaminant of drinking water, and accumulates in aquatic organisms posing a health risk, if eaten. Restricts sports fishing.
Toxic Wastes	Stormwater Runoff, Stream Modifications, Lawn Fertilizers	Source is runoff from home gardens and lawns. Can bioaccumulate in organisms and create toxic health hazards within the food chain. Observed levels are currently below standards.
Thermal Energy	Construction, Stream Modifications	Reduces vigor and growth of fish, decreases dissolved oxygen content of the water, promotes eutrophication of water resources, and accelerates corrosion of water supply pumps and equipment.
Chlorides	Road Salting, Irrigation	Toxic to freshwater organisms, creates increased stress on plants, and reduces drinking water quality.
Trash and Debris	Stormwater Runoff, Careless Disposal Practices	Lowers dissolved oxygen in water bodies.
Acids	Stormwater Runoff, Incomplete Combustion	Increase toxicity to animals and fishery resources that can result in their death.

Sediment is one of the most significant pollutants transferred by stormwater. Sediment consists mostly of soil materials eroded as a result of natural processes and human activities. Sediment loads increase with accelerated stormwater runoff, certain agricultural practices, and deforestation from logging operations. Sediment clogs storm drains, fills in waterbodies, reduces hydraulic capacities of bridges and culverts, and fills in water supply reservoirs. High concentrations of suspended solids in water bodies cause many adverse consequences including increased turbidity, reduced light penetration, reduced prey capture for sight-feeding predators, clogged gills of fish, and reduced angling success. Additional impacts can result after sediment is deposited in slower moving waters, including the smothering of benthic communities, alterations in the composition of the bottom substrate, the rapid filling-in of small impoundments and reductions in the overall aesthetic value of the water resource. Sediment is in an efficient carrier of toxins and trace metals. Once deposited, such pollutants can be remobilized and pose a risk to aquatic life. The increase surface water temperature decreases the dissolved oxygen concentration in the water decreasing the value of aquatic habitats. Sediment can carry other materials, such as nutrients, pesticides, and trace metals, that can harm both aquatic life and human health (Trerrene Institute, 3/1994).

Nutrients are phosphorus and nitrogen, substances that plants use in various forms in the process of photosynthesis. Pollution from inorganic phosphorous and inorganic nitrogen are of chief concern. Excessive levels of inorganic phosphorus and inorganic nitrogen pose a severe problem as urban development intensifies (Terrene Institute, 3/1994). Fertilizer spread on lawns during the winter months contributes nutrients to runoff in the spring. Similarly, animal waste contributes nutrients to stormwater runoff on a year-round basis. Other pollutants include detergents and raw sewage.

Nutrients encourage undesirable algae blooms and excessive aquatic weed growth (Terrene Institute, 3/ 1996). This process is referred to as eutrophication and it has a significant deleterious effect on water quality. For example, in lakes decomposing plants can create surface scum, unpleasant odors, discoloration of water, release of toxins, and decreases oxygen content. This breakdown of plant matter can limit swimming, boating, fishing, and other recreational uses; reduce fish and wildlife habitat; and contaminate water supplies. It can also adversely affect tourism and property values.

Bacteria in surface water results from runoff that can contain high levels of harmful bacteria and viral strains, including fecal streptococcus and fecal coliform from human and animal wastes (Terrene Institute, 3, 1994). In humans, gastroenteritis is the leading waterborne infectious disease in the United States (New Jersey Department of Environmental Protection, 1994).

Petroleum hydrocarbons in water are considered to be very harmful to the natural ecology. Oil and grease problems are highest in runoff from parking lots, roads, and service stations. Residential land uses generate less hydrocarbon export, although illegal disposal of waste oil into storm sewers can be a local problem (Scheuler, 1987). Hydrocarbons are lighter than water and are frequently evidenced by a rainbow colored film on the water's surface. Hydrocarbons are attracted to sediment and settle to the bottom in water bodies. Once in the bottom sediments, harm to bottom dwelling organisms (i.e., benthic organisms) occurs and is transferred through the food chain. Hydrocarbons tend to rapidly accumulate in the bottom sediments of water bodies, where they persist for long periods of time, and can eventually seep into groundwater supplies

or be carried by local streams. Hydrocarbons can also lower dissolved oxygen levels in the water by limiting the interaction between the air and water.

Trace metals found in water can have adverse effects upon public health and aquatic life. Lead, copper, cadmium, mercury, arsenic, and some forms of chromium are all metals of concern. Among the sources of metals are roofing materials, downspouts, galvanized pipes, metal plating, paints, wood preservatives, catalytic converters, brake linings, and tires. Metals occur naturally in soil and arise from man-made sources. The amount of these metals that leach into water from natural sources is influenced largely by the water's pH. Acid rain and the low pH water often found in swamps may increase the solution of metals into water. Although mercury and copper have been shown to cause serious health problems, lead is the primary public health concern. It has a cumulative, toxic neurologic effect and may be particularly harmful to children. Some trace metals found in stormwater runoff come from corroding, decaying metals (i.e., copper, automobiles, and drain spouts). The decaying process is often accelerated by acid rain and the leaching of materials (i.e., solid waste disposal operations).

Trace metals accumulate in sediments, posing a risk to bottom feeding organisms and their predators. Bioaccumulation of metals occurs in fish tissue, creating a risk to humans who eat them and restricting angling success. Trace metals affect the reproductive rates and life span of aquatic organisms and hinder photosynthesis in aquatic plants. Trace metals can also create a health hazard if toxic metals contaminate water supplies.

Toxic wastes are found in pesticides, fertilizers, herbicides, and household substances such as paints and cleaning materials. Toxic wastes enter surface water bodies from stormwater runoff originating on lawns and golf courses treated with pesticides and fertilizers. Toxic wastes accumulate in sediments, posing a risk to bottom feeding organisms and their predators. Toxic wastes bioaccumulate in fish tissue and can kill fish and other aquatic organisms. The reproductive rates and life spans of fish and other aquatic organisms are affected. Photosynthesis is hindered in aquatic plants. Some toxic organisms are carcinogens and create increased public health risks.

Thermal energy refers to a rise in water temperature created by the simultaneous occurrence of three events. First, the urban landscape heats up and, in turn, heats any runoff passing flowing over it. Second, fewer trees are present on the stream banks to shade the stream channel, adding to the warming effect. Third, runoff stored in shallow wet ponds and other impoundments is heated in between storm events and is rapidly released during a storm. An increase in water temperature of only a few degrees can reduce or eliminate sensitive stream insects and fish species (i.e., mayflies and trout) (Scheuler, 1987). This is particularly true of streams that alternate seasonally between cold and warm water. In general, sustained summertime water temperatures in excess of 70 degrees Fahrenheit is considered to be stressful, if not lethal, to many cold water organisms (Scheuler, 1987).

Increased stream temperatures reduce the vigor, growth, and disease resistance of fish. As water temperatures increase, dissolved oxygen levels decrease and the corrosion of drinking water pumping and piping facilities accelerates. Additional water quality effects include the development of odors, objectionable tastes, and conditions favorable to bacterial growth. Recreation is affected by the promotion of eutrophication and increased algae and weed growth.

Chlorides or salts are a result of road salting to remove ice and snow. Chlorides run off of roads, parking lots, and sidewalks and flow into surface water bodies and ground water supplies. Salt levels in snow melt runoff have been reported to exceed several thousand milligrams per liter. This is about as salty as the water in the Chesapeake Bay (Scheuler, 1987). Due to the extreme solubility of salt, almost all of the chloride applied for snow removal ends up in surface and ground water resources (Scheuler, 1987). Chlorides are toxic to many freshwater aquatic organisms which can tolerate only a limited level of salinity. Increased levels of salt in surface and ground waters affect the soil and can stress plant respiration and reduce plant viability. Excessive salt in water supplies can also reduce drinking water quality.

Trash and debris are floatable wastes that collect at impasses in streams and lakes, disturbing water flow and impairing the aesthetic quality of the environment. This debris, from street litter and careless disposal practices, washes into water bodies both over land and through stormwater drainage systems. An increase in trash and debris lowers dissolved oxygen levels and result in the release of other pollutants into the water column.

NONSTRUCTURAL WATER QUALITY BEST MANAGEMENT PRACTICES

Nonstructural best management practices (BMPs) prevent, reduce or eliminate pollutants before they are washed off a site by stormwater runoff. Nonstructural BMPs will reduce pollutant loadings on their own and enhance the performance of structural BMPs. The ability to reduce pollutants increases as BMPs are used together as a system. Public education and outreach in explaining these techniques and their benefits is important since they may involve changes to local government land use regulations and planning.

Nonstructural BMPs include:

- Public education
- Effective land use planning
  - Comprehensive planning
  - Zoning
  - Land use regulations
- Maintenance practices
- Pollution prevention / source control

Public Education

Public education and citizen participation is an important part of an overall community program to reduce nonpoint source pollution from stormwater runoff. Many people are not aware of the dangers of nonpoint source pollution and how it affects their community. Education of citizens and political leaders will heighten awareness of pollution problems and the means available to prevent them. It can also broaden support for other stormwater and nonpoint source pollution management strategies. Education efforts can include: public meetings and presentations; program materials such as newsletters, fact sheets, brochures, and posters; homeowner education programs; press releases; coordination with interest groups; and community events and demonstration projects. Citizen participation may include providing input, collecting data, and identifying problems areas. All of this can help to avert potential water quality problems and build overall support for remedial actions to improve conditions.

Effective Land Use Planning

Land use planning in Pennsylvania is primarily a municipal and county government function. Local governments have the legal authority to develop comprehensive plans and programs that can assist in preventing pollution problems by protecting water quality, open spaces, stream valleys, and flood plains. This must be accomplished by balancing environmental needs with local economic needs. Land use planning can reduce pollution in two ways: by managing the type, size, and location of development in a given area, and by reducing pollution generated a specific levels of development. Comprehensive planning provides general guidance in managing nonpoint source pollution. Specific practices are put into place through zoning laws that regulate development.

Comprehensive Planning

Comprehensive plans can be used as a vehicle for defining the water quality concerns, problems, and goals of a municipality and laying a system of land use planning and control techniques that can be used to address these issues.

Zoning

The zoning process specifies the density and type of land use that can occur in a given area. Zoning is the working arm of a comprehensive plan that controls overall local development. It can consider water quality and environmental goals along with a myriad of other community concerns. Zoning ordinances apply only to uses that begin after the ordinance is enacted and, therefore, effects only future practices. Because zoning ordinances also regulate authorized uses (i.e., buildings, lot sizes, designs) they can be structured to control nonpoint source pollution. This control is particularly relevant on highly erodible steep slopes and shores or in high-density areas where developers must provide adequate drainage systems for their projects. The following types of zoning practices apply to water quality issues:

Open space development preserves the existing topography and provides the community with more open green space by concentrating residential development on a limited portion of the site. This leaves area for amenities such as playgrounds, parks, and woods. Preserving open space and the existing tree canopy reduces impervious surfaces and the resulting runoff. Also, by following the land's natural contours, preserving open space can reduce the amount of erosion, improve aesthetics, and preserve sensitive habitats.

Planned unit developments (PUDs) provide a mix of zoning classifications so that commercial, residential, and light industry all occur within the same development. PUDs blend varying uses to create an attractive, interrelated unit that preserves both property values and aesthetics. One of a PUD's goals is to maintain density with maximizing open space. The ideal PUD locates residences and offices within walking distance of each other, reducing traffic.

A PUD's main water quality benefit is large scale urban runoff management planning. Local governments control PUDs through negotiations between the developer and the public review authority. PUDs must maintain open space to facilitate stormwater drainage and may require developers to provide special structures to handle runoff.

Incentive zoning is used to promote open space development. It permits the developer to utilize higher density than normal in one area of a development while maximizing open and/or public uses of space in a different location.

Downzoning changes an established zone to a lower density level or to a less intense use. Typically, industrial zoning permits the most intense land use, followed by light industrial, commercial, and residential uses. Downzoning can be used on strips of land adjacent to streams or on an entire area surrounding a waterbody to reduce pollution.

Floating zoning is defined by characteristics rather than geographical location. The proposed use must be compatible with the surrounding uses and conform to the zone's expressed purposes. For example, multi-family dwellings that conform to specific code requirements regarding septic tanks, grading, and open space preservation could be acceptable in an area zoned for single family dwellings. Alternatively, a floating zone might restrict certain development in a wetland or around a well or aquifer recharge zone. A developer would need to show that the project does not fall within the area subject to floating zones or take adequate steps to protect water quality within the zone.

Overlay zoning is a mapped district that places restrictions or requirements in addition to those of the underlying zone. Overlay zones are used to meet a special public interest that is not met by the existing zone or by rezoning. For example, these zones can protect specific water sources such as ponds, wells, or wetlands lying within residential, commercial, or industrial zones. Stream valley corridor buffer overlay zones provide special protection for water resources located with the existing zones, reducing the impact of uses on water and natural habitat.

Buffer zones around sensitive water resource areas can reduce the impact of stormwater runoff. Forested and grassed areas around water bodies can trap pollutants, encourage infiltration, and reduce erosion. Buffer zone regulations can be a part of a community's and/or state's wetland protection laws, well head protection programs, and public surface drinking water programs.

Setback requirements are discrete distances traditionally administered by boards of health and zoning boards to protect human health needs. They can also be used to protect resource areas, ensure ecological integrity, and avoid concentration of flood flows.

Easements are an alternative method to protect land around critical resource areas. Easements are an effective tool to use along with designated buffer zones and setbacks. Traditionally, easements are negotiated with individual landowners, and are included as a part of the deed to the property.

Reduced impervious areas can increase infiltration, which reduces pollution and flooding. Pollution from urban runoff increases when areas are covered with impervious materials that collect pollutants and then release them during rainstorms or snow melts. Impervious areas can be reduced by incorporating open spaces in urban areas, protecting wetlands, and using alternatives to impervious surfaces, such as gravel or porous pavement (discussed under the structural BMPs section). An important goal for every community is to minimize impervious areas that are directly connected to the stormwater system. Such minimization will help

to reduce storm flow volumes and velocity, and, with proper implementation techniques, pollutant loadings. Zoning regulations can be used to ensure that new development includes vegetated open space areas.

Land Use Regulations

Requirements contained in subdivision and land use ordinances and regulations can be an effective tool in requiring that developers consider the stormwater implication of there activities and institute provisions that serve to adequately control stormwater runoff and reduce the potential for pollution.

Maintenance Practices

The following is a listing of actions that can be taken to encourage maintenance practices that can serve to reduce stormwater nonpoint source pollution.

- Institute programs to remove accumulations of litter and debris. For example, organizations can sponsor stream bank and street sweeping efforts.

- Institute environmentally protective road maintenance practices. For example, cover salt storage areas, avoid excessive application rates, use salt substances such as sand or magnesium chloride in sensitive areas, and consider low maintenance vegetation instead of herbicide use.

- Encourage neighborhood recycling programs designed to remove pollutants from households. These programs can include recycling of cans, bottles, and plastics, which often end up as floating litter and composting yard wastes. Also household hazardous waste collection and proper disposal of wastes such as used oils and antifreeze ensure that these pollutants do not enter streams and lakes.

Pollution Prevention / Source Controls

The following are examples of possible pollution prevention / source control actions.

- Exclude inappropriate discharges to stormwater systems: Encourage proper use and disposal of materials by homeowners. The contaminants addressed by this

control activity may include materials, such as fertilizers, pesticides, and herbicides; oil and antifreeze; paints; and solvents. Specific actions for preventing discharge may include educating the public about the proper storage and use; developing and implementing programs for recycling; strengthen and enforce existing regulations; and label storm drain inlets.

- Encouraging the proper application and use of herbicides, pesticides, and fertilizers and appropriate rates.

- Reducing street and land surface sources of pollutants and control litter and improper waste disposal practices: Specific actions include educating the public about nonpoint source pollution, providing funds for research, strengthening and enforcing existing regulations, developing and implementing community clean up days, and providing and maintaining litter receptacles.

- Controlling animal waste: Animal waste is a source of bacteria in stormwater runoff. The level of bacteria can be lowered by reducing or eliminating waste left where it can be washed into stormwater runoff. Regulations requiring the collection and proper disposal of pet wastes from parks, roadways, and other developed areas can help to reduce this problem.

Summary

This stormwater management plan does not require municipalities to implement nonstructural BMPs. However, each municipality is encouraged to consider the nonstructural BMPs introduced above as it makes decisions concerning its policies.

STRUCTURAL WATER QUALITY BEST MANAGEMENT PRACTICES

The structural BMPs outlined in this report are a sampling of devices currently being utilized. These devices have evolved from single purpose stormwater quality controls to ones exhibiting both quantity and quality benefits.

The success or failure of BMPs are ties to factors occurring with three stages of their lives: design, construction, and maintenance. For example, although a structure may be designed correctly for volume control and water quality, it will fail if the design is not followed during construction or if it is not properly maintained.

General information about the design, pollutant removal mechanisms, and maintenance of structural water quality best management practices is presented in this section. In is important to recognize that the application and effectiveness of these measures are very site specific. Therefore, we recommended that the literature cited be consulted for additional information.

It is also important to note that although the structural BMPs are described here individually, they are best utilized in combination or in conjunction with nonstructural BMPs and/or other structural BMPs. No single BMP is 100% effective in removing pollutants. However, pollutant reductions can frequently be maximized by using two or more BMPs together in a system. Nevertheless, structural BMPs should be viewed as a means to reduce the amount of pollutants in runoff - not a means of eliminating pollutants entirely.

Vegetative Best Management Practices

All of the following practices rely on various forms of vegetation to enhance the pollutant removal, habitat value, or appearance of a development site. Although, in practice, each technique, by itself, is usually not capable of entirely controlling increased runoff and pollutant export for a development site, they can improve the performance and amenity value of other BMPs. These practices, therefore, should be considered as an integral part of every development site plan.

Limiting the Amount of Land Disturbed (Urban Forestry)

Limiting the amount of land disturbed and/or replanting vegetation following completion of construction can reduce pollutants in stormwater runoff in several ways: 1) through plant uptake and storage, 2) by reducing the volume of stormwater runoff and the associated pollutants, 3) through filtering, and 4) by preventing soil erosion. With careful landscape design, as much as 50% of a residential lot can be converted into an attractive natural setting of trees, shrubs,

and ground covers. The extent to which pervious, vegetated areas can be preserved and/or created will have a direct effect upon the volume of stormwater runoff and the quantities of associated pollutants that will be produced. Moreover, the cost of maintaining the vegetated areas is relatively low and the aesthetic value to the overall development can be quite high.

Grassed Swales

Grassed swales are typically applied in residential developments and highway medians as an alternative to curb and gutter drainage systems. Figure VI-12 presents an example of a grassed swale. Grassed swales remove pollutants through the filtering action of the grass, deposition in low velocity areas, and by infiltration into the subsoil. These mechanisms are most effective in removing particulate pollutants and have a negligible effect on soluble pollutants. Swales are generally less expensive to construction than curb and gutter systems and maintenance is relatively low cost, generally consisting of normal lawn maintenance activities such as mowing and watering as needed.

Figure VI-12
Illustration of Grassed Lined Swale

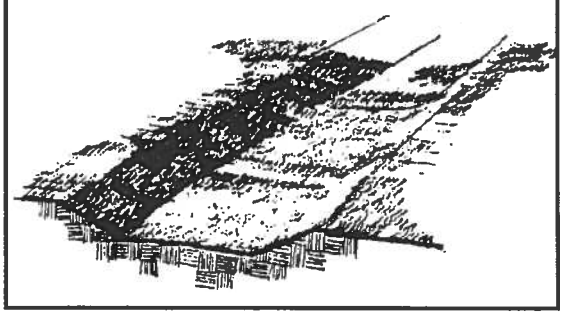


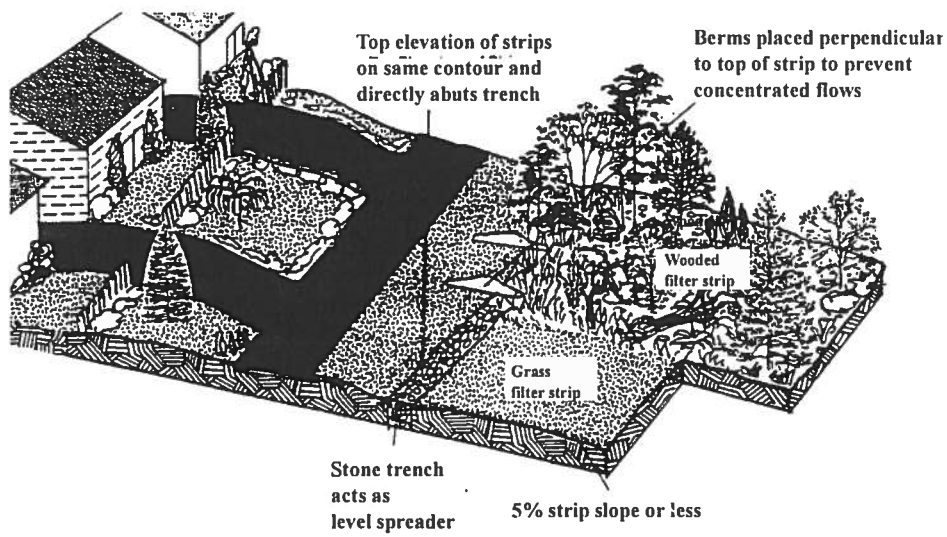
Figure VI-13
Illustration of Rock Lined Channel

An alternative to grassed swales are rock lined waterways (Figure VI-13). A rock lined waterway consists of a channel lined with rock. These channels are generally less effective than grassed swales in the removal of pollutants due to a reduced filtering through the grass. However, some suspended pollutants are removed through deposition in low velocity areas.

Filter Strips

Filter strips are similar to grassed swales in many respects. However, they differ in that they are designed to only accept overland sheet flow and are not intended to serve a dual purpose as a conveyance facility. In practice, runoff from an adjacent impervious area is evenly distributed across the filter strips. To perform properly, a filter strip must be: 1) equipped with some sort of level spreading device; 2) densely vegetated with a mix of erosion resistant plant species that effectively bind the soil; 3) graded to a uniform, even, and relatively low slope, and 4) be at least as long as the contributing runoff area. Filter strips are especially effective when constructed as a buffer between the development activities and adjacent streams, curbs, and swales. They can also be used to protect surface infiltration trenches from clogging by sediment. An example of an application of filter strips is presented in Figure VI-14.

Figure VI-14
Example Application of Vegetated Filter Strips



The pollutant removal mechanisms in filter strips are similar to those presented previously for grassed swales. As is the case with grassed swales, filter strips are particularly effective in removing particulate pollutants such as sediment, organic material, and many trace metals. Filter strips are relatively inexpensive to

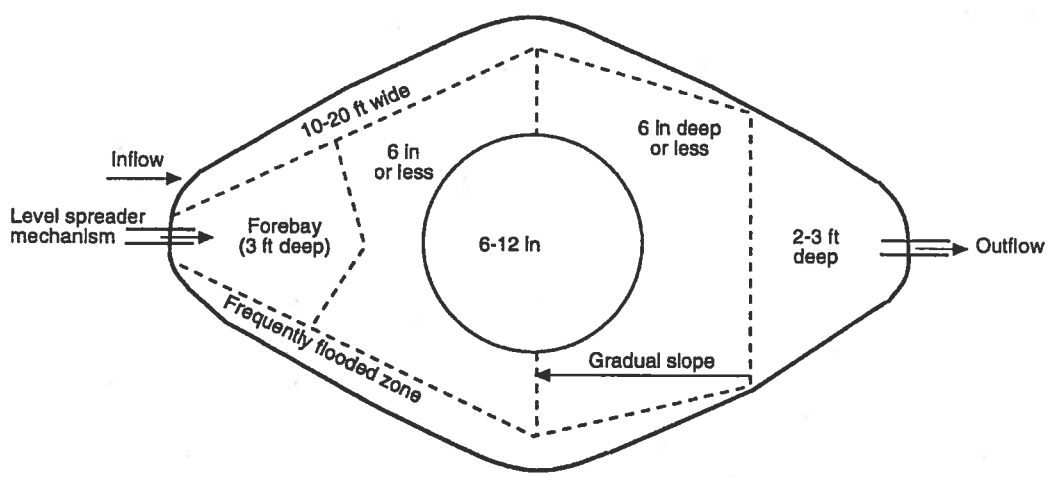
establish and cost almost nothing if preserved during site development. A creatively landscaped filter strip can become a valuable community amenity, providing wildlife habitat, screening, and stream protection. The open space created by the filter strips can also be applied toward meeting established development density limitations that may be contained in local ordinances.

Constructed Wetlands

There are two prevalent types of constructed wetlands in use: 1) shallow constructed wetlands (Figure VI-15) and 2) wet detention systems (Figure VI-16). Constructed wetland systems perform a series of pollutant mechanisms, including sedimentation, filtration, adsorption, microbial decomposition, and vegetative uptake to remove sediment, nutrients, oil and grease, bacteria, and metals. While constructed wetlands can be very effective in the removal of the broad range of pollutants encountered in stormwater runoff, it is important that they be properly designed, sited, and maintained. The critical design consideration is the maximization of the detention time in the wetland through proper sizing and configuration to prevent short circuiting.

Figure VI-15

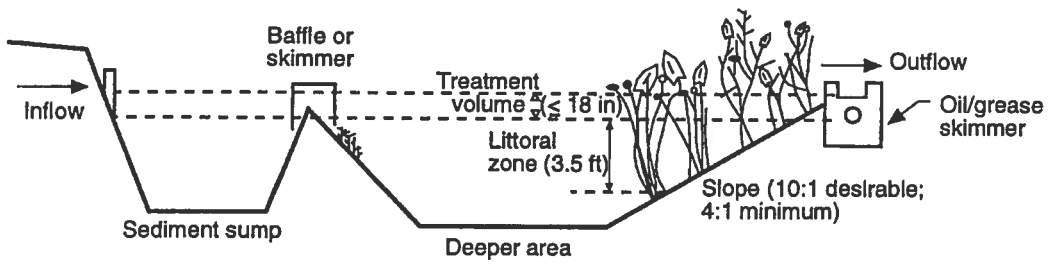
Schematic of a Shallow Constructed Wetland



Siting of wetlands can be difficult due to the importance of soil properties (chiefly permeability) to performance, size requirements, and concerns relative to potential nuisance insect breeding. In addition, created wetlands become a resource area that will subsequently be protected by federal and state laws.

Figure VI-16

Example Wet Detention Wetland System



Infiltration Facilities

Infiltration facilities permanently capture runoff so that it soaks to the ground water. As was presented previously, to the extent of their capacity to handle the volumes of stormwater runoff produced, they are very effective in controlling stormwater runoff flows. They also can be very effective in removing pollutants. Pollutant removal in these BMPs occurs primarily through infiltration, which eliminates the runoff volume or lowers it by the capacity of the facility. Currently, the three types of facilities commonly employed to remove pollutants from stormwater runoff through infiltration are: 1) infiltration basins; 2) infiltration trenches / dry wells; and 3) porous pavements (grassed swales, which also promote infiltration were discussed previously under vegetative practices).

Infiltration Basins

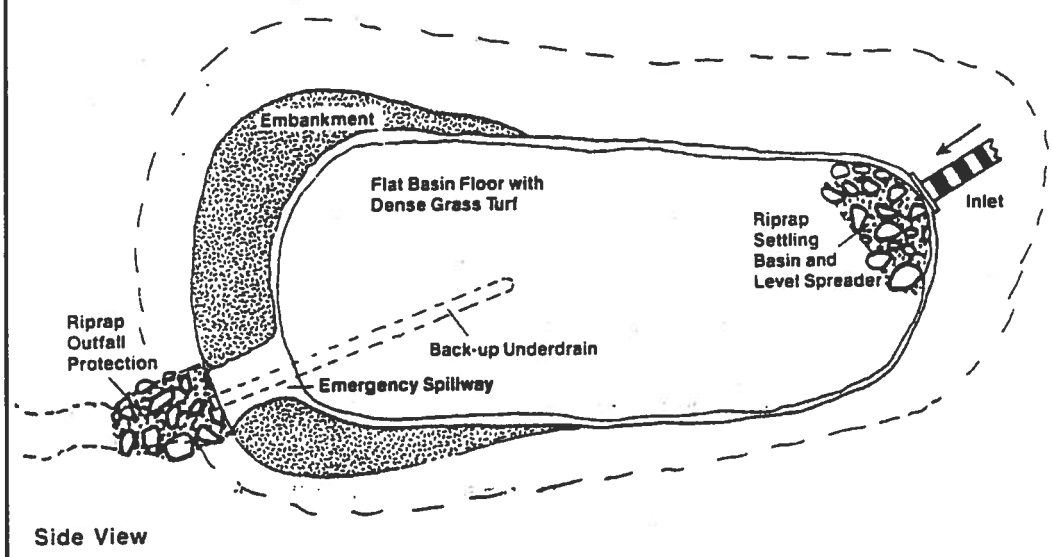
Infiltration basins are similar to dry ponds, except that infiltration basins have only an emergency spillway and no standard outlet structure (see Figure VI-17). All flow entering an infiltration basin (up to the capacity of the basin) is retained and allowed to infiltrate into the soil. Infiltration basins provide pollutant

removal through volume reduction, filtration, and settling. They are particularly effective in removing bacteria, suspended solids, insoluble nutrients, oil and grease, and floating wastes. They are less effective in removing dissolved nutrients, some toxic pollutants, and chlorides. Therefore, infiltration basins should not be used in cases where the runoff can be suspected to contain significant amounts of those pollutants.

Infiltration basins often have relatively large land requirements and require a suitable soil to be effective. Accumulating runoff must be able to infiltrate the soil in the bottom of the basin. Typically sand and loam, with infiltration rates greater that or equal to 0.27 inches per hour are the preferred soils. Soils with percolation rates meeting this criteria exist throughout the watershed. However, high or seasonally high water tables predominate throughout most of the watershed. For infiltration to occur, ground water levels should be located at least 2 to 4 feet below the bottom of the basin. Consequently, the use of infiltration basins will not be practical throughout most of the Beaverdam Branch Watershed.

Figure VI-17

Example Infiltration Basin Layout



Infiltration Trenches / Dry Wells

Subsurface infiltration practices, such as infiltration trenches or dry wells force runoff into the soil to recharge ground water and remove pollutants. Filtration is the primary pollutant removal mechanism active in these facilities. They effectively remove suspended sediments, floating materials, and bacteria. They are less effective at removing dissolved materials.

The soil infiltration rate and structure size are the most important considerations in the design of infiltration structures. The soils underlying the structures must be tested to determine their infiltration capacity and the ground water level. The soil must neither be too impermeable to runoff nor to rapidly permeable. Moreover, a distance of at least 2 feet should be maintained between the bottom of the infiltration structure and the mean high ground water elevation. Due to the nature of prevailing conditions in the area, siting of infiltration facilities must be made carefully throughout the Beaverdam Branch Watershed.

Porous Pavement

By allowing stormwater to infiltrate into the soil, porous pavements can reduce runoff volume and pollutant discharge. Porous pavements can remove significant amounts of both soluble and particulate pollutants. Porous pavement is primarily designed to remove pollutants deposited from the atmosphere, as coarse solids can clog the pavement pores. As a result, porous pavements are generally designed into parking areas that receive light traffic.

As is the case with all of the infiltration systems, the effectiveness of porous pavements for pollutant removal is highly dependent upon soil characteristics and ground water levels. The soils under the pavement system must produce adequate infiltration and ground water levels should be 2 to 4 feet below the bottom of the paving and subbase system. Proper maintenance of porous pavements is important and can be extensive. The pavement must be kept free of coarse particles that can clog the pavement and prevent runoff from infiltrating. The pavement must, therefore, be regularly inspected and cleaned with a vacuum sweeper and high pressure jet.

Detention Facilities

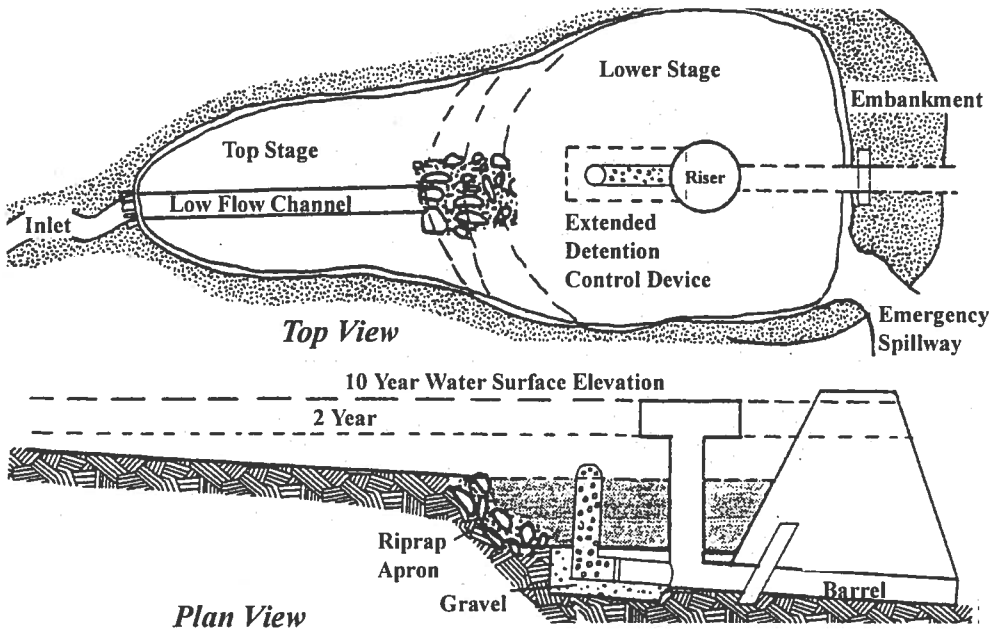
One of the most common structural methods of controlling runoff is through the construction of ponds to collect runoff, detain it, and release it to receiving waters at a controlled rate. Pollution reduction during the temporary period of runoff storage results primarily from the settling of solids. Detention facilities, therefore, are most effective at reducing the concentrations of solids and the pollutants that adhere to solids, and less effective at removing dissolved pollutants.

The three types of detention facilities commonly used to remove pollutants from stormwater runoff are extended detention dry ponds, wet ponds, and constructed wetlands. The first two types of facilities are discussed below. Constructed wetlands were introduced previously under the topic of vegetative methods.

Extended Detention Dry Ponds

As was discussed previously in regard to flow control devices, dry ponds are frequently used to control peak discharges by temporarily detaining runoff. They are designed to completely drain at the conclusion each rainstorm event. When designed to achieve pollutant load reductions, the design of the ponds are modified to achieve longer detention times than are necessary solely to adequately control peak discharges. Generally, the ponds are designed to retain a specified runoff volume for a period of time sufficient to achieve the desired pollutant removal. This requires sufficient storage volume and an outlet flow control devices to accomplish the desired flow detention. Dry ponds should also include a low flow channel designed to reduce erosion; vegetation on the bottom of the pond to promote filtering, sedimentation, and uptake of pollutants. In addition, dry pond designs frequently include upstream structures to remove coarse sediments and reduce sedimentation and clogging of the outlet. An example of a layout of an extended detention pond is illustrate in Figure VI-18.

Figure VI-18
Schematic of a Dry Extended Detention Pond



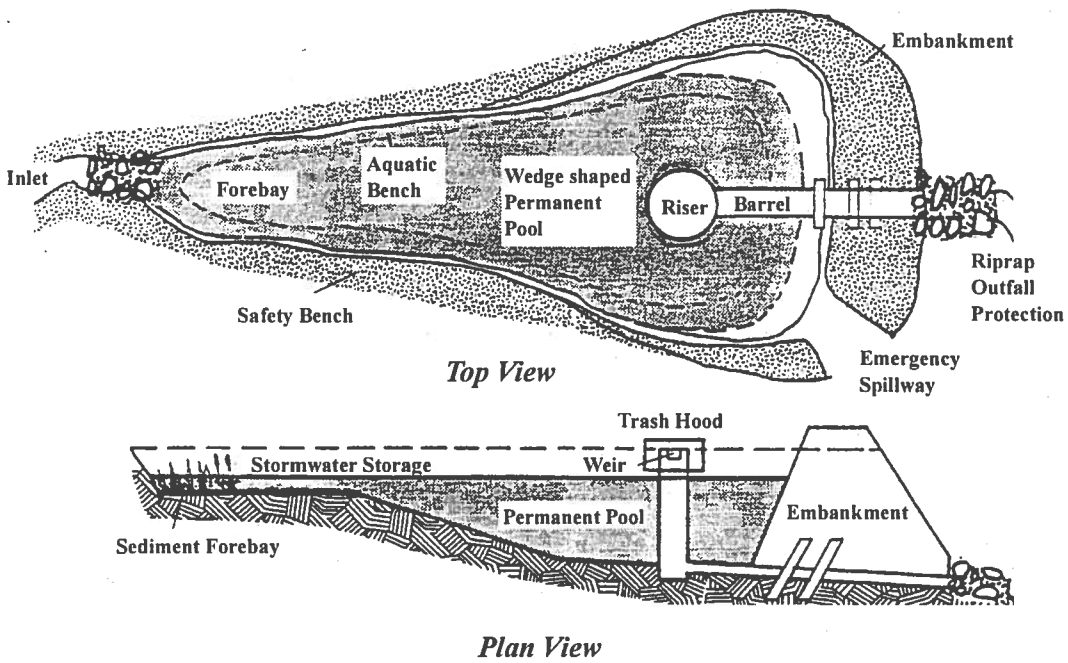
Maintenance of water quality dry ponds is important. Regular mowing, inspection, erosion control, and debris and litter removal are necessary to prevent excessive sediment buildup and vegetative overgrowth. Also, periodic nuisance and pest control could be required. The primary constraints to siting dry ponds are land requirements, topography, and depth to bedrock.

Wet Ponds

The design of wet ponds is similar to that of dry ponds. In wet ponds, however, stormwater runoff is directed into a constructed pond or enhanced natural pond, in which a permanent pool of water is maintained. Once the capacity of a wet pond is exceeded, collected runoff is discharged through an outlet structure or emergency spillway. An example of a wet pond system is presented in Figure VI-19.

The primary pollutant removal mechanism in wet ponds is settling. The ponds are designed to collect stormwater runoff during rainfall and detain it until additional stormwater enters the pond and displaces it. While the runoff is detained, settling of particulates and associated pollutants takes place in the pond. Wet ponds can also remove pollutants from runoff through vegetative uptake. Wet ponds should be vegetated with native emergent aquatic plant species, which can remove dissolved pollutants such as nutrients from the runoff before it is discharged to the receiving water.

Figure VI-19
Schematic of a Wet Pond



Wet ponds are typically designed with a number of different water levels. One level has a permanent poll of water. The next level periodically is inundated with water during storm. This level should be vegetated and relatively flat to promote settling and filtering of sediments and vegetative uptake of nutrients. The highest

level will be inundated only during extremely heavy rainfall. This level should also be vegetated. Sizing of wet ponds is determined by requirements for storage volumes and desired detention times.

Maintenance requirement for wet ponds include periodic sediment removal (approximately once every 10 to 20 years), mowing, and litter removal. Factors affecting siting include land requirements, soil conditions (soils should not be excessively porous and ground water tables should be relatively high), and topography.

Summary of Water Quality Best Management Practices

As was indicated in the preceding discussion, there are a number of techniques that represent best management practices for reducing pollution associated with stormwater runoff. These techniques all also have application in efforts to control runoff volumes and peak rates of dicharge. Consequently, appropriately designed stormwater management facilities can improve runoff water quality while achieving the required control of stormwater discharge flows. Table IV-3 contains a comparison of the pollutant removal effectives for the range of BMPs discussed under various design approaches. As is indicated in Table VI-3, the effectiveness of the BMPs varies. It is important, however, to recognize the water quality benefits that are offered and to consider these benefits in the overall selection and design of stormwater management controls.

EROSION AND SEDIMENTATION CONTROL MEASURES

The ability of storm water runoff to transport material is a function of flow velocity and the erosion resistance of the material. As stormwater runoff flow rates increase, the flow velocity increases and more eroded material is transported. As the water travels down the watershed, channel gradients reduce flow velocity and sediment begins to be deposited in streams and storm sewers. This process, known as sedimentation, continues as the flow rate and flow velocity reduces. New developments further increase the sedimentation problem by removing natural vegetation and making the bare ground susceptible to erosion.

Table VI-3
Comparative Pollutant Removal of Stormwater BMP Designs

Best Management Practice / Design	Suspended Sediment	Total Phosphorus	Total Nitrogen	Oxygen Demand	Trace Metals	Bacteria	Overall Effectiveness
Grassed Swale							
Design 1	○	○	○	○	○	⊕	Low
Design 2	◔	◔	◔	◔	○	⊕	Low
Filter Strip							
Design 3	◔	○	○	○	◔	⊕	Low
Design 4	●	◑	◑	◕	●	⊕	Moderate
Porous Pavement							
Design 5	◑	◕	◑	◕	◑	◕	Moderate
Design 6	●	◕	◕	◕	●	●	High
Design 7	●	◕	◕	●	●	●	High
Infiltration Basin							
Design 5	●	◑	◑	◕	●	◕	Moderate
Design 6	●	◑	◑	◕	●	◕	High
Design 7	●	◕	◕	●	●	●	High
Infiltration Trench							
Design 5	◕	◑	◑	◕	◕	◕	Moderate
Design 6	◕	◑	◑	◕	●	◕	High
Design 7	●	◕	◕	●	●	●	High
Wet Pond							
Design 8	◕	◑	◔	◔	◔	⊕	Moderate
Design 9	●	◑	◔	◔	◕	⊕	Moderate
Design 10	●	◕	◑	◑	◕	⊕	High
Extended Detention Pond							
Design 11	◕	◔	◔	◔	◑	⊕	Moderate
Design 12	●	◑	◔	◑	◕	⊕	Moderate
Design 13	●	◕	◑	◑	◕	⊕	High

Key

- ○ 0 to 20% Removal
- ◔ 20 to 40% Removal
- ◑ 40 to 60% Removal
- ◕ 60 to 80% Removal
- ● 80 to 100% Removal
- ⊕ Insufficient Knowledge

Source: Schueler, Thomas R., Controlling Urban Runoff: A Practical Manual For Planning and Designing Urban BMP's.

Design 1: High slope swales with no check dams
Design 2: Low gradient swales with check dams
Design 3: 20 foot wide turf strip
Design 4: 100 foot wide forested strip with level spreader
Design 5: Facility exfiltrates first - flush: 0.5 inch runoff / impervious acre
Design 6: Facility exfiltrates one inch runoff volume per impervious acre
Design 7: Facility exfiltrates all runoff up to 2 year design storm

Design 8: Permanent pool equal to 0.5 inch storage per impervious acre
Design 9: Permanent pool equal to 2.5 (Vr); where Vr equals the mean storm runoff
Design 10: Permanent pool equal to 4.0 (Vr); where Vr equals the mean storm runoff
Design 11: First - flush runoff volume detained 6-12 hours
Design 12: Runoff volume produced by 1.0 inch detained for 24 hours
Design 13: As in design 12, but with shallow marsh in bottom stage

The following principles should be practiced for urban soil erosion and sedimentation control.

1. Keep disturbed areas small: Areas vulnerable to erosion should be disturbed the minimum amount possible. As much natural cover as possible should be retained and protected. The construction plan should be phased whenever possible in small units and in sequence such that only the area being developed is exposed. All other areas should have a good cover of vegetation or mulch.

2. Stabilize and Protect Disturbed Areas: Mechanical and/or structural methods and vegetative methods are available for stabilizing disturbed areas. These methods include seeding, mulching, sodding, retaining walls, terracing, use of chemical stabilizers, and others.

3. Keep Runoff Velocities Low: Removal of existing vegetative cover and the resulting increase in impermeable surface during development increase both the volume and velocity of runoff. Short slopes, low gradients and the preservation of natural vegetation cover help to keep stormwater velocities low and thus limit soil erosion.

4. Protect Disturbed Areas from Runoff: Protective measures that can be utilized to prevent water from entering and running over disturbed areas are diversions, waterways, structures etc.

5. Retain Sediment within the Site Area: Sediment can be retained by two methods: filtering runoff as it flows, and detaining sediment laden runoff for a period of time large enough to allow the soil particle settle. Sediment basins, vegetative filter strips, terraces and sediment barriers may be used to retain sediment. However one should not rely solely

upon vegetation filter strips, since sediment may rapidly render such areas useless by killing the vegetation.

6. In-stream Control: After precipitation and runoff has concentrated, an outlet channel is needed for safe release of the water off the site. This outlet channel needs to be protected from erosion. A wide, shallow grassed water way can be a very good method. Channels with steeper gradients need structural protection along with, or instead of vegetative measures. Typical structural measures include: earth dams with a full flow pipe through the fill, weirs, flood gates, and check dams. In designing such facilities, it is important to consider the effects of the dam or embankment on upstream properties. The design must include safety features in the form of spillways and bypasses to prevent overtopping which can cause embankment failure.

The details on the design and implementation of practices described above and many others can be obtained from the Soil Conservation Service and the County Conservation District.

SOIL CHARACTERISTICS VERSUS STORMWATER MANAGEMENT ALTERNATIVES

It was mentioned earlier that the soil characteristics at the development site, such as soil permeability, water capacity, frost penetration etc. play an important role in the selection of stormwater management alternatives. This section gives specific soil information for the Beaverdam Branch Watershed and discusses the soil characteristics and their impact on alternative stormwater management techniques.

Soil information for Blair County can be obtained from the publications, "Soil Survey of Blair County, Pennsylvania". These publications are prepared by the Natural Resources Conservation Service of U.S. Department of Agriculture. The survey has a general soil map showing in color, the soil associations in the county. A soil association is a landscape that has a distinct pattern of soils in defined proportions. The soil association map should not be used to determine the soil type, for selecting stormwater water management alternatives. The reason is that, a general soil map is intended to be a

general guide in evaluating large areas such as a watershed, or in county-wide planning for community development. It is not a suitable map for selecting a site for locating a stormwater detention or retention facility. For example, this map can be used to establish a generalized idea, that Berks Channery Silt Loam soils occur in the Beaverdam Branch Watershed. Also, the survey tells that these soils have seasonal high water tables ranging from zero to six inches below the surface, thus having severely limitations for infiltration storage. Thus, a general rule can be established that infiltration storage alternative should not be approved in the Berks Channery Silt Loam soils unless the occurrence of the ground water table at shallow depths has been ruled out by on-site engineering tests.

Table VI-4 presents some relevant properties of the Beaverdam Branch Watershed soils significant to the use of various stormwater management techniques. Table VI-5 indicates the suitability of the soils for some generalize construction activiities associated with stormwater management alternatives. General conclusions that can be drawn from the information contained in Tables VI-4 and VI-5 include the following.

1. Activities designed to minimize the creation of impervious surfaces will be appropriate throughout the watershed.

2. The construction and operation of dry and wet ponds will generally be feasible throughout the watershed, although consideration must be given to site specific soil conditions.

3. The use of large scale induced infiltration systems will generally be limited by soil and ground water conditions that frequently are not suitable for those techniques.

Table VI-4
Beaverdam Branch Watershed: Relevant Soil Properties

Soil Name	Depth to Seasonal High Ground Water (Feet)	Depth To Bedrock (Inches)	Permeability (Inches/Hour)
Albrights gravelly silt loam	0.5 - 3.0	>60	0.2 - 2.0
Andover variant extremely stony loam	0.0 - 0.5	>60	0.06 - 2.0
Basher soils	0.5 -2.0	>60	0.6 - 6.0
Berks channery silt loam	0.0 - 0.5	20 - 40	0.6 - 2.0
Berks-Weikert channery silt loam	>6.0	20 - 40	0.6 - 6.0
Blairton silt loam	0.5 - 3.0	20 - 40	0.2 - 2.0
Brinkerton silt loam	0.0 - 0.5	>60	0.06 - 2.0
Buchanan gravelly silt loam	1.0 - 2.0	>60	0.06 - 2.0
Cavode silt loam	0.5 - 1.5	>40 - 60	0.06 - 2.0
Clarksburg silt loam	1.5 - 3.0	>60	0.06 - 2.0
Clymer loam	>6.0	>40	0.06 - 2.0
Clymer very stony loam	>6.0	>40	0.6 - 2.0
Ernest silt loam	1.5 - 3.0	>60	0.06 - 2.0
Gilpin channery silt loam	>6.0	20 - 40	0.6 - 2.0
Hagerstown-Rock outcrop complex	>6.0	>40	0.6 - 2.0
Hazleton channery sandy loam	>6.0	>40	0.2 - 2.0
Hazleton very stony sandy loam	>6.0	>40	2.0 - 20.0
Hublersburg very silty clay loam	>6.0	>60	0.6 - 2.0
Laidig channery loam	3.0 - 4.0	>60	0.2 - 6.0
Leck Kill channery silt loam	>6.0	>40	0.6 - 6.0
Leetonia flaggy loamy sand	>6.0	>60	6.0 - 20.0
Lehew very stony loam	>6.0	>20 - 40	0.6 - 20.0
Meckesville gravelly silt loam	3.0 - 6.0	>60	0.2 - 2.0
Meckesville very stony silt loam	3.0 - 6.0	>60	0.2 - 2.0
Mertz channery silt loam	>6.0	>60	0.2 - 2.0
Monongahela silt loam	1.5 - 3.0	>60	0.06 - 2.0
Morrison sandy loam	>6.0	>60	0.6 - 6.0
Morrison very stony sandy loam	>6.0	>60	0.6 - 6.0
Murrill gravelly silt loam	>6.0	>60	0.6 - 2.0
Opequon-Hagerstown-Rock outcrop	>6.0	>12 - 20	0.2 - 2.0
Purdy silt loam	0.0 - 0.5	>48	0.0.62 - 0.6
Tyler silt loam	0.5 - 1.5	>60	0.0.62 - 0.6
Urban land - Berks complex	>6.0	20 - 40	0.06 - 0.12
Urban land - Edom complex	>6.0	>40	0.2 - 2.0
Wharton silt loam	1.5 - 3.0	>48	0.06 - 2.0

Table VI-5
Beaverdam Branch Watershed
Soil Limitations to Selected Stormwater Management Techniques

Soil Name	Ponds	Terraces and Diversions	Grassed Waterways
Albrights gravelly silt loam	Slope	Slope, percs slowly	Percs slowly, wetness
Andover variant extremely stony loam	Slope	Percs slowly, erodes easily, wetness	Percs slowly, wetness, large stones
Basher soils	Seepage	None	Erodes easily
Berks channery silt loam	Depth to rock, seepage	Depth to rock, slope, small stones	Depth to rock, droughty, slope
Berks-Weikert channery silt loam	Depth to rock, seepage	Depth to rock, slope, small stones	Depth to rock, droughty, slope
Blairton silt loam	Depth to rock	Depth to rock, percs slowly, wetness	Rooting depth, percs slowly, wetness
Brinkerton silt loam	Slope	Percs slowly, erodes easily, wetness	Percs slowly, wetness, erodes easily
Buchanan gravelly silt loam	Slope	Slope, percs slowly	Slope, wetness
Cavode silt loam	Slope, depth to rock	Wetness, percs slowly	Wetness, percs slowly
Clarksburg silt loam	Slope	Slope, erodes easily, percs slowly	Wetness, percs slowly
Clymer loam	Slope, depth to rock, seepage	Slope, small stones	Slope
Clymer very stony loam	Depth to rock, large stones, slope	Large stones, slope	Large stones, slope
Ernest silt loam	Slope	Slope, erodes easily, percs slowly	Slope, erodes easily, percs slowly
Gilpin channery silt loam	Slope, depth to rock, seepage	Slope, depth to rock	Slope, depth
Hagerstown-Rock outcrop complex	Seepage, slope	None	None
Hazleton channery sandy loam	Slope, depth to rock, seepage	Slope, depth to rock	Slope

Table VI-5
Beaverdam Branch Watershed
Soil Limitations to Selected Stormwater Management Techniques
(continued)

Soil Name	Ponds	Terraces and Diversions	Grassed Waterways
Hazleton very stony sandy loam	Slope, seepage	Slope, large stones	Slope, large stones
Hublersburg very silty clay loam	Slope	Slope,erodes easily	Slope, erodes easily
Laidig channery loam	Slope, seepage	Slope, rooting depth	Large stones, slope, rooting depth
Leck Kill channery silt loam	Seepage, slope	Slope	Slope
Leetonia flaggy loamy sand	Seepage, slope	Too sandy, piping, slope	Droughty, slope
Lehew very stony loam	Depth to rock, seepage, slope	Depth to rock, large stones	Droughty, depth to rock, large stones
Meckesville gravelly silt loam	Slope	Slope	Slope
Meckesville very stony silt loam	Slope, large stones	Large stones, slope	Large stones, slope
Mertz channery silt loam	Slope	Slope, piping	Slope
Monongahela silt loam	Slope, seepage	Percs slowly, piping, rooting depth	Slope, percs slowly, erodes easily
Morrison sandy loam	Seepage	Slope, erodes easily	Slope, erodes easily
Morrison very stony sandy loam	Seepage	Slope, erodes easily, large stones	Slope, erodes easily, large stones
Murrill gravelly silt loam	Slope	Slope	Slope
Opequon-Hagerstown-Rock outcrop	Depth to rock, slope	Depth to rock	Slope, rooting depth, depth to rock
Purdy silt loam	None	Wetness	Wetness
Tyler silt loam	None	Erodes easily, wetness, rooting depth	Wetness, erodes easily, rooting depth
Urban land - Berks complex	Depth to rock, seepage	Depth to rock, slope, small stones	Depth to rock, droughty, slope
Urban land - Edom complex	Slope	Erodes easily, slope	Erodes easily, slope
Wharton silt loam	Slope	Slope, percs slowly, erodes easily	Slope, percs slowly, erodes

OPERATION AND MAINTENANCE CONSIDERATIONS

Most stormwater control facilities or systems must be monitored and maintained regularly following construction to assure effective operation, long life and compatibility with the local setting. Table VI-6 contains a summary of key operation and maintenance considerations for the stormwater management alternatives discussed previously.

As is indicated in Table VI-6, there is range of operation / maintenance items which must be performed depending upon the type of stormwater management techniques employed. It is recommended that individual municipal stormwater management ordinance require that the enumeration of specific recommended operation and maintenance activities be be outlined by the design engineer at the time applications for permit approval are made. The designer of the facilities should be in the best position to define the maintenance requirements associated with the facilities being proposed. However, operation and maintenance plan should be reviewed in consideration of the general requirements presented in Table VI-6. The approved set of operation and maintenance activities should then be used as the basis of an on-going operation and maintenance plan. Also, provisions should be made in the appropriate ordinances or regulations to provide for effective mechanisms through which the completion of critical maintenance can be assured.

PUBLIC ACCEPTANCE OF ON-SITE DETENTION

On-site detention, also has the disadvantage of not having wide spread public acceptance. This is mostly because the individuals have to spend extra dollars to satisfy the runoff control regulations. Also, they are concerned about the safety of their children also, which are usually attracted toward the ponds. Therefore, it is highly recommended to employ multi-purpose use of detention facilities. In the minds of a community, the multi-purpose use of such a detention facility greatly improves the perception that such a facility is a justifiable expense by the public or by the private developer [APWA, 1981]. Detention ponds are excellent examples of multi-purpose adaptability. When conceived and designed artistically, they can support different kind of activities throughout the year, such as, water sports and fishing. During winter months, shallow detention ponds with a permanent pool of water provide opportunities for ice skating.

Table VI-6
Operation and Maintenance Considerations

	Dredging	Debris / Sedimentation Removal	Weed Control	Insect Control	Mechanical Maintenance	Mowing	Cleaning	Repair	Inspection
Detention/Retention Basins		✱	✱	✱		✱		✱	✱
Detention/Retention Tanks				✱	✱		✱	✱	✱
Ponds	✱	✱	✱	✱				✱	✱
Parking Lot Detention							✱	✱	✱
Roof-top Retention							✱	✱	✱
Open Space Detention		✱				✱			✱
Road Embankment Detention		✱	✱	✱			✱	✱	✱
Infiltration Strips			✱				✱		✱
Infiltration Beds *		✱					✱		✱
Porous Pavement							✱	✱	✱
Open Channels **		✱	✱			✱			✱
Pipe Systems		✱					✱	✱	✱

* Includes dutch drains, seepage pits and seepage beds.

** Includes grassed and rock lined channels

A detention basin that is dry between runoff events can be used for field sports such as football, soccer, baseball, and various passive recreational pursuits such as badminton, model airplane operation, shuffleboard, croquet, and picnicking. Some detention basins may double as tennis or baseball courts. It might be difficult to convince some developers that the benefits derived from recreation outweighs the cost of the land plus construction costs. However, should the recreation area be redesigned as a multi-purpose recreational/detention basin, the cost would look insignificant compared to the cost of upgrading a storm drainage system or the amount of potential flood damages.

Detention facilities may also contribute to the protection and preservation of wildlife habitats and other natural resources. One example is a 602 ha (244 ac) tract in Chester County, Pennsylvania, where 315 homes were to be constructed. Approximately 84 ha (34 ac) of open space were provided containing two detention ponds designed to store runoff from the 100-year rainstorm. One year following the completion of the detention ponds, wildlife was observed returning to its former habitat. Geese have nested and fish have returned to the streams and newly constructed channels. The dual purpose utilization of stormwater detention facilities as wetlands represents a potential useful means of coping with the increasingly stringent wetland protection requirements and associated wetland replacement activities.

Although multiple uses are a better alternative for securing the community acceptance, maintenance costs for such facilities may be higher. Therefore, when considering multiple uses, it is important to look at all the associated costs and intangible benefits, to determine if it is practical to proceed with the multiple use concept.

SAFETY CONSIDERATIONS

A survey conducted by APWA in 1980, based on 325 respondents, revealed that there have been two drownings reported at the detention facilities. It is, therefore, essential to take precautions in design and selection of storm water management alternatives, to minimize hazards. Embankment slopes, railings, fencing and other features are obvious considerations. The importance of designing and constructing outflow structures and dams with safety considerations in mind should never be ignored. In general, the approaches that can be used to promote safety are [APWA, 1981]:

1. Keep people off the detention facility site
2. Provide escape aids
3. Make the onset of the hazards gradual
4. Eliminate the hazards

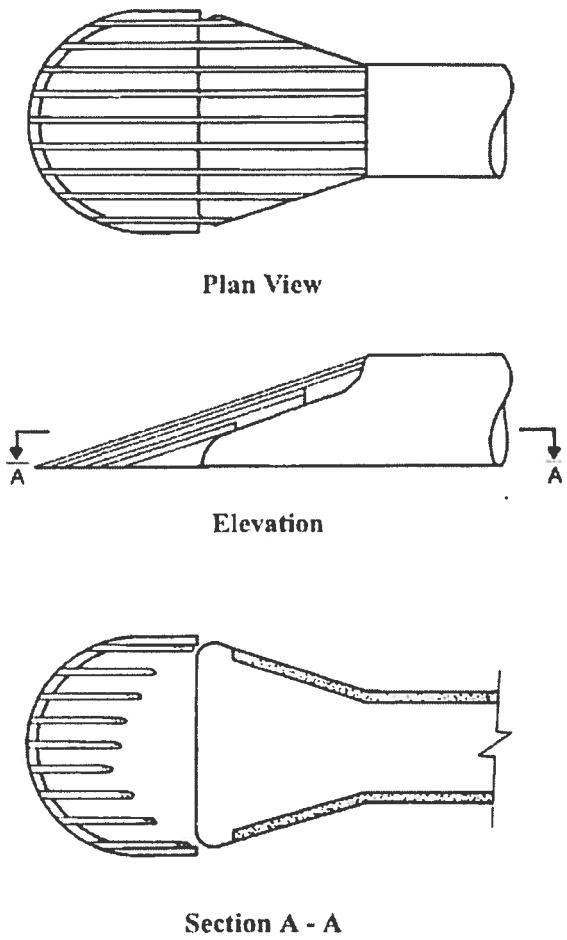
The designers and reviewers of stormwater control facilities, particularly those using detention / retention facilities should pay particular attention to incorporating appropriate safety features in the design of the facilities.

Special attention must be given to the design of outflow structures to satisfy the safety considerations. Water currents constitute a distinct hazard to persons who enter a detention pond or basin during periods when stormwater is being discharged. The force of the currents may push a person into an outflow structure or may hold a victim under the water where a bottom discharge is used. Several features designed to either eliminate or reduce such hazards are illustrated in Figures VI-20 and VI-21.

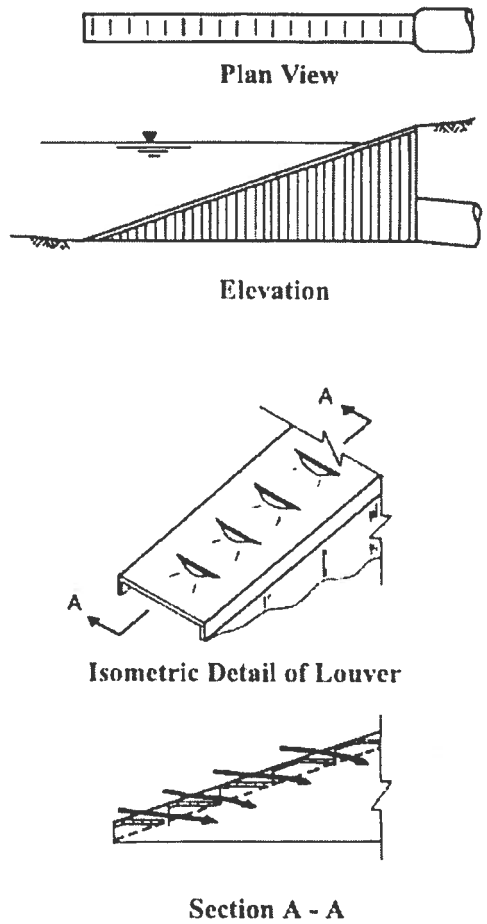
Figure VI-20 illustrates two versions of designs for non-submerged outlets: 1) curvilinear trash/safety racks for standard flared end sections and 2) narrow flume outlets. Both of these designs represent methods which tend to reduce the potential for persons to be drawn into or trapped against the outlet devices.

Figure VI-21 presents suggested safety features for submerged outlets: 1) outflow velocities and hence the associated hazards can be reduced through the use of a porous dam type of outlet facility; and 2) the illustrated safety rack for submerged outlets reduces the entrapment potential and provides a means of egress from the basin. As is also illustrated in Figure VI-21, drowning hazards can also be reduced by using a floating inlet for a basin outlet structure. The floating inlet reduces the drowning hazard by eliminating the water force which could trap a person at the outflow structure.

Figure VI-20
Suggested Safety Features for Non-Submerged Outlets

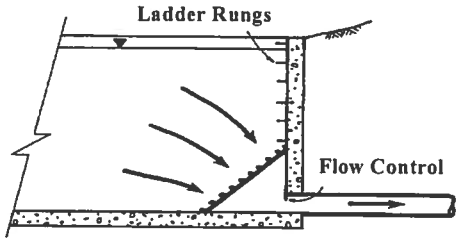


Curvilinear Trash/Safety Rack for Standard Flared End Sections

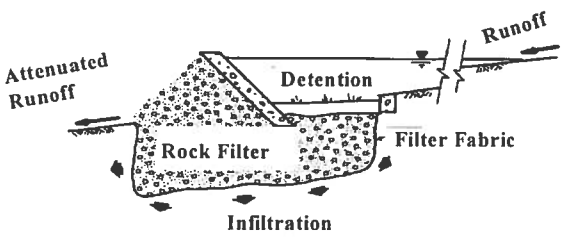


Narrow Flume Outlet For Detention Ponds

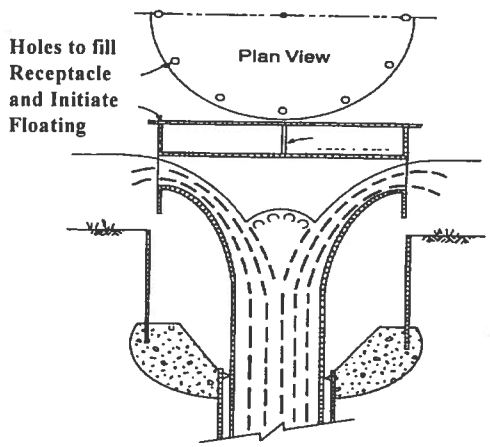
Figure VI-21
Suggested Safety Features for Submerged Outlets



Safety Rack for Submerged Outlets



Porous Dam for Detention Ponds With Low Velocity Discharge



Floating Inlet With Recessed Receiving Receptacle

DISTRIBUTED STORAGE

GENERAL

The stormwater management techniques discussed thus far have been geared primarily to on-site control methods. It is likely that on-site controls will be the predominant form of stormwater management in the Beaverdam Branch watershed. Off-site, distributed

storage is, however, an alternative or adjunct to on-site control techniques which should be recognized and considered for use where appropriate. Simply defined, distributed storage is the process of utilizing the most suitable site or sites for regional detention facilities.

The combination of on-site detention and distributed storage approaches may significantly improve the capability of land developers and communities to control stormwater on a watershed basis. Distributed storage may also offer a means of accommodating development in a manner which minimizes total costs and optimizes land utilization through the sharing of a single, strategically located detention or retention facility. Finally, the use of distributed storage may increase the feasibility of dual or multi-purpose facilities. For example, certain recreation areas might easily be used to provide temporary stormwater storage; natural or artificial ponds and lakes can serve both recreation and stormwater management objectives; and stormwater management facilities may be constructed as replacement wetlands.

SUMMARY

The institution of stormwater management regulations throughout the watershed will require that land developers include provisions in their land development plans to limit increases in the volume of runoff and to control peak rates of stormwater discharges to levels specified in the local ordinances. These standards will be presented as performance standards. That is, the standards will set limits on the peak rate of discharge permitted from the development site without specifying the exact methods to be used in order to meet the standards. The owner of the development will be afforded a high degree of flexibility in the selection and design of the specific measures to be incorporated into the design of the development. This will permit the developer to select and arrange the various available control techniques in a manner that is most efficient for the particular information and that best accommodates the intended use of the development.

Nevertheless, the various stormwater control techniques offer differing degrees of benefit. For example, measures such as the preservation of pervious areas, the use of filter strips and buffers, and the use of vegetated swales offer the following significant advantages:

1. Minimization of total runoff volumes

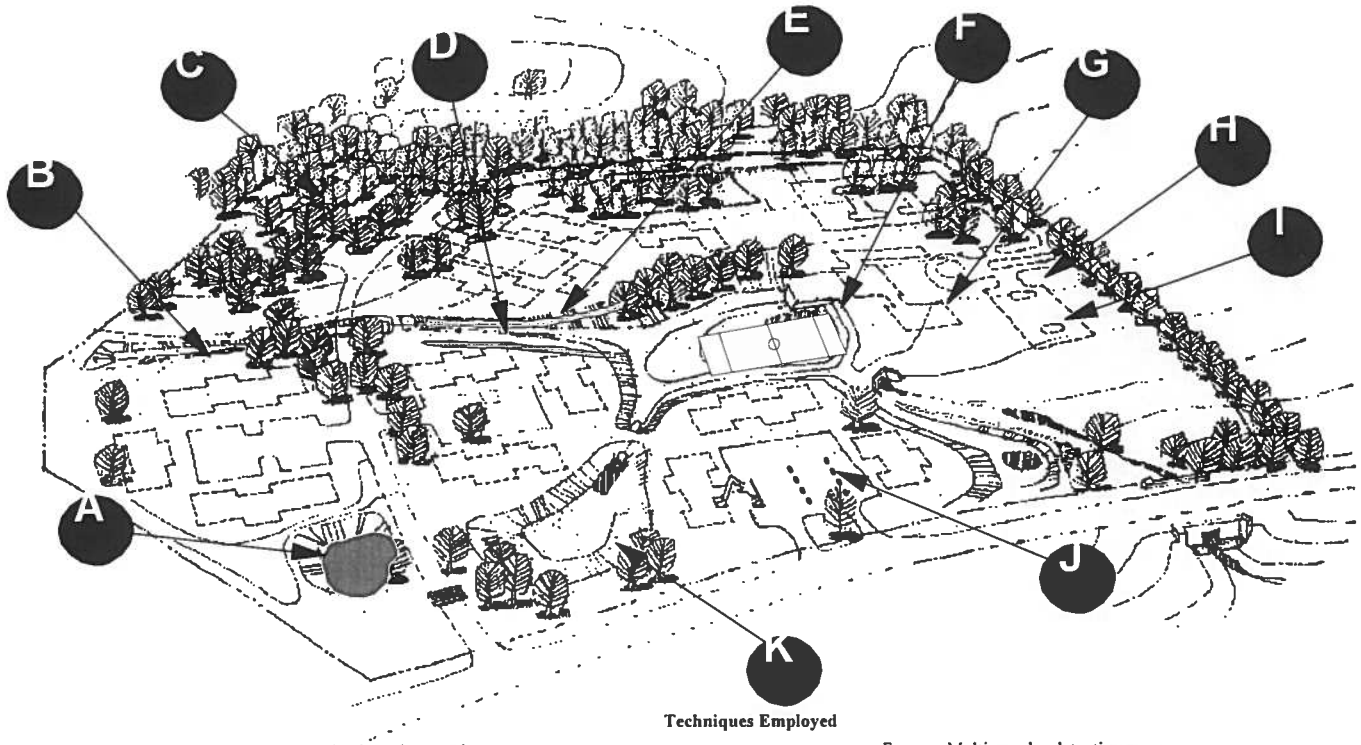
2. Promotion of aquifer recharge
3. Stormwater pollution reduction
4. Ease of construction and maintenance
5. Low construction and maintenance costs
6. Preservation of open space

The opportunity for realizing these benefits is lost if no effort is made to utilize these techniques and the stormwater performance standards are satisfied solely through the construction of detention facilities. It is important, therefore, that the land developers be encouraged to make use of the full range of available control techniques in an integrated approach that maximizes the attributes of each. To that end, the municipal stormwater ordinances should encourage the land developers to select the general types of stormwater controls used in his/her stormwater management plan in the general order of preference:

1. Maximization of infiltration on-site by minimizing land disturbance, maximizing the amount of pervious surfaces incorporated in the development, and creating vegetated strips and buffer areas.
2. Flow attenuation through the use of open vegetated swales, rock lined channels, and natural depressions
3. Stormwater detention / retention structures (dry, wet, multi-purpose)

An example of a land development that employs the broad range of applicable control techniques is present in Figure VI-22. The concept illustrated in Figure VI-22 is an approach to providing stormwater management techniques in a manner that incorporates them into the overall design of the development while using the flow and pollution control capabilities of each technique in an integrated stormwater management and overall land development plan.

Figure VI-22
Example of Development Integrating Variety of Stormwater Control Techniques



Techniques Employed

A: Wet detention pond
B: Grassed swale
C: Original growth woodlands preserved
D: Rock-lined channel
E: Grassed strips
F: Multi-use dry detention area
G: Dutch drains under roof eves
H: Pervious surface walkways
I: Parking lot detention storage
J: Grassed strips in parking area
K: Dry detention pond

BEAVERDAM BRANCH WATERSHED
STORMWATER MANAGEMENT PLAN
SECTION VII
EXISTING MUNICIPAL ORDINANCES

OVERVIEW

As part of the development of this watershed stormwater management plan for the Beaverdam Branch Watershed, an evaluation of the relevant ordinances that are in force in the municipalities in the watershed was conducted. The municipal ordinances were reviewed to identify, to the extent expressed in the ordinances, development objectives, the current extent of control of stormwater related aspects of development, existing enabling ordinance provisions, and current stormwater management responsibilities and procedures. Table VII-1 lists the general categories of relevant ordinances that have been adopted by or are in effect in the municipalities in the watershed.

Table VII-1
Existing Relevant Ordinances

Municipality Relevant Ordinances	**Municipality** Relevant Ordinances
Allegheny Township Subdivision and Land Development Ordinance (Ord. No. 150-96, Proposed Stormwater Management Ordinance, Flood Plain Ordinance (Ord. No. 103).	**Freedom Township** Subdivision and Land Development Ordinance (No. 1987-1 and amendments), Stormwater Management Ordinance (No. 1991-2), Flood Plain Management Ordinance (No. 1975-2 and amendments).
Altoona City Subdivision and Land Development Ordinance (Ord. No. 4545), Stormwater Management Ordinance (Part 3 of SD/LD Ordinance), Zoning Ordinance (Ord. No. 4765), Flood Plain Regulations (Part 2 of Zoning Ordinance).	**Hollidaysburg Borough** Subdivision and Land Development Ordinance (No. 598 and amendments), Zoning Ordinance (No. 441 and amendments), Flood Plain Management Ordinance (N0. 598 and amendments).
Blair Township Subdivision and Land Development Ordinance (Ord. No. 1983-1 and amendments), Proposed Subdivision and Land Development Ordinance, Soil Erosion, Sedimentation and Grading Ordinance (Ord. No. 1987-6) Flood Plain Ordinance (Ord. 1983-4 and amendments.	**Juniata Township** Flood Plain Management Ordinance (Ord. No. 1981-30 and amendments).

Table VII-1
Existing Relevant Ordinances
(Continued)

Municipality Relevant Ordinances	**Municipality** Relevant Ordinances
Duncansville Borough Subdivision and Land Development Ordinance (Ord. No. 1-91-1), Zoning Ordinance (No. 20), Flood Plain Ordinance (Ord. No. 10-90-2).	**Logan Township** Subdivision and Land Development Ordinance (No. 5/17/79 and amendments), Zoning Ordinance (No. 11/15/79 and amendments).
Frankstown Township Subdivision and Land Development Ordinance (No. 11-23-76 and amendments), Zoning Ordinance (No. 24 of 1965 and amendments), Flood Plain Management Ordinance (No. 8-4-81-A).	

The ordinance review determined what types of stormwater management provisions are contained in the existing ordinances and the general extent to which these provisions will have to be modified in order to accommodate implementation of the Beaverdam Branch Watershed Stormwater Management Plan. The scope of the review of existing ordinances consisted of reviewing the following general types of ordinances and regulations as they exist for each of the municipalities:

1. Subdivision and Land Development Ordinances and Regulations
2. Zoning Ordinances
3. Flood Damage Prevention Ordinances
4. Stormwater Management Ordinances

ORDINANCE MATRIX

Table VII-2 presents a municipal ordinance matrix developed for the Beaverdam Branch Watershed. This matrix contains descriptions of specific ordinance language relevant to stormwater management issues that is contained in the ordinances currently in force in each of the municipalities. The municipalities' ordinances were reviewed to determine the manner in which the following general categories of provisions related to stormwater management are addressed.

1. General land use planning standards
2. Stormwater control requirements
3. Specified runoff calculation methods
4. Design standards for stormwater controls

5. Erosion and sedimentation control requirements
6. Formal plan review process
7. Established basis for assessment of fees
8. Specified facilities inspection schedule
9. Identified maintenance provisions

The information in Table VII-2 is provided to serve as a guide to the municipalities as they take steps to incorporate the provisions recommended by this plan. Recommendations relative to methods for modifying the existing ordinances to comply with the model ordinance are provided in Section VIII.

Table VII-2
Existing Ordinance Matrix

Existing Regulatory Controls	Municipality Allegheny Township
Relevant Ordinances	Subdivision and Land Development Ordinance (No. 150-96) Proposed Stormwater Management Ordinance
Land Use Planning Standards	No local zoning ordinance.
Stormwater Controls	Section 509 of the SD/LD requires as a general standard that post-development peak runoff rates shall not exceed pre-development runoff rates for 2-, 10-, 25, and 100-year storm events. Proposed Stormwater Ordinance incorporates all control requirements as specified in the model ordinance.
Specific Calculation Method	Section 509 of the SD/LD specifies Natural Resources Conservation Service Soil Cover Complex Method and Rational Method. Proposed Stormwater Management Ordinance specifies calculation methods identified in model ordinance.
Design Standards for Stormwater Controls	Section 509 of the SD/LD contains limited design standards for stormwater controls. The proposed Stormwater Management Ordinance contains the design standards contained in the model ordinance.
Erosion / Sedimentation Controls	The SD/LD (Section 511) contains specific erosion and sedimentation control requirements.
Plan Review Process	Article III of the SD/LD Ordinance language regarding the plan submittal and review process.
Fees	Article X of the SD/LD contains provisions for charging fees.
Inspection Schedule	Section 306 of the SD/LD references to inspections as determined by the Township.
Maintenance Provisions	The proposed Stormwater Management Ordinance contains requirement for maintenance as suggested in the model ordinance.

Table VII-2
Existing Ordinance Matrix
(continued)

Existing Regulatory Controls	Municipality Altoona City
Relevant Ordinances	Subdivision and Land Development Ordinance (Ord. No 4545), Zoning Ordinance (Ord. No. 4765)
Land Use Planning Standards	Zoning Ordinance Articles IX through XVIII present standards for specific open space, residential, business, and industrial land use zones.
Stormwater Controls	The Stormwater Management Ordinance is Part 3 of the SD/LD Ordinance. Section 302 of the Stormwater Management Ordinance specifies that the post development peak discharge rate shall not exceed the pre-development rate for the 2, 10, 25, and 100 year return frequency storms. PennDOT intensity, duration, frequency curves are referenced but specific rainfall volumes are not specified. Section 401 contains an exemption for less than 4,000 sq. ft. of pervious surface is included. Allowable control techniques are listed in Section 301.
Specific Calculation Method	Section 301 of the Stormwater Management Ordinance specifies T.R. 55 for areas greater than 5 acres and rational method permitted for areas under 5 acres in size.
Design Standards for Stormwater Controls	Section 302 of the Stormwater Management Ordinance contains general design standards for stormwater facilities. Section 303 contains general design standards for stormwater collection and conveyance facilities.
Erosion / Sedimentation Controls	Erosion and sedimentation controls are contained in Part 2 of the SD/LD Ordinance.
Plan Review Process	Article IV of the Stormwater Management Ordinance outlines plan requirements and procedures.
Fees	Sections 502, 503, and 504 of the Stormwater Management Ordinance authorizes the charging of fees covering costs for plan reviews, permit issuance, and inspections.
Inspection Schedule	Section 501 of the Stormwater Management Ordinance contains a schedule of inspection at five points in the construction process.
Maintenance Provisions	Section 402 of the Stormwater Management Ordinance requires that a maintenance plan be submitted as part of the application process. Section 601 defines maintenance responsibilities and Section 602 describes required maintenance agreements for privately owned systems.

Table VII-2
Existing Ordinance Matrix
(continued)

Existing Regulatory Controls	Municipality Blair Township
Relevant Ordinances	Subdivision and Land Development Ordinance (Ord. No. 1983-1 and amendments), Proposed Subdivision and Land Development Ordinance, Soil Erosion, Sedimentation and Grading Ordinance (Ord. No. 1987-6), Flood Plain Ordinance (Ord. No. 1983-4 and amendments).
Land Use Planning Standards	No local zoning ordinance.
Stormwater Controls	Section 12 of Soil Erosion, Sedimentation and Grading Ordinance prohibits modifying, filling, excavating, paving, grading, or regrading land without protecting adjacent property or street from flooding. Existing SD/LD Ordinance requires that proposals for disposing with surface water shall meet the standards of the Blair County Conservation District. Sections 509 and 602 of the proposed SD/ LD states that developments creating surface changes in excess of 5,000 sq. ft. shall prepare and submit a stormwater management plan in accordance with the Beaverdam Branch Watershed Stormwater Management Plan and any Township stormwater management ordinance.
Specific Calculation Method	None
Design Standards for Stormwater Controls	General standards for drainage facilities contained in Section 509 of the proposed SD/LD Ordinance.
Erosion / Sedimentation Controls	Requirements specified in Soil Erosion, Sedimentation Ordinance. Section 551 of the proposed SD/LD ordinance requires that erosion and sedimentation control plans be developed in accordance with DEP's Chapter 102 regulations.
Plan Review Process	Article 200 of the existing SD/LD Ordinance contains general language regarding plan review procedures. Article III of the proposed SD/LD Ordinance outlines the plan review process.
Fees	Article X of the proposed SD/LD Ordinance provides for charging fees as established by the Township.
Inspection Schedule	No inspection schedule defined.
Maintenance Provisions	No specific maintenance provisions.

Table VII-2
Existing Ordinance Matrix
(continued)

Existing Regulatory Controls	Municipality Duncansville Borough
Relevant Ordinances	Subdivision and Land Development Ordinance (Ord. No. 1-91-1), Zoning Ordinance (No. 20), Flood Plain Ordinance (Ord. No. 10-90-2).
Land Use Planning Standards	Zoning Ordinance Article V, VI, VII, VIII, and IX present standards for specific agricultural, residential, commercial, and manufacturing districts. Planned unit development applications are permitted under Zoning Article II, Paragraph G. This paragraph requires information concerning stormwater disposal. Flood Plain Ordinance regulates uses, activities, and development in flood plains.
Stormwater Controls	SD/LD Paragraph 509.1 requires that Stormwater management controls be provided to: permit unimpeded flow of natural watercourses, ensure adequate drainage of low points along streets, intercept runoff along streets, provide positive drainage, lead water from springs, preserve existing nature drainage systems, encourage natural infiltration, and manage runoff in accordance with any stormwater management plan adopted pursuant to Act 167. SD/LD Paragraph 509.2 specifies that maximum rate of stormwater runoff is no greater after development than prior to development activities or otherwise protect health and property (general Act 167 language). Section 8.02 of the Flood Plain Ordinance requires proper drainage consistent with local and regional drainage plans. Facilities shall be designed to prevent discharge of excess runoff onto adjacent properties.
Specific Calculation Method	SD/LD Paragraph 509.5 specifies the use of the SCS TR-55 method or the Rational method for sites less than one acre.
Design Standards for Stormwater Controls	SD/LD Paragraph 509.5 requires the control of the peak rate of stormwater discharge for a range of storms from 2- to 100-year storms, with design storms determined by applicant's engineer in consultation with Borough Engineer. SCS Type II storm distribution shall be used. SD/LD Paragraphs 509.6 and 509.7 contain stormwater detention facility and conveyance facility general design standards.
Erosion / Sedimentation Controls	SD/LD Section 510 contains requirements for erosion and sedimentation controls.
Plan Review Process	Part 3 of the Subdivision and Land Development Ordinance outlines plan submission and review procedures.
Fees	Schedule of fees is authorized under SD/LD Section 703.
Inspection Schedule	SD/LD Section 603 requires inspection of improvements in accordance with an inspection schedule contained in developer's agreement.
Maintenance Provisions	SD/LD Section 606 contains requirements for dedication of facilities and maintenance bonds in the form and amount approved by the Borough Solicitor.

Table VII-2
Existing Ordinance Matrix
(continued)

Existing Regulatory Controls	Municipality Frankstown Township
Relevant Ordinances	Subdivision and Land Development Ordinance (No. 11-23-76 and amendments), Zoning Ordinance (No. 24 of 1965 and amendments), Flood Plain Ordinance (No. 8-4-81-A).
Land Use Planning Standards	Articles III, IV, and V present standards for residential, diverse residential, and manufacturing-farming land uses. The Flood Plain Ordinance regulates uses, activities, and development in flood plains.
Stormwater Controls	Section 505 of the SD/LD Ordinance requires that all sites limit the rate of stormwater runoff to no greater than the pre-development rate for the 2, 10, 25, and 100 year frequency storms. Minimum storage capacity for the stormwater management system shall be that required to accommodate a post-development 25-year , 24-hour frequency storm to be released at a rate not to exceed the pre-development 10-year, 24-hour discharge. More stringent criteria may be required in sensitive areas where stormwater problems presently exist.
Specific Calculation Method	Section 505 of the SD/LD specifies use of the Soil Conservation Service Soil-Cover Complex methods.
Design Standards for Stormwater Controls	Section 505 of the SD/LD requires that detention ponds and retention basins be designed in accordance with the "Standard Specifications for Ponds," Service Manual, USDA.
Erosion / Sedimentation Controls	Section 507 of the SD/LD requires an approved sedimentation control plan.
Plan Review Process	Part 3 of the SD/LD outlines the plan review and approval process.
Fees	Section 302 authorizes charging a filing and review fees.
Inspection Schedule	No specific inspection schedule.
Maintenance Provisions	Maintenance issues not specifically addressed.

Table VII-2
Existing Ordinance Matrix
(continued)

Existing Regulatory Controls	Municipality Freedom Township
Relevant Ordinances	Subdivision and Land Development Ordinance (No. 1987-1 and amendments), Stormwater Management Ordinance (No. 1991-2), Flood Plain Management Ordinance (No. 1975-2 and amendments).
Land Use Planning Standards	No local zoning ordinance.
Stormwater Controls	Section 302 of the Stormwater Management Ordinance requires that the post-development peak discharges not exceed the pre-development peak discharge rates for the 2, 10, and 25 year storms.
Specific Calculation Method	Section 302 of the Stormwater Management Ordinance requires use of TR-55 or modified rational method.
Design Standards for Stormwater Controls	Section 302 of the Stormwater Management Ordinance requires use of basic SCS design criteria
Erosion / Sedimentation Controls	Not specifically addressed.
Plan Review Process	Sections 402, 403, 404, and 405 of the Stormwater Management Ordinance describe plan submission and review procedures.
Fees	Article VI of the Stormwater Management Ordinance authorizes charging fees for plan review and inspection.
Inspection Schedule	Article V of the Stormwater Management Ordinance outlines an inspection schedule.
Maintenance Provisions	Article VII of the Stormwater Management Ordinance describes maintenance responsibilities.

Table VII-2
Existing Ordinance Matrix
(continued)

Existing Regulatory Controls	Municipality Hollidaysburg Borough
Relevant Ordinances	Subdivision and Land Development Ordinance (No. 598 and amendments), Zoning Ordinance (No. 441 and amendments), Flood Plain Management Ordinance (N0. 598 and amendments).
Land Use Planning Standards	Part 2 of the Zoning Ordinance presents standards for specific residential, business, commercial, industrial, and special districts.
Stormwater Controls	Section 509 of the SD/LD Ordinance limits the peak rates of discharge from sites to 75% of the pre-development rates for the 2, 10, 25, and 100 year 24-hour storm events. Specific storm volumes area defined.
Specific Calculation Method	Section 509 of the SD/LD Ordinance specifies computational methods consistent with the Beaverdam Branch Stormwater Management Plan recommendations.
Design Standards for Stormwater Controls	Section 509 of the SD/LD Ordinance presents design criteria for stormwater management controls per recommendations of the Beaverdam Branch Stormwater Management Plan.
Erosion / Sedimentation Controls	Section 509 of the SD/LD Ordinance requires submittal of erosion / sedimentation control plan in accordance with DEP regulations and requirements of the Blair County Conservation District.
Plan Review Process	Section 509 of the SD/LD Ordinance describes the plan review process and requirements.
Fees	Part 7 of the SD/LD Ordinance authorizes charging fees
Inspection Schedule	Part 6 of the SD/LD Ordinance describes inspection requirements.
Maintenance Provisions	Maintenance responsibilities for stormwater management controls are outlined in Section of the SD/LD Ordinance.

Table VII-2
Existing Ordinance Matrix
(continued)

Existing Regulatory Controls	Municipality
	Juniata Township
Relevant Ordinances	Flood Plain Management Ordinance (Ord. No. 1981-30 and amendments).
Land Use Planning Standards	No local zoning ordinance.
Stormwater Controls	None
Specific Calculation Method	None
Design Standards for Stormwater Controls	None
Erosion / Sedimentation Controls	None
Plan Review Process	None
Fees	None
Inspection Schedule	None
Maintenance Provisions	None

Table VII-2
Existing Ordinance Matrix
(continued)

Existing Regulatory Controls	Municipality Logan Township
Relevant Ordinances	Subdivision and Land Development Ordinance (No.5/17/79 and amendments), Zoning Ordinance (No. 11/15/79 and amendments).
Land Use Planning Standards	Parts 4, 5, 6, 7, 8, and 9 present standards for specific agricultural, residential, business, and industrial districts.
Stormwater Controls	Part 3, Paragraph IV of the SD/LD Ordinance requires that sites must limit the rate of runoff to no greater than the pre-development rate for the 2, 10, 25, 50 and 100 year storm events
Specific Calculation Method	Part 3, Paragraph IV of the SD/LD Ordinance specifies the use of USDA Soil Conservation Service Soil-Cover Complex Methods or other methods approved by the Township.
Design Standards for Stormwater Controls	Part 3, Paragraph IV of the SD/LD Ordinance requires that stormwater management facility construction conform to PaDOT specifications and RC Standards.
Erosion / Sedimentation Controls	Part 3, Paragraph 302 of the SD/LD Ordinance requires a erosion and sediment control plan approved by the Blair County Conservation District.
Plan Review Process	Part 3, Paragraph 302 of the SD/LD Ordinance describes the plan review process.
Fees	Part 3, Paragraph 308 of the SD/LD Ordinance authorizes charging review fees.
Inspection Schedule	Part 3, Paragraph 304 of the SD/LD Ordinance describes a schedule for inspecting streets. Inspection of stormwater facilities not specifically reference.
Maintenance Provisions	Maintenance issues not specifically addressed.

Figure VII-1 contains information that indicates the extent to which the required stormwater management elements are contained in the ordinances currently in force in each municipality. As the matrix indicates, six of the municipalities currently have provisions in effect that directly relate to specific requirements for the control of stormwater and the design of stormwater management facilities. However, in most cases, the municipal ordinances do not adequately address stormwater control issues. In all cases, amendments to the current ordinance packages will be required to implement the stormwater management plan. Specific information describing the desired content of the municipal ordinances is provided in Section VIII of the Plan.

Figure VII-1
Tabulation of Key Ordinance Provisions

Beaverdam Branch Watershed Matrix of Stormwater Ordinance Provisions

Municipality	General Runoff Control Standards	Design Storm Criteria	Runoff Calculation Method	Conveyance System Design Standards	Infiltration System Design Standards	Detention Facility Design Standards	Plan Submission Requirements	Plan Review Procedures	Maintenance Provisions	Inspection Schedule	Permitting Fees
Allegheny Township	Proposed Ordinance Contains Model Ordinance Provisions										
Altoona City	●	⊕	●	●	○	⊕	●	●	●	●	●
Blair Township *	◐	○	○	◐	○	○	⊕	⊕	○	○	○
Duncansville Borough	●	⊕	●	●	○	⊕	●	●	●	●	●
Frankstown Township	⊕	⊕	●	◐	○	◐	●	●	○	○	●
Freedom Township	⊕	◐	●	◐	◐	◐	●	●	●	●	●
Hollidaysburg Borough	●	●	●	●	●	●	●	●	●	●	●
Juniata Township	○	○	○	○	○	○	○	○	○	○	○
Logan Township	⊕	⊕	●	◐	○	◐	●	●	○	○	●

○ Topic not mentioned in ordinance - will require addition

⊕ Topic contained in ordinance but some modifications will be required

◐ Topic contained in ordinance but significant modifications will be required

● Topic well covered in ordinance and will require minimal modification

Note: *refers to existing ordinances.

BEAVERDAM BRANCH WATERSHED
STORMWATER MANAGEMENT PLAN
SECTION VIII
INSTITUTIONAL AND REGULATORY REQUIREMENTS

INTRODUCTION

The purpose of stormwater management is to control surface drainage, flooding, soil erosion and to a certain extent, pollutants in stormwater runoff. In Pennsylvania, stormwater management is regulated on a watershed-wide basis by the terms and provisions of Act 167, The Storm Water Management Act. The primary objective of the Act is to prevent or mitigate potential adverse impacts from increased runoff by making those altering land responsible for safely managing the stormwater runoff resulting from their activities. Also, as part of the prevention efforts, the Act requires counties to prepare stormwater management plans for each state designated watershed within their jurisdiction; subsequent land development must include stormwater management measures that are consistent with the county plans to assure that stormwater problems are not created or worsened in the watershed.

WATERSHED STORMWATER MANAGEMENT PLAN IMPLEMENTATION

The process for adopting a watershed stormwater management plan as required by Act 167, includes the following steps:

Planning

The county's responsibility for developing a watershed plan includes the preparation of a planning program and the establishment of an advisory committee composed of representatives of each municipality within the watershed and the conservation district.

Review

The county's watershed plan must be reviewed by the advisory committee, the planning commission and governing body of each municipality within the watershed, and county and regional planning agencies.

Adoption

Once a plan has been prepared, the county must schedule public hearings with public notice, prior to adoption of the plan by a majority vote of the county governing body.

Approval

The watershed stormwater plan must be submitted to the Pennsylvania Department of Environmental Protection (DEP) for approval. DEP has ninety (90) days to review the plan using the following criteria:

1. Is it consistent with flood plain management plans, flood control programs, and dams and encroachment regulations?
2. Is it compatible with the stormwater management plans of other watersheds in the basin?
3. Is it compatible with the purposes and policies of Act 167?

Implementation

Within six (6) months of the watershed plan's adoption and approval, Act 167 requires each municipality within the watershed to adopt and implement ordinances which "regulate development within the municipality in a manner consistent with the provisions of the Act." Penalties for failure to adopt such ordinances are included in Section 12 of the Act. These penalties consist of withholding payments of all funds payable to the municipality from the Commonwealth of Pennsylvania's General Fund.

The Act emphasizes the importance of local support for the watershed plan and recognizes the ability of the municipalities to use their police powers to enforce the plan and assure safe stormwater management in the watershed.

STORMWATER MANAGEMENT FUNCTIONS

The stormwater activities necessary to implement the plan are implied by Section 11 of Act 167 and by the watershed stormwater management plan itself. Municipal ordinances that satisfy these requirements must provide for the various stormwater activities or functions. However, not all of these activities must be performed by the municipality; the county planning agency, the county conservation district and other private and public sector organizations can participate in stormwater management throughout the watershed.

Before presenting an analysis of a model ordinance, the stormwater functions must be reviewed. Stormwater management consists of the following key functions:

- Planning (watershed plan updates)
- Development Regulations (site plan review and approval)
- Construction
- Inspection
- Maintenance
- Financing
- Monitoring and Enforcement
- Information and Education

Planning

Act 167 requires watershed stormwater plans to be reviewed, revised and updated at least every five years. In order to perform this task, the database on stormwater facilities within the watershed that had been developed for the initial plan should be maintained. Another aspect of the planning function should be the coordination of the stormwater management plan with other functional type plans that are required for development in the watershed, i.e. land use plans, recreation plans, etc.

Development Regulation

Stormwater facilities and construction practices must comply with the standards and criteria established in the watershed stormwater management plan. The municipalities must adopt and enforce ordinances to implement these standards and criteria, and apply them to all types of development activity to assure compliance with the stormwater plan. For example, subdivision plans that are routinely reviewed by the local and county planning agencies, must also be reviewed and approved for compliance with the stormwater plan.

Other regulatory activities that could be undertaken as part of this stormwater management function include: a review of site development plans to assure that erosion and sedimentation plans and/or permits are in place and a review of all public

improvement projects to assure their compliance with the standards and criteria of the watershed stormwater management plan.

Construction

This function includes providing private developers with the specifications for construction of stormwater facilities, and assuring that publicly-built stormwater control facilities are designed and constructed in conformance with the standards and criteria of the watershed plan. Also, coordination with other public agencies involved in the construction of stormwater-related structures, such as flood control projects, is necessary to assure consistency with the watershed plan.

Inspection

From preliminary site preparation through completion of final grading of a development, it is important that stormwater controls be inspected regularly. To satisfy this requirement, it is necessary that inspectors have the legal right of entry onto private property and the right to stop work if soil conditions are different from the plan application or if stormwater controls are not being built in accordance with the standards and criteria of the watershed plan. This stormwater management function can be broadened to include the scheduling of inspections of stormwater facilities annually, or after a major storm event.

Maintenance

Stormwater maintenance includes such tasks as clearing debris from detention ponds, cleaning catch basins, dredging creeks and repairing stream embankments. Provisions to perform this task vary according to ownership and responsibility for maintenance of stormwater control facilities. Publicly owned facilities require ongoing maintenance; formal agreements may be executed to assure maintenance of privately owned stormwater control facilities; coordination with state agencies may be necessary to be sure that state-owned stormwater control structures (i.e., culverts, bridges) are adequately maintained; services may be provided by contract for the maintenance of both public and private facilities within the watershed.

Financing

This function includes such items as funding for the costs associated with the administration of the stormwater ordinances, inspections and maintenance, ongoing

planning and monitoring of stormwater facilities, and long-term financing for the construction of any public stormwater control facilities.

In the past, the financial burden for stormwater control rested with the local municipality, the private developer and the new user or property owner. More recently, however, stormwater runoff has been viewed as a concern of all the municipalities, developers and users within the watershed, and stormwater management has been viewed as a watershed-wide responsibility. This approach to the management of stormwater runoff would ensure the consistent implementation of the plan throughout the watershed and would allocate the management costs in an equitable manner throughout the watershed as well.

Monitoring and Enforcement

This is a police function that is essential to any stormwater management program. The municipalities can exercise their police powers to take a variety of enforcement actions, such as fines, the use of permits, court actions and civil penalties. With regard to enforcement of erosion and sedimentation controls, the County Conservation District and DEP have the power to enforce compliance with state regulations.

Information and Education

In order to prepare specifications and review site development plans for consistency with the standards and criteria of the watershed stormwater management plan, municipal officials must have a working knowledge of the technical aspects of the Plan. Similarly, information regarding the stormwater plan and stormwater control facilities should be available to private developers. Workshops, seminars and well-informed agency staff can perform this stormwater management function.

RECOMMENDATIONS FOR PERFORMING THE MANAGEMENT FUNCTIONS

Local municipalities are vested with the primary responsibility for the administration and enforcement of stormwater management ordinances and regulations, including plan review and approval; inspections; and either performing or requiring the performance of routine maintenance. Blair County's role in stormwater management will consist of the completion of stormwater management planning in other designated watersheds in Blair County and the completion of stormwater management plan updates as required by Act 167.

STORMWATER MANAGEMENT ORDINANCES

The Stormwater Management Act recognizes that the alteration of land may increase the rate of runoff, and accelerated runoff must be controlled to prevent downstream flooding, siltation and other water related damage. Section 13 of the Act makes those altering land, whether public or private entities, responsible for managing any increased runoff resulting from their activities. Since Pennsylvania's local municipalities have almost exclusive control over land use and development activities, Section 11 of the Act assigns them the responsibility of regulating development consistent with the watershed stormwater plan.

The approach recommended by this Plan, consistent with Act 167, is for municipalities to adopt regulations to minimize the potential for future stormwater problems from private land development as well as from public improvement projects.

In order to implement the standards and criteria of the Beaverdam Branch Watershed Stormwater Management Plan, the municipal ordinances must contain certain key provisions. These include the following items:

- Storm frequencies
- Control standard
- Method of calculation
- Control techniques
- Site plan requirements
- Plan review procedures
- Continuing maintenance agreements
- Fees
- Enforcement remedies and penalties

Storm Frequencies or Control Storms

The design frequency criteria developed in the watershed plan refers to the peak rates of discharge for which the components of drainage systems are designed, i.e., the 2-, 10-, 25- and 100-year storms. Typical criteria require stormwater facilities to manage the

runoff in such a manner that the discharge from new development will maintain the pre-development discharge level.

The design frequency criteria that is developed as part of the watershed plan must be implemented by the municipalities as a provision of their stormwater management ordinances.

Control Standard

The basic control standard to be applied throughout the Beaverdam Branch Watershed is that the peak rate of stormwater discharge from a development site shall not exceed the peak rate of discharge that occurred prior to the development activities.

Method of Calculation

The ordinance must prescribe the acceptable calculation methods for use in determining storm water runoff. To maintain a uniform, watershed-wide approach, the following methods have been stipulated in the standards and criteria of the watershed plan: SCS TR-55 and TR-20, HEC-1, the Penn State Runoff Model and the Modified Rational Method.

Control Techniques

Each developer must select the technique or combination of techniques that are most appropriate to the site. In order to make these selections, the developer may be required to perform soil or geotechnical investigations. It is important to encourage the developer to utilize the techniques that reduce runoff volume and promote ground water discharge. Therefore, in selecting control techniques the developer should be encouraged to first apply all suitable techniques that can avoid the increase in runoff. These include efficient site development plans in terms of the amount of impervious surfaces that are created (clustering, etc.), the use of porous pavements, and the application of other runoff controls that promote infiltration. Once these methods are incorporated to the maximum feasible extent, then flow attenuation methods using of vegetated swales and natural depressions should be applied before finally utilizing stormwater retention/detention facilities.

The watershed plan includes a section on the possible infiltration techniques and the developer will have to justify the rejection of each practice based on site conditions. The

municipal stormwater management ordinance should also contain certain design performance standards for retention and detention facilities.

Site Plan Requirements

Local ordinances should precisely describe site plan submission requirements for stormwater management. For example, the ordinance should require stormwater plans to be prepared by a registered professional, engineer, surveyor or landscape architect, and should set forth the content and form of information that must be included on the plan. Generally, the stormwater plan submission will be made in two stages: preliminary and final. The local ordinances should also identify specific activities that are exempted from plan preparation and submission requirements.

Plan Review Procedures

Ordinarily, all stormwater plans will be submitted to the local municipality as part of the overall development plan application.

Continuing Maintenance Agreements

As a condition of stormwater plan approval, the developer must submit a maintenance plan for all proposed stormwater control facilities. This maintenance plan is necessary regardless of whether the facilities will be publicly or privately owned. The maintenance plan should indicate the proposed ownership arrangement, the type and frequency of required maintenance activities, personnel and equipment necessary for adequate maintenance, the estimated annual cost, and the method of financing the cost of maintenance and a signed maintenance agreement if the facilities will be privately owned. The plan must be approved by the municipal engineer and governing body.

In addition to the maintenance plan and agreement, the municipal ordinances should also provide for the submission of construction or performance bonds and maintenance bonds consistent with the Pennsylvania Municipalities Planning Code. The ordinances may also establish a system of financing maintenance activities through a special fund. In the case of privately owned facilities, the ordinance may require developers to deposit fees to cover municipal inspections for a stated period of time (i.e., 10 years).

Fees

The municipal ordinances may provide for the adoption of a fee schedule to cover the cost of administering the stormwater program and implementing the requirements of the ordinance. A system of flat fees or direct reimbursement for costs may be imposed if consistent with the Pennsylvania Municipalities Planning Code. Municipalities may also be able to be reimbursed for some of their administrative costs through the Pennsylvania Department of Environmental Protection under the terms of Act 167.

Inspections

The ordinance should include a schedule for periodic inspections of stormwater facilities during the course of construction to assure that they are installed as specified in the approved stormwater plan application.

Enforcement, Remedies, and Penalties

In order to enforce the provisions of the stormwater management ordinance, municipalities may incorporate into the ordinance remedies and penalties similar to those prescribed by the Pennsylvania Municipalities Planning Code for violations of zoning, subdivision and land development, or other municipal codes.

Municipalities can also utilize the enforcement remedies of Act 167, whereby action to enforce the provisions of the watershed plan or the stormwater management ordinance can be instituted by the municipality or any "aggrieved person."

MODEL STORMWATER PROVISIONS

Introduction

The model ordinance provisions presented in Appendices A, B, and C provide a guide for constructing a workable regulatory approach using the legal authorities established by the Pennsylvania Municipalities Planning Code which enables local governments to adopt and enforce zoning and subdivision and land development ordinances. Appendix A contains a model ordinance structured as a separate stormwater management ordinance. Appendix B contains a model ordinance structured in a format compatible with being adopted as an element of a subdivision and land development ordinance. Appendix C contains a model amendment to a zoning ordinance.

It is anticipated that the municipalities will select the approach to use (either the separate standalone ordinance or provisions of a Subdivision and Land Development ordinance) based upon the type of the ordinances that are currently in place as well as local preferences. General recommendations regarding implementation in each municipality are offered at the end of this section.

General Objectives for Ordinance Provisions

Before concluding this section on model stormwater ordinances, some general comments on ordinance drafting may be helpful. From meetings with local officials, developers and builders, it is clear that all parties are concerned with implementing a successful regulatory effort with respect to a complex issue like stormwater management. Therefore, it is essential that the stormwater management ordinances must be:

- clear (understandable) and readily obtainable.
- flexible (encourage creative solutions to stormwater problems).
- uniform throughout the area.

Clarity is very important both for the technical and engineering requirements, as well as for administrative processes. Developers should be able to obtain copies of all applicable ordinances, and they should be able to determine what is expected of them. Similarly, municipalities should be clear about what their ordinances mean and what they want developers to do. Vague, general or complex ordinances usually only result in legal problems (and costs) for all involved entities.

Flexibility in stormwater management is extremely important. Since it is impossible to write an ordinance that will apply equally to all sites and conditions, the municipality will want to encourage developers to seek solutions that best fit their site, while meeting the objectives of the stormwater plan. Whenever possible, ordinances should use incentives to encourage good stormwater management practices rather than negative regulations. Both developer and municipality will profit when the most technically feasible and economically efficient approaches are applied.

Flexibility in stormwater management can best be obtained by using a performance standard approach in the municipal regulations, as recommended in this study. A

performance standard states an end result or outcome which is to be achieved but does not prescribe specific means for achieving it. In contrast, a specification standard specifies the exact characteristic or design standard to be used. The release rate percentage is an example of a performance standard, while a standard for the maximum percent of impervious surface per lot is a specification standard.

Finally, ***uniformity*** of the regulatory measures will be essential within the watershed. Each municipality cannot adopt a different approach and set of technical standards. Ordinances must be compatible with one another and with the watershed plan, or the result may be even a greater potential for flooding and stormwater damage to downstream communities. A uniform approach has several other advantages. Municipalities can reduce costs by joint administration of the stormwater portions of their ordinances. This more efficient administration can also translate into cost savings for developers. With today's high cost of financing, unnecessary administrative delays for development reviews and inspections can add substantially to project costs.

A uniform system of stormwater regulations will make it easier for developers to know what is expected of them. Also, it minimizes the potential for unfair competition resulting from situations where one developer is required to provide only minimal stormwater controls, while another in a neighboring municipality must invest substantially more to meet the ordinance standards.

RECOMMENDED ORDINANCE ADOPTION PROCEDURES

The method used to adopt the necessary ordinance provisions should be selected by each municipality based upon the recommendations of their solicitor. However, the it is recommended that the methods listed in Table VIII-1 be considered for use in adopting the necessary ordinance provisions.

The model stormwater management ordinances contain a number of articles or sections that contain recommendations relative to content and language. Much of the model ordinance is presented as guidance to the municipalities and can be modified to comply with local preferences and current practices. However, in order to accomplish the goals of Act 167 and the watershed stormwater management plan, it is important that the specific language of the following key sections of the model ordinances be adopted essentially verbatim:

- General Provisions

- Stormwater Management Performance Standards
- Stormwater Plan Requirements - General Exemptions
- Stormwater Plan Requirements - Exemptions

The portions of the model ordinances listed define the types of activities for which stormwater controls are required and define the specific stormwater control standards to be met. The general content of the other portions of the model ordinances should be included in the municipalities' ordinances; however, there is a greater opportunity for customizing these sections to satisfy local preferences and procedures while accomplishing the overall goals of this plan.

Table VIII-1
Recommended Ordinance Adoption Options

Status of Current Ordinances	Municipalities in this Category	Recommended Actions
Existing zoning ordinance and subdivision and land development ordinance in effect	City of Altoona Borough of Duncansville Borough of Hollidaysburg Township of Franklin Township of Logan	Amend the existing zoning ordinance **and** the subdivision and land development ordinance using the *Model Stormwater Management Provisions for the Municipal Zoning Ordinance* **and** *Model Stormwater Management Provisions for Municipal Subdivision/Land Development Ordinance* (Appendicies B and C, respectively). **OR** Adopt the *Model Stormwater Management Provisions for Stormwater Management Ordinance* (Appendix A) as stand alone ordinance **and** place explicit references to this ordinance in the existing zoning ordinance and subdivision and land development ordinance.
Existing subdivision and land development ordinance is in effect, but no zoning ordinance has been enacted	Township of Allegheny Township of Blair Township of Freedom	Amend the existing subdivision and land development ordinance using the *Model Stormwater Management Provisions for Municipal Subdivision/Land Development Ordinance* (Appendix B). **OR** Adopt the *Model Stormwater Management Provisions for Stormwater Management Ordinance* (Appendix A) **and** place an explicit reference to this ordinance in the existing subdivision and land development ordinances.

BEAVERDAM BRANCH WATERSHED
STORMWATER MANAGEMENT PLAN
SECTION IX
IMPLEMENTATION, ADOPTION AND UPDATING

PRIORITIES FOR IMPLEMENTATION

Introduction

The plan has been prepared in order to present the mechanisms through which the requirements of Act 167 can be met throughout the watershed. The specific standards and criteria presented in this plan have been developed to represent a rationally derived set of requirements which must be satisfied by land developers in order to protect downstream persons and/or properties from damage from stormwater runoff originating at the development site. The measures to be taken by the developers include such actions as are required by Section 13 to:

1. assure that the maximum rate of stormwater runoff is no greater after development than prior to development activities; and
2. manage the quantity, velocity and direction of resulting runoff in a manner which otherwise adequately protects health and property from possible injury.

This plan also contains recommendations relative to the roles to be played by the various governmental agencies in the watershed and presents specific ordinance provisions recommended for inclusion in local municipal ordinances. These recommendations are presented in order to assist local governments in fulfilling their mandated role in the administration of stormwater management requirements within the watershed. Since Act 167 places the ultimate responsibility for implementation and on-going administration and enforcement of stormwater management requirements in the hands of the local municipalities, each of the municipalities in the watershed will be involved in plan implementation.

The Beaverdam Branch Watershed Stormwater Management Plan preparation process is complete with the Blair County Commissioners' adoption of the Plan and submission of the Plan to DEP for approval. Subsequent activities necessary to carry out the provisions of the Plan are considered by DEP to be part of the implementation of the Plan. The initial step in Plan implementation is DEP approval. Plan approval sets in motion the mandatory schedule of adoption of municipal ordinance provisions to implement the

stormwater management standards and criteria. The Blair County watershed municipalities will have six (6) months from the date of DEP approval within which to adopt the necessary ordinance provisions. Failure to do so could result in the withholding of all state funds to the municipality per Act 167.

Additional implementation activities are the development of a local program to coordinate DEP Chapter 105 and 106 permit application reviews and the development of a systematic approach for the correction of storm drainage problem areas.

County Plan Adoption

Formal adoption of the Plan is the responsibility of Blair County. Under the requirements of Act 167, prior to the adoption of the Plan, the County will hold a public hearing pursuant to public notice of not less than two (2) weeks prior to the hearing date. Act 167 also stipulates that adoption of the Plan must be by a resolution carried by an affirmative vote of at least a majority of the members of County Council. The resolution must refer expressly to the plan and all associated maps, charts and textural materials.

DEP Approval of the Plan

Upon adoption of the watershed plan by the County, the Plan is submitted to DEP for approval. The DEP review process involves the determination that all of the activities specified in the approved Scope of Work have been satisfactorily completed in the Plan. Further, DEP will only approve the Plan if it determines the following:

1. That the Plan is consistent with municipal flood plain management plans, State programs which regulate dams, encroachments and other water obstructions and State and Federal flood control programs; and
2. That the Plan is compatible with other watershed stormwater plans for the basin in which the watershed is located and is consistent with the policies and purposes of Act 167.

DEP action to either approve or disapprove the Plan must take place within ninety (90) days of receipt of the Plan by DEP. Otherwise, the Plan would be approved by default. If the plan is initially disapproved by DEP it must be revised as necessary to secure approval and resubmitted to DEP.

Municipal Adoption of Ordinance Provisions to Implement the Plan

The key ingredient for implementation of the Plan is the adoption of the necessary ordinance provisions by the Beaverdam Branch watershed municipalities. Model ordinance provisions to be used by the municipalities as a guide to modifying their ordinances are provided as part of the Plan (Appendices B, C, and D

Development of a Local Program to Coordinate With DEP Regarding Chapter 105 and 106 Permit Application Reviews

Stream encroachments, stream enclosures, waterway diversions and other activities regulated by Chapters 105 and 106 of DEP's Rules and Regulations may have a bearing on the effectiveness of the runoff control strategy developed for the Beaverdam Branch watershed. Activities of these types may modify the conveyance characteristics of the watershed and, thereby, impact the relative timing of watershed peak flows and/or the ability of the conveyance facilities to safely transport peak flows. Therefore, to ensure that the DEP permitting process is consistent with the adopted and approved watershed plan, a local review of Chapter 105 and 106 applications should be coordinated with the DEP review process.

Development of a Systematic Approach for the Correction of Storm Drainage Problems

Correction of storm drainage problem areas in the watershed is not specifically part of the Act 167 planning process. However, the development of a watershed plan has provided a framework for the correction of problems because: (1) existing storm drainage problems have been identified; (2) implementation of the runoff control criteria specified in this Plan should prevent the existing drainage problems from becoming worse; and (3) the hydrologic model developed to formulate the runoff control criteria could be used as an analytical tool for identifying engineering solutions to major drainage problems.

Another way in which the completion and implementation of this plan can be of assistance in addressing storm drainage problems is by opening the avenue of funding assistance through the PENNVEST program. The PENNVEST Act of 1988, as amended, provides low interest loans to governmental entities for the construction, improvement or rehabilitation of stormwater projects including the transport, storage and infiltration of

stormwater and best management practices to address point or non-point source pollution associated with stormwater.

In order to qualify for a loan under PENNVEST, the municipality or county:

1. must be located in a watershed for which there is an existing county adopted and DEP approved stormwater plan with enacted stormwater ordinances consistent with the plan or,
2. must have enacted a stormwater control ordinance consistent with the Storm Water Management Act.

With the above in mind, the Beaverdam Branch Area watershed municipalities should include the following steps in any efforts to implement solutions to significant storm drainage problems:

1. Prioritize storm drainage problems within the municipality based upon frequency of occurrence, potential for injury to persons or property, damage history, public perception of the problems and other appropriate criteria.
2. For the top priority drainage problems in the municipality, conduct detailed engineering evaluations to determine the exact nature of the problems, determine alternative solutions, provide cost estimates for the alternative solutions, and recommend a course of municipal action. The number of drainage problems to be evaluated by a municipality as a first cut from the priority list should be based on a schedule commensurate with completing engineering studies on all problem areas The engineering studies must include consideration of the downstream effects of eliminating specific drainage problems so as to avoid the transfer of problems progressively downstream.
3. On a priority and cost basis, incorporate implementation of recommended solutions to the drainage problems in the annual municipal capital or maintenance budgets as funds are available. Funding investigations should consider available funding assistance programs and joint municipal project implementation.

The procedure outlined above for dealing with storm drainage problems is not a mandatory action placed on the municipalities with the adoption of this Plan. Rather, it represents a systematic method for approaching the problems uniformly throughout the watershed in an attempt to improve the current runoff situation in the basin. The key elements involved in the success of the remedial strategy will be the ability of the municipalities to construct any required corrective measures and the consistent and proper application of the runoff control standards and criteria specified in this Plan. The

latter element is essential to ensure that remedial measures do not become obsolete (under-designed) by increases in peak flows as a consequence of development activities.

PLAN UPDATING

Schedule for Plan Updating

Under the requirements of Act 167, this Plan should be updated at intervals not exceeding five (5) years. More frequent updating of this plan may be warranted if significant changes in the watershed occur sooner. Factors which would warrant an update prior to the statutory date may include the following:

1. Changes to major stream segments or primary stormwater conveyance elements occur which serve to affect watershed hydraulics such that the potential for damage is materially.

2. Peculiarities in the application of specific standards and criteria are experienced which interfere with the effective and equitable administration of the Plan requirements.

All of the involved agencies (county, municipalities, and DEP) should monitor conditions in the watershed. In the event that any of the above listed conditions (or others) arise, the county should proceed with updating this Plan as warranted.

Appendix A
Model Separate Stormwater Management Ordinance

This model stormwater management ordinance contains a number of articles or sections that contain recommendations relative to content and language. Much of the model ordinance is presented as guidance to the municipalities and can be modified to comply with local preferences and current practices. However, in order to accomplish the goals of Act 167 and the watershed stormwater management plan, it is important that the specific language of the following key sections of the model ordinance be adopted essentially verbatim:

- **General Provisions**
- **Stormwater Management Performance Standards**
- **Stormwater Plan Requirements - General Exemptions**
- **Stormwater Plan Requirements - Exemptions**
-

The portions of the model ordinance listed define the types of activities for which stormwater controls are required and define the specific stormwater control standards to be met. The general content of the other portions of the model ordinance should be included in the municipalities' ordinances; however, there is a greater opportunity for customizing these sections to satisfy local preferences and procedures while accomplishing the overall goals of this plan.

MODEL STORMWATER MANAGEMENT PROVISIONS FOR STORMWATER MANAGEMENT ORDINANCE

ARTICLE I
GENERAL PROVISIONS

Section 101 - Purpose

These regulations have the following general purposes and objectives:

1. To assure safe management of stormwater runoff resulting from land alteration and disturbance activities in accordance with watershed stormwater management plans adopted pursuant to the Pennsylvania Storm Water Management Act (Act 167 of 1978, as amended).

2. To utilize and preserve the existing natural drainage systems and to preserve the flood-carrying capacity of streams.

3. To encourage natural infiltration of rainfall to preserve groundwater supplies and stream flows.

4. To provide for adequate maintenance of all permanent stormwater management structures in the municipality.

Section 102 - Applicability

The following activities involving alteration or development of land are deemed to have possible effects upon storm water runoff characteristics and are included within the scope of this ordinance:

1. Subdivision

2. Land Development

3. Construction of new or additional impervious surfaces or surfaces with reduced permeability (driveways, parking lots, etc.)

4. Diversion or piping of any natural or man-made stream channel

5. Installation, replacement or substantial repair of storm water systems or appurtenances

Section 103 - Repealer

This ordinance shall repeal all other ordinances, or parts thereof, which are contrary to or conflict with the provisions of this ordinance to the extent necessary to give this ordinance full force and effect.

Section 104 -Severability

Should any section or provision of this ordinance be declared invalid by a court of competent jurisdiction, such decision shall not affect the validity of this ordinance as a whole or any other part hereof; the parts or sections remaining shall remain in effect as if the part of the section declared unconstitutional had never been a part of this ordinance.

Section 105 - Liability Disclaimer

1. Neither the granting nor the denial of any approval nor the compliance with the provisions of this ordinance or with any condition imposed by the municipality, its officials, employees, or designated representatives thereunder, shall relieve any person from any responsibility for damage to persons or property resulting therefrom, or as otherwise imposed by law, nor impose any liability upon the municipal officials, employees or its designated representatives to the maximum extent permitted by law.

2. Neither the granting nor the denial of any permit which includes any stormwater management requirements shall not constitute a representation, guarantee or warranty of any kind by the municipality, the municipal officials, employees, or designated representatives thereof of the practicability or safety of any stormwater structure or facility, use or other plan proposed, and shall create no liability or cause of action upon any municipal official, employee, or designated representative thereof for any damage that may result pursuant thereto to the maximum extent permitted by law.

ARTICLE II
DEFINITIONS

Act: The Storm Water Management Act (Act of October 4, 1978, P.L. 864 No. 167; 32 P.S. Sections 680.1-680.17, as amended by Act of May 24, 1984, No. 63).

Applicant: A landowner or developer who has filed an application for development including his/her heirs, successors and assigns.

Channel: A perceptible natural or artificial waterway which periodically or continuously contains moving water or which forms a connecting link between two bodies of water. It has a definite bed and banks which confine the water.

Conservation District: The Blair County Conservation District.

County: Blair County, Pennsylvania

Culvert: A closed conduit for the free passage of surface drainage under a highway, railroad, canal or other embankment.

Design criteria: (1) Engineering guidelines specifying construction details and materials. (2) Objectives, results, or limits which must be met by a facility, structure, or process in performance of its intended functions.

Design storm: (see storm frequency)

Detention: The slowing, dampening or attenuating of runoff flows entering the natural drainage pattern or storm drainage system by temporarily holding water on a surface area in a detention basin or within the drainage system.

Detention pond or basin: A basin or reservoir, usually small, constructed to impound or retard surface runoff temporarily.

Developer: The person, persons, or any corporation, partnership, association, or other entity or any responsible person therein or agent therefor that undertakes the activities associated with changes in land use. The term "developer" is intended to include but not necessarily be limited to the term "subdivider", "owner", and "builder" even though the individuals involved in successive stages of a project may vary.

Development: Any activity, construction, alteration, change in land use or practice that affects stormwater runoff characteristics.

Discharge: The flow or rate of flow from a canal, conduit, channel or other hydraulic structure.

Drainage: In general, the removal of surface water from a given area. Commonly applied to surface water and ground water.

Drainage Area: (1) The area of a drainage basin or watershed, expressed in acres, square miles, or other unit of area. Also called catchment area, watershed, river basin. (2) The area served by a sewer system receiving storm and surface water, or by a watercourse.

Encroachment: Any structure or activity which in any manner changes, expands or diminishes, the course, current or cross section of any watercourse, floodway or body of water.

Erosion: Wearing away of the lands by running water, glaciers, winds and waves.

Erosion control: The application of measures to reduce erosion of land surfaces.

Ground Cover: Materials covering the ground surface,

Ground Water: Subsurface water occupying the saturation zone, from which wells and springs are fed.

Ground Water Recharge: Replenishment of ground water naturally by precipitation or runoff or artificially by spreading or injection.

Impervious: Not allowing or allowing only with great difficulty the movement of water; impermeable.

Infiltration: (1) The flow or movement of water through the interstices or pores of a soil or other porous medium. (2) The absorption of liquid by the soil.

Land Development: Any of the following activities:

(1) the improvement of one lot or two or more contiguous lots, tracts or parcels of land for any purpose involving: (a) a group of two or more residential or non-residential buildings, whether proposed initially or cumulatively, or a single non-residential building on a lot or lots regardless of the number of occupants or tenure; or (b) the division or allocation of land or space, whether initially or cumulatively, between or among two or more existing or prospective occupants by means of, or for the purpose of streets, common areas, leaseholds, condominiums, building groups or other features;

(2) a subdivision of land;

(3) development in accordance with Section 503 (1.1) of the Pennsylvania Municipalities Planning Code.

Land Disturbance: Any activity involving the changing, grading, transportation, fill and any other activity which causes land to be exposed to the danger of erosion.

Maintenance: The upkeep necessary for efficient operation of physical properties.

Municipality: (name of municipality), Blair County

Municipal engineer: A professional engineer licensed in the Commonwealth of Pennsylvania, duly appointed by the (name of municipality).

Natural Stormwater Runoff Regime: A watershed where natural surface configurations, runoff characteristics and defined drainage conveyances have attained the conditions of equilibrium.

Outfall: (1) The point, location or structure where drainage discharges from a sewer, drain or other conduit. (2) The conduit leading to the ultimate discharge point.

Outlet Control Structure: The means of controlling the relationship between the headwater elevation and the discharge, placed at the outlet or downstream end of any structure through which water may flow.

Performance Standard: A standard which establishes an end result or outcome which is to be achieved but does not prescribe specific means for achieving it.

Peak Flow: Maximum flow.

Pennsylvania DEP: Pennsylvania Department of Environmental Protection.

Release Rate Percentage: The watershed factor determined by comparing the maximum rate of runoff from a subbasin to the contributing rate of runoff to the watershed peak rate at specific points of interest.

Retention Pond: A basin, usually enclosed by artificial dikes, that is used to retard stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate.

Return Period: The average interval in years over which an event of a given magnitude can be expected to recur.

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

Runoff Characteristics: The surface components of any watershed which affect the rate, amount, and direction of stormwater runoff. These may include but are not limited to: vegetation, soils, slopes and man-made landscape alterations.

SCS: U.S. Department of Agriculture Soil Conservation Service.

Sediment: Mineral or organic solid material that is being transported or has been moved from its site of origin by air, water or ice and has come to rest.

Sedimentation: The process by which mineral or organic matter is accumulated or deposited by moving water, wind or gravity.

Storage Facility: (See detention pond and retention pond).

Storm Frequency: The average interval in years over which a storm event of a given precipitation volume can be expected to occur.

Storm Sewer: A sewer that carries intercepted surface runoff, street water and other drainage but excludes domestic sewage and industrial waste.

Stormwater: That portion of precipitation which runs over the land.

Stormwater Collection System: Natural or man-made structures that collect and transport stormwater through or from a drainage area to the point of final outlet including, but not limited to, any of the following: conduits and appurtenant features, canals, channels, ditches, streams, culverts, streets, and pumping stations.

Stormwater Management Plan: The plan for managing stormwater runoff adopted by Blair County as required by the Storm Water Management Act.

Subdivision: The division or redivision of a lot, tract or parcel of land by any means into two or more lots, tracts, parcels or other divisions of land including changes in existing lot lines for the purpose, whether immediate or future, of lease, partition by the court for distribution to heirs or devisees, transfer of ownership or building or lot development, provided, however, that the subdivision by lease of land for agricultural purposes into parcels of more than 10 acres, not involving any new street or easement of access or any residential dwelling, shall be exempted.

Swale: A low-lying stretch of land which gathers or carries surface water runoff.

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

Watershed: The entire region or area drained by a river or other body of water whether natural or artificial. A "designated watershed" is an area delineated by the Pennsylvania DEP and approved by the Environmental Quality Board for which counties are required to develop watershed stormwater management plans.

ARTICLE III
STORMWATER QUANTITY MANAGEMENT REQUIREMENTS

Section 301 - General Standards

A. Erosion and Sedimentation: All land disturbance activities shall be conducted in such a way as to minimize accelerated erosion and sedimentation. Measures to control erosion and sedimentation shall at a minimum meet the standards of the Conservation District and the Rules and Regulations of the Pennsylvania Department of Environmental Protection.

Section 302 - Stormwater Runoff Quantity Control Standards

A Runoff Rates: There shall be no increase in the peak rate of stormwater runoff discharge from any activity covered by the Ordinance following the completion of the activity (post-development conditions) over the rate that would have occurred from the land prior to the activity (pre-development conditions). This criteria shall apply to the total activity even if the activity is to take place in stages.

1. Off site areas which drain through a proposed development site are not subject to the control standard when determining allowable peak runoff rates. However, on-site drainage facilities shall be designed to safely convey off-site flows through the development site.

2. Where the site area to be impacted through a proposed development activity differs significantly from the total site area, only the proposed impact area shall be subject to the runoff criteria.

B. Storm Frequencies: Stormwater management facilities on all development sites shall control the peak stormwater discharge for the 2-, 10-, 25- and 100-year storm frequencies. The USDA NRCS 24-hour, Type II Rainfall Distribution shall be used for analyzing stormwater runoff for both pre- and post-development conditions. The 24-hour total rainfall for these storm frequencies in the watershed are:

Storm Frequency	Rainfall Depth (inches)
2-year	2.6
10-year	3.8
25-year	4.6
100-year	6.1

C. Calculation Methods

1. Development Sites: For the purpose of computing peak flow rates and runoff hydrographs from development sites, calculations shall be performed

using one of the following: USDA NRCS publications, Technical Release (TR) 55 or 20, HEC I or Penn State Runoff Model (PSRM) or Modified Rational Method. Under special circumstances other computation methods may be used subject to the approval of the municipality.

2. Stormwater Collection/Conveyance Facilities: For the purposes of designing storm sewers, open swales and other stormwater runoff collection and conveyance facilities, the Rational Method or other method as approved by the municipality may be applied. Rainfall intensities for design should be obtained from the Pennsylvania Department of Transportation rainfall charts.

3. Routing of hydrographs through detention / retention facilities for the purpose of designing those facilities shall be accomplished using the Modified-Puls Method or other recognized reservoir routing method subject to the approval of the municipality.

4. Predevelopment Conditions: Predevelopment conditions shall be assumed to be those which exist on any site at the time prior to the commencement of development activities. SCS runoff curve numbers selected for use in the calculations shall accurately reflect existing conditions subject to the approval of the municipality. At its discretion, the municipality may direct that hydrologic conditions for all areas with pervious cover (i.e., fields, woods, lawn areas, pastures, cropland, etc.) shall be assumed to be in "good" condition, and the lowest recommended SCS runoff curve number (CN) shall be applied for all pervious land uses within the respective range for each land use and hydrologic soil group Impervious cover shall include, but not be limited to, any roof, parking, or driveway areas, and any new streets and sidewalks. Any areas designed to initially be gravel or crushed stone shall be assumed to be impervious for the purposes of these criteria. The Municipality has the authority to require that computed existing runoff rates be reconciled with field observations and conditions. If the designer can substantiate through actual physical calibration that more appropriate runoff values should be used at a particular site, then appropriate variations may be made upon review and recommendations of the municipal engineer. Calibration shall require detailed gauge and rainfall data for the particular site in question.

D. Post-development rates of runoff shall not exceed the peak rates of runoff prior to development for the 2, 10, 25, and 100 year design storms.

ARTICLE IV
STORMWATER QUALITY MANAGEMENT REQUIREMENTS

Section 401 - Applicability

A. In addition to the performance standards and design criteria requirements of Article III of this Ordinance, the land developer shall implement the following water quality requirements of this Article unless otherwise exempted by the provisions of this ordinance.

Section 402 - Water Quality Requirements

A. No discharge materials, toxic or otherwise, shall be permitted into any stormwater management system except as may be permitted by applicable laws of the Commonwealth of Pennsylvania or the United States. Where required by federal and state regulation, the landowner or developer shall be responsible for obtaining an NPDES permit for stormwater discharges.

(Note: The following water quality management requirements are recommended for incorporation into the overall stormwater management requirements. However, they are presented as a suggestion - not as a required element of this plan.)

B. In addition to the quantity requirements of this ordinance, the land developer shall:

1. Design stormwater detention / retention basins so that the outlet of the basin shall, in addition to any other stormwater requirements imposed by the municipal stormwater regulations, discharge the 1 year, 24 hour storm over a 24 hour period.

2. As an alternative to subsection 402.A.1., above, the water quality objectives may be achieved through a combination of best management practices (BMPs) including, but not limited to, infiltration structures, detention / retention basins, vegetation filter strips and buffers. The combination of BMPs shall be designed according to the requirements listed under Section 403 and in consultation with the municipal engineer.

3. In lieu of 1 and 2 above, the land developer may submit original and innovative designs to the municipal engineer for review and approval.

Section 403 - BMP Selection Criteria

A. In selecting the appropriate BMP's or combinations thereof, the land developer shall consider the following:

1. Total contributing area

2. Permeability and infiltration rate of the site soils
3. Slope and depth to bedrock
4. Seasonal high water table
5. Proximity to building foundations and well heads
6. Erodibility of soils
7. Land availability and configuration of the topography

B. The following additional factors should be considered when evaluating the suitability of the BMPs used to control water quality at a given development site.

1. Peak discharge and required volume control
2. Streambank erosion
3. Efficiency of the BMPs to mitigate potential water quality problems
4. The volume of runoff that will be effectively treated
5. The nature of the pollutant(s) being removed
6. Maintenance requirements
7. Recreation value
8. Enhancement of aesthetics and property values

ARTICLE V
DESIGN CRITERIA FOR STORMWATER MANAGEMENT CONTROLS

Section 501 - General criteria

A. Applicants may select runoff control techniques, or a combination of techniques, which are most suitable to control stormwater runoff from the development site. All controls shall be subject to approval of the municipal engineer. The municipal engineer may request specific information on design and/or operating features of the proposed stormwater controls in order to determine their suitability and adequacy in terms of the standards of this ordinance.

B. The applicant should consider the effect of the proposed stormwater management techniques on any special soil conditions or geological hazards which may exist on the development site. In the event such conditions are identified on the site, the municipal engineer may require in-depth studies by a competent geotechnical engineer. Not all stormwater control methods may be advisable or allowable at a particular development site.

C. In developing a stormwater management plan for a particular site, stormwater controls shall be selected according to the following order of preference:

1. minimization of impervious surfaces during site design

2. flow attenuation by use of open vegetated swales and natural depressions

3. stormwater detention/retention structures

D. Infiltration practices shall be used to the extent practicable to reduce volume increases and promote groundwater recharge. A combination of successive practices may be used to achieve the applicable minimum control requirements. Justification shall be provided by the applicant for rejecting each of the preferred practices based on actual site conditions.

Section 502 - Criteria for Infiltration Systems

A. Infiltration systems shall be sized and designed based upon local soil and ground water conditions.

B. Infiltration systems greater than three (3) feet deep shall be located at least ten (10) feet from basement walls.

C. Infiltration systems shall not be used to handle runoff from commercial or industrial working or parking areas. This prohibition does not extend to roof areas

which are demonstrated to be suitably protected from the effects of the commercial/industrial activities.

D. Infiltration systems may not receive runoff until the entire drainage area to the system has received final stabilization.

E. The stormwater infiltration facility design shall provide an overflow system with measures to provide a non-erosive velocity of flow along its length and at the outfall.

F. Areas proposed for infiltration BMPs shall be protected from sedimentation and compaction during the construction phase, so as to maintain their maximum infiltration capacity.

Section 503 - Criteria for Flow Attenuation Facilities

A. If flow attenuation facilities are employed to assist in the control of peak rates of discharge, their effects must be quantified using the SCS Technical Release (TR) 55 Urban Hydrology for Small Watersheds or other approved method. The effects of the flow attenuation facilities on travel time should be reflected in the calculations.

B. Flow attenuation facilities such as swales and natural depressions should be properly graded to ensure positive drainage and avoid prolonged ponding of water.

C. Swales shall be properly vegetatively stabilized or otherwise lined to prevent erosion.

D. Swales shall be designed according to the recommendations contained in the Commonwealth of Pennsylvania Erosion and Sediment Pollution Control Program Manual.

Section 504 - Criteria for Stormwater Detention Facilities

A. If detention facilities are utilized for the development site, the facility(ies) shall be designed such that post-development peak runoff rates from the developed site are controlled to those rates defined by this Ordinance.

B. All detention facilities shall be equipped with outlet structures to provide discharge control for the four (4) designated storm frequencies. Provisions shall also be made to safely pass the post-development 100-year storm runoff without damaging or impairing the continued function of the facilities. Should any stormwater management facilities be regulated by PA DEP Chapter 105 regulations, the facility shall be designed in accordance with those regulations and meet the regulations concerning dam safety which may require the passage of storms larger than the 100-year event.

C. Shared-storage facilities which provide detention of runoff for more than one development site within a single subarea are encouraged wherever feasible and provided such facilities meet the criteria contained in this section. In addition, runoff from the development sites involved shall be conveyed to the facility in a manner that avoids adverse impacts (such as flooding or erosion) to channels and properties located between the development site and the shared-storage facilities.

D. Where detention facilities will be utilized, multiple use facilities, such as wetlands, lakes, ballfields or similar recreational/open space uses are encouraged wherever feasible, subject to the approval of the municipality and compliance with the Pennsylvania Department of Environmental Protection's Chapter 105 regulations.

E. Other considerations which should be incorporated into the design of the detention facilities include:

1. Inflow and outflow structures shall be designed and installed to prevent erosion and bottoms of impoundment type structures should be protected from soil erosion.

2. Control and removal of debris both in the storage structure and in all inlet or outlet devices shall be a design consideration.

3. Inflow and outflow structures, pumping stations, and other structures shall be designed and protected to minimize safety hazards.

4. The water depth at the perimeter of a storage pond should be limited to that which is safe for children. Restriction of access (fence, walls, etc.) may be necessary depending on the location of the facility and the maximum depths of water.

5. Side slope of storage ponds shall not exceed a ratio of two-and-one-half to one (2.5:1) horizontal to vertical dimension.

6. Landscaping shall be provided for the facility which harmonizes with the surrounding area.

7. Facilities shall be located to facilitate maintenance, considering the frequency and type of equipment that will be required.

8. Bottoms of detention basins should be graded with sufficient slope to provide positive surface drainage. A subdrainage system may be required depending on the location of the pond bottom relative to groundwater levels.

9. Fencing shall be provided if required by the municipality.

Section 505 - Criteria for Collection/Conveyance Facilities

(Note: The municipality should review the specific requirements of this section for consistency with its existing requirements and local preferences. Specific design and construction details suggested here may be modified upon recommendation of the municipal engineer in order to reflect the municipality's current standard practices, local conditions and preferences.)

A. All stormwater runoff collection or conveyance facilities, whether storm sewers or other open or closed channels, shall be designed in accordance with the following basic standards:

1. All sites shall be graded to provide drainage away from and around the structure in order to prevent any potential flooding damage.

2. Lots located on the high side of streets shall extend roof and French drains to the curb line storm sewer (if applicable). Low side lots shall extend roof and french drains to a stormwater collection/conveyance/control system or natural watercourse in accordance with the approved stormwater management plan for the development site.

3. Collection/conveyance facilities should not be installed parallel and close to the top or bottom of a major embankment to avoid the possibility of failing or causing the embankment to fail.

4. All collection/conveyance facilities shall be designed to convey the 25-year storm peak flow rate from the contributing drainage area and to carry it to the nearest suitable outlet such as a stormwater control facility, curbed street, storm sewer or natural watercourse without damage to the drainage structure or roadway, with runoff from the 25-year design storm at a minimum 1.0 foot of freeboard measured below the lowest point along the top of the roadway. Roadway crossings located within designated floodplain areas must be able to convey runoff from a 100-year design storm with a minimum of 1.0 foot freeboard measured below the lowest point along the top of the roadway.

   When it can be shown that, due to topographic conditions, natural darainage ways on the site cannot adequately provide for drainage, open channels may be constructed conforming substantially to the lilne and grade of such natural drainage ways. Work within natural drainage ways shall be subject to approval by PAADEP through the Joint Permit Application process, or, where appropriate by PADEP, through the General Permit process.

5. Where drainage swales or open channels are used, they shall be suitably lined to prevent erosion and designed to avoid excessive velocities.

6. Stormwater drainage systems shall be provided in order to permit unimpeded flow along natural watercourses, except as modified by stormwater management facilities or open channels consistent with this Ordianance.

7. Existing points of concentrated drainage that discharge onto adjacent property shall not be altered without permission of the altered property owner(s) and shall be subject to any applicable discharge criteria specified in this Ordinance.

8. Areas of existing diffused drainage discharge shall be subject to any applicable discharge criteria in the general direction of existing discharge, whether proposed to be concentrated or maintained as diffused drainage areas, except as otherwise provided by this ordinance. If diffused flow is proposed to be concentrated and discharged onto adjacent property, the developer must document that adequate downstream conveyance facilities exist to safely transport the concentrated discharge, or otherwise prove that no erosion, sedimentation, flooding, or other harm will result from the concentrated discharge.

9. Where a development site is traversed by watercourses, drainage eaasements shall be provided conforming to the line of such watercourses. The terms of the easements shall prohibit excavation, the placing of fill or structures, and any alterations that may adversely affect the flow of stormwater within any portion of the easement. Also maintenance, including mowing of vegetation within the easement shall be required, except as approved by the appropriate governing authority.

10. Any stormwater management facilities regulated by this Ordinance that would be located in or adjacent to waters of the Commonwealth of Pennsylvania or wetlands shall be subject to approval by PADEP through the Joint Permit Application process, or, where deemed appropriate by PADEP, the General Permit process. When there is a question whether wetlands may be involved, it is the responsibility of the Developer or his agent to show that the land in question cannot be classified as wetlands, otherwise approval to work in the area must be obtained by PADEP.

11. Any stormwater management facilities regulated by this Ordinance that would be located on State highway rights-of-way shall be subject to approval by the Pennsylvania Department of Transportation.

12. In order to promote overland flow and infiltration/percolation of runoff where it is advantageous to do so, roof drains must not be connected to streets, sanitary or storm sewers, or roadside ditches. When it is more advantageous to connect directly to streets or storm seewers, then it shall be permitted on a case by case basis by the municipality.

B. Wherever storm sewers are proposed to be utilized, they shall comply with the following criteria:

1. Where practical, designed to traverse under seeded and planted areas. If constructed within ten (10) feet of road paving, walks or other surfaced areas, drains shall have a narrow trench and maximum compaction of backfill to prevent settlement of the superimposed surface or development.

2. Preferably installed after excavating and filling in the area to be traversed is completed, unless the drain is installed in the original ground with a minimum of three (3) feet cover and/or adequate protection during the fill construction.

3. Designed: (1) with cradle when traversing fill areas of indeterminate stability, (2) with anchors when gradient exceeds twenty (20) percent, and (3) with encasement or special backfill requirements when traversing under a paved area.

4. Designed to adequately handle the anticipated stormwater flow and be economical to construct and maintain. The minimum pipe size shall be fifteen (15) inches in diameter.

5. Drain pipe, trenching, bedding and backfilling requirements shall conform to the requirements of the municipality and/or applicable PennDOT Specifications, Form 408.

6. All corrugated metal pipe shall be polymer coated, and with asbestos bonding and paved inverts where prone to erode. Pipe within a municipal right-of-way shall be reinforced concrete pipe with a minimum diameter of 15 inches.

7. Storm inlets and structures shall be designed to be adequate, safe, self-cleaning and unobtrusive and consistent with municipal standards.

8. Approved grates shall be designed for all catch basins, stormwater inlets and other entrance appurtenances.

9. Manholes shall be designed so that the top shall be at finished grade and sloped to conform to the slope of the finished grade. Top castings of structures located in roads or parking areas shall be machined or installed to preclude "rattling."

10. Where a proposed storm sewer connects with an existing storm sewer system, the applicant shall demonstrate that sufficient capacity exists in the downstream system to handle the additional flow.

11. Storm sewer outfalls shall be equipped with energy dissipation devices to prevent erosion and conform with applicable requirements of the Pennsylvania DEP for stream encroachments (Chapter 105 of Pennsylvania DEP Rules and Regulations).

ARTICLE VI
EROSION AND SEDIMENTATION CONTROLS

Section 601 - Erosion and Sedimentation Control Requirements

A. An erosion/sedimentation plan shall be prepared for each development site in accordance with the Pennsylvania Erosion/Sedimentation Regulations (25 PA Code, Chapter 102) and the standards and guidelines of the County Conservation District.

(Note: If the municipality has a grading or other ordinance which contains its erosion/sedimentation provisions, then it should be referenced here.)

ARTICLE VII
MAINTENANCE OF STORMWATER MANAGEMENT CONTROLS

Section 701 - Maintenance Responsibilities

A. The maintenance plan for stormwater management facilities located on the development site shall establish responsibilities for the continuing operation and maintenance of all proposed stormwater control facilities, consistent with the following principals:

1. If a development consists of structures or lots which are to be separately owned and in which streets, storm sewers and other public improvements are to be dedicated to the municipality, stormwater control facilities should also be dedicated to and maintained by the municipality.

2. If a development site is to be maintained in single ownership or if storm sewers and other public improvements are to be privately owned and maintained, then the ownership and maintenance of stormwater control facilities should be the responsibility of the owner or private management entity.

B. The governing body, upon recommendation of the municipal engineer, shall make the final determination on the continuing maintenance responsibilities prior to final approval of the stormwater management plan. The governing body reserves the right to accept the ownership and operating responsibility for any or all of the stormwater management controls and to determine the terms and conditions under which it will accept ownership and operating responsibility.

Section 702 - Maintenance Agreement for Privately Owned Stormwater Facilities

A. Prior to final approval of the site's stormwater management plan, the applicant and municipality shall execute a maintenance agreement covering all stormwater control facilities which are to be privately owned. The maintenance agreement shall be recorded with the final subdivision/land development plan for the site. The agreement shall stipulate that:

1. All facilities shall be maintained in accordance with the approved maintenance schedule and in a safe and attractive manner.

2. Easements and or rights-of-way shall be conveyed to the municipality to assure access for periodic inspections by the municipality and maintenance if required.

3. The name, address and telephone number of the person or company responsible for maintenance activities shall be filed with the municipality.

In the event of a change, new information will be submitted to the municipality within ten (10) days of the change.

4. If the facility owner fails to maintain the stormwater control facilities, the municipality may perform the necessary maintenance work or corrective work following due notice by the municipality to the facility owner to correct the problem(s). The facility owner shall reimburse the municipality for all costs.

B. Other items may be included in the agreement where determined necessary to guarantee the satisfactory maintenance of all facilities.

Section 703 - Municipal Stormwater Maintenance Fund

(Note: This provision illustrates one way a municipality could establish a special fund to finance its maintenance and inspection activities for stormwater retention/detention facilities. It is an optional provision of the ordinance. If a municipality is interested in establishing such a fund, it is recommended that it consult with its solicitor for legal requirements and procedures.)

A. Persons installing stormwater storage facilities shall be required to pay a specified amount to the Municipal Stormwater Maintenance Fund to help defray costs of periodic inspections and maintenance expenses. The amount of the deposit shall be determined as follows:

1. If the storage facility is to be privately owned and maintained, the deposit shall cover the cost of periodic inspections performed by the municipality for a period of ten (10) years, as estimated by the municipal engineer. After that period of time, inspections will be performed at the expense of the municipality.

2. If the storage facility is to be owned and maintained by the municipality, the deposit shall cover the estimated costs for maintenance and inspections for ten (10) years. The municipal engineer will establish the estimated costs utilizing information submitted by the applicant.

3. The amount of the deposit to the fund shall be converted to present worth of the annual series values. The municipal engineer shall determine the present worth equivalents which shall be subject to the approval of the governing body.

B. If a storage facility is proposed that also serves as a recreation facility (e.g., ballfield, lake), the municipality may reduce or waive the amount of the maintenance fund deposit based upon the value of the land for public recreation purposes.

C. If in the future a storage facility (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 the facility and connecting to the storm sewer system or other facility. Any amount of the deposit remaining after the costs of abandonment are paid will be returned to the depositor.

ARTICLE VIII
STORMWATER PLAN REQUIREMENTS

Section 801 - General Requirements

No final subdivision/land development plan shall be approved, no permit authorizing construction shall be issued, or an earth moving or land disturbance activity initiated until the final stormwater management plan for the site is approved in accordance with the provisions of this ordinance.

Section 802 - General Exemptions

The following activities are specifically exempt for the plan preparation provisions of this Ordinance unless the municipality determines that the activity is likely to, has, or will negatively impact the purposes and objectives set forth in Article I. For example, where an activity occurs on very steep terrain or where an activity is the latest in a series of incremental developments expected to cause pronounced stormwater impacts, it may be that these activities will be required to comply with the plan preparation requirements contained herein even though their activities qualify under the listing in this section. Upon making such determination, the municipality shall give notice in writing to the land owner and the developer, if known, and direct the landowner and any developer to immediately cease and desist all activity and affirmatively comply with the formal plan, submission, and approval procedures of this ordinance. Exemption shall not relieve the applicant from providing adequate stormwater management to meet the purpose of this Ordinance.

A. Any regulated activity that would create 5,000 square feet or less of impervious area. This criteria shall apply to the total development even if development is to take place in phases.

B. Land disturbances associated with existing one and two family dwellings provided that the activities will not create in excess of 5,000 square feet of impervious area.

C. Use of land for gardening for home consumption.

D. Agriculture when operated in accordance with a conservation plan or erosion and sedimentation control plan approved by the County Conservation District. The agricultural activities such as growing crops, rotating crops, filling of soil and grazing animals and other such activities are specifically exempt from complying with the requirements of this Ordinance when such activities are conducted in accordance with a conservation plan prepared by the County Conservation District. The construction of buildings, parking lots or any activity that may result in impervious surface which increases the rate and volume of stormwater runoff shall comply with the requirements of this Ordinance.

E. Forest management operations which are following the Department of Environmental Protection's management practices contained in its publication "Soil

Erosion and Sedimentation Control Guidelines for Forestry" and are operating under an erosion and sedimentation control plan.

Section 803 - Stormwater plan Contents

A. General Format: The stormwater plan shall be drawn on sheets no larger that 16" X 22" with a graphics scale of not less than 1 inch = 200 feet. All sheets shall contain a title block with; Name and address of applicant and engineer, scale, north arrow, legend and date of preparation.

B. Existing and Proposed Features: The plan shall show the following under both pre-development and post-development conditions:

1. Watershed location - Provide a key map showing the location of the development site within the watershed(s) and watershed subarea(s). On all site drawings, show the boundaries of the watershed(s) and subarea(s) as they are located on the development site and identify watershed names(s) and subarea number(s).

2. Floodplain boundaries - Identify 100-year floodplains on the development site (as appropriate) based on the municipal Flood Insurance Study maps.

3. Natural features - Show all bodies of water (natural or artificial), watercourses (permanent and intermittent), swales, wetlands and other natural drainage courses on the development site, or which will be affected by runoff form the development.

4. Soils - Provide an overlay showing soil types and boundaries within the development site (consult county, SCS and U.S. Geological Survey for information).

5. Contours - Show existing and final contours at intervals of two (2) feet; in areas with slopes greater than fifteen (15) percent, five (5) foot contour intervals may be used.

6. Land cover - Show existing and final land cover classifications as necessary to support and illustrate the runoff calculations performed.

7. Drainage area delineations - Show the boundaries of the drainage areas employed in the runoff calculations performed.

8. Stormwater management controls - Show any existing stormwater management or drainage controls and/or structures, such as storm sewers, swales, culverts, etc. which are located on the development site, or which are located off-site but will be affected by runoff from the development.

C. Professional certification: The principal in charge of preparing the stormwater management plan (including all calculations) shall be a registered professional

engineer or registered land surveyor and the stormwater management plan shall be sealed by a registered professional engineer or professional land surveyor with training and expertise in hydrology and hydraulics. Documentation of qualifications may be required by the municipality.

D. Runoff calculations: Calculations for determining pre- and post-development discharge rates and for designing proposed stormwater control facilities must be submitted with the stormwater management plan. All calculations shall be prepared using the methods and data prescribed by Section 302 of this Article.

E. Stormwater controls: All proposed stormwater runoff control measures must be shown on the plan including methods for collecting, conveying and storing stormwater runoff on-site, which are to be used both during and after construction. Erosion and sedimentation controls shall be shown in accordance with Section 104 of this Article. The plan shall provide information on the exact type, location, sizing, design and construction of all proposed facilities and their relationship to the existing watershed drainage system. The plan shall include technical specifications for materials and methods to be used in the construction of the stormwater management facilities.

1. If the development is to be constructed in stages, the applicant must demonstrate that stormwater facilities will be installed to manage stormwater runoff safely during each stage of development.

2. A schedule for the installation of all temporary and permanent stormwater control measures and devices shall be submitted.

3. If appropriate, a justification should be submitted as to why any preferred stormwater management techniques, as listed in Articles IV and V, are not proposed for use.

F. Easements, right-of-ways, deed restrictions: All existing and proposed easements and rights-or-way for drainage and/or access to stormwater control facilities shall be shown along with any areas subject to special deed restrictions relative to or affecting stormwater management on the development site.

G. Other permits/approvals: A list of any approvals/permits relative to stormwater management that will be required from other governmental agencies (Pennsylvania DEP Chapter 105 and 106 permits and/or NPDES permit) and anticipated dates of submission/receipt should be included with the stormwater plan submission. Copies of permit applications may be requested by the municipality where they may be helpful for the plan review.

H. Maintenance program: The proposed maintenance plan for all stormwater control facilities shall:

1. Identify the proposed ownership entity (e.g., municipality, property owner, private corporation, homeowner's association, or other entity).

2. Identify the type of maintenance, probable frequencies, personnel and equipment requirements and estimated annual maintenance costs.

3. Identify the method for financing the continuing operation and maintenance of the facility if the facility is to be owned by other than a governmental agency.

4. Include copies of any legal agreements required to implement the maintenance program and, if applicable, copies of the maintenance agreement as required by Article VII.

I. Financial guarantees: Submit financial guarantees in accordance with the provisions of Article XI.

J. Evidence of notification of downstream municipality: The developer shall notify (by certified mail) the municipality immediately downstream of the municipality within which the development is proposed that a stormwater control plan has been prepared and submitted. This letter should identify the location of the proposed development site and the name of the affected stream. The developer shall submit a copy of this letter and a copy of the certified mail return receipt.

ARTICLE IX
PLAN REVIEW PROCEDURES

Section 901 - Pre-application Phase

A. Before submitting the stormwater plan, applicants are urged to consult with the municipality on the applicable regulations and techniques for safely managing runoff from the development site. The municipality may also be helpful in providing necessary data for the stormwater management plan.

B. Applicants are encouraged to submit a sketch plan with a narrative description of the proposed stormwater management controls for general guidance and discussion with the municipality and other agencies.

C. The pre-application phase is not mandatory; any review comments provided by the municipality are advisory only and do not constitute any legally binding action on the part of the municipality.

Section 902 - Stormwater Plan Reviews

A. Submission of plans: Stormwater plan applications shall be submitted with the preliminary and final subdivision/land development applications.

B. Notification of affected municipalities: The developer is required to notify municipalities adjacent to the development site that a stormwater control plan has been submitted. Copies of the plans will be made available to the municipalities upon request. Comments received from any affected municipality will be considered by the municipal engineer and county agencies in their reviews.

C. Municipal engineer's review: The municipal engineer shall recommend approval or disapproval of the stormwater management plan based on the requirements of the municipal ordinances, the standards and criteria of the watershed plan and good engineering practice. The engineer shall submit a written report, along with supporting documentation, stating their reasons for approval or disapproval.

(Note: 1) If the municipal Planning Commission has the final authority for approving plans, then this section should be changed as appropriate.)

E. Permits required from other governmental agencies: Where the proposed development requires an obstruction permit from the Pennsylvania DEP or an erosion/sedimentation permit from the County Conservation District, final stormwater management plan approval shall be granted subject to the receipt of such permits. No building permit shall be issued, nor construction started, until the permits are received and copies filed with the municipality.

Section 903 - Status of the Stormwater Plan after Final Approval

A. Upon final stormwater plan approval, receipt of all necessary permits, and recording of the final subdivision or land development plan in the Blair County Recorder of Deeds Office, the applicant may commence to install or implement the approved stormwater management controls.

B. If site development or building construction does not begin within two years of the date of final approval of the stormwater management plan, then before doing so, the applicant shall resubmit the stormwater management plan to verify that no condition has changed within the watershed that would affect the feasibility or effectiveness of the previously approved stormwater management controls. Further, if for any reason development activities are suspended for two years or more, then the same requirement for resubmission of the stormwater management plan shall apply.

Section 904 - Stormwater Plan Modifications

A. If the request for a plan modification is initiated <u>before</u> construction begins, the stormwater plan must be resubmitted and reviewed according to the procedures contained in Section 902 above.

B. If the request for a plan modification is initiated <u>after</u> construction is underway, the municipal engineer shall recommend approval or disapproval of the modification based on field inspection <u>provided</u>: (1) the requested changes in stormwater controls do not result in any modifications to other approved municipal land use/development requirements (e.g., building setbacks, yards, etc.) and (2) the performance standards in Articles III and IV are met. Notification of the engineer's action shall be sent to the governing body which may issue a stay of the plan modification within fourteen (14) days and require the permittee to resubmit the plan modification for full stormwater plan review in accordance with Section 902 above.

ARTICLE X
INSPECTIONS OF STORMWATER MANAGEMENT CONTROLS

Section 1001 - Inspections

A. The municipal engineer or a designated representative of the municipality shall inspect the construction of the temporary and permanent stormwater management system for the development site. The permittee shall notify the municipal engineer 48 hours in advance of the completion of the following key development phases:

1. At the completion of preliminary site preparation including stripping of vegetation, stockpiling of topsoil and construction of temporary stormwater management and erosion control facilities.

2. At the completion of rough grading but prior to placing topsoil, permanent drainage or other site development improvements and ground covers.

3. During construction of the permanent stormwater facilities at such times as specified by the municipal engineer.

4. Completion of permanent stormwater management facilities including established ground covers and plantings.

5. Completion of final grading, vegetative control measures or other site restoration work done in accordance with the approved plan and permit.

B. No work shall commence on any subsequent phase until the preceding one has been inspected and approved. If there are deficiencies in any phase, the municipal engineer shall issue a written description of the required corrections and stipulate the time by which they must be made.

C. If during construction, the contractor or permittee identifies any site condition, such as subsurface soil conditions, alterations in surface or subsurface drainage which could affect the feasibility of the approved stormwater facilities, he/she shall notify the municipal engineer within 24 hours of the discovery of such condition and request a field inspection. The municipal engineer shall determine if the condition requires a stormwater plan modification.

D. In cases where stormwater facilities are to be installed in areas of landslide-prone soils or other special site conditions exist, the municipality may require special precautions such as soil tests and core borings, full-time inspectors and/or similar measures. All costs of any such measures shall be borne by the permittee.

ARTICLE XI
FINANCIAL GUARANTEES AND DEDICATION OF PUBLIC IMPROVEMENTS

Section 1101 - Financial Guarantees

A. Guarantee of completion: A completion guarantee in the form of a bond, cash deposit, certified check or other negotiable securities acceptable to the municipality, shall be filed. The guarantee shall cover all streets, sanitary sewers, stormwater management facilities, water systems, fire hydrants, sidewalks and other required improvements; it shall be in the amount and form prescribed by the Pennsylvania Municipal Planning Code (Section 509).

B. Release of completion guarantee: The procedures for requesting and obtaining a release of the completion guarantee shall be in a manner prescribed by the Pennsylvania Municipalities Planning Code (Section 510).

C. Default of completion guarantee: If improvements are not installed in accordance with the approved final plan, the governing body may enforce any corporate bond or other security by appropriate legal and equitable remedies. If proceeds of such bond or other security are insufficient to pay the cost of installing or making repairs or corrections to all the improvements covered by said security, the governing body may at its option install part of such improvements in all or part of the development and may institute appropriate legal or equitable action to recover the moneys necessary to complete the remainder of the improvements. All proceeds, whether resulting from the security or from any legal or equitable action brought against the developer, or both, shall be used solely for the installation of the improvements covered by such security and not for any other municipal purpose.

Section 1102 -Dedication of Public Improvements

A. When streets, sanitary sewers, stormwater management facilities, water lines or other required improvements in the development have been completed in accordance with the final approved plan, such improvements shall be deemed private until such time as they have been offered for dedication to the municipality and accepted by separate ordinance or resolution or until they have been condemned for use as a public facility.

B. Prior to acceptance of any improvements or facilities, the municipal engineer shall inspect them to ensure that they are constructed in accordance with the approved plan and are functioning properly. In the case of any stormwater control facility, it must be free of sediment and debris.

C. The owner shall submit as-built plans for all facilities proposed for dedication.

D. Prior to acceptance of any improvements or facilities, the applicant shall provide a financial security to secure the structural integrity and functioning of the improvements. The security shall: (1) be in the form of a bond, cash, certified

check or other negotiable securities acceptable to the municipality, (2) be for a term of 36 months, and (3) be in an amount equal to 25 percent of the actual cost of the improvements and facilities so dedicated.

(Note: The duration and amount of the security may be established at the discretion of the municipality.)

ARTICLE XII
FEES

Section 1201 - Fee Schedule

The municipal governing body may adopt by resolution from time to time a reasonable schedule of fees to cover the cost of plan reviews, inspections and other activities necessary to administer the provisions of this ordinance. All fees shall be set in accordance with the applicable provisions of the Pennsylvania Municipalities Planning Code and any dispute over the fee amount shall be resolved in the manner prescribed by the Pennsylvania Municipalities Planning Code.

ARTICLE XIII
ENFORCEMENT PROCEDURES AND REMEDIES

Section 1301 - Right of Entry

Upon presentation of proper credentials, duly authorized representatives of the municipality may enter at reasonable times upon any property to investigate or ascertain the condition of the subject property in regard to an aspect regulated by this ordinance.

Section 1302 - Notification

In the event that the applicant, developer, owner or his/her agent fails to comply with the requirements of this ordinance or fails to conform to the requirements of any permit, a written notice of violation shall be issued by the municipal engineer or any designated municipal official. Such notification shall set forth the nature of the violations(s) and establish a time limit for correction of the violation(s). Upon failure to comply within the time specified, unless otherwise extended by the municipality, the applicant, developer, owner or his/her agent shall be subject to the enforcement remedies of this ordinance.

Section 1303 - Preventive Remedies

A. In addition to other remedies, the municipality may institute and maintain appropriate actions at law or in equity to restrain, correct or abate a violation, to prevent unlawful construction, to recover damages and to prevent illegal occupancy of a building or premises.

B. In accordance with the Pennsylvania Municipalities Planning Code (Sec. 515.1), the municipality may refuse to issue any permit or grant approval to further improve or develop any property which has been developed in violation of this ordinance.

Section 1304 - Enforcement Remedies

A. Any person, who has violated or permitted the violation of the provisions of this Ordinance shall, upon being found liable therefor in a civil enforcement proceeding commenced by the municipality, pay a fine of not less than $_____ and not more than $ plus court costs, including reasonable attorney fees and engineers and other expert witness fees incurred by the municipality. No judgment shall commence or be imposed, levied or be payable until the date of the determination of a violation by a court of competent jurisdiction.

B. If the defendant neither pays nor timely appeals the judgment, the municipality may enforce the judgment pursuant to applicable rules of civil procedure.

C. Each day that a violation continues shall constitute a separate violation unless the court of competent jurisdiction further determines that there was a good faith basis for the person violating the ordinance to have believed that there was no such

violation. In such case there shall be deemed to have been only one such violation until the fifth day following the date of the initial determination of a violation; thereafter each day that a violation continues shall constitute a separate violation.

D. All judgments, costs and reasonable attorney fees collected for the violation of this Ordinance shall be paid over to the municipality.

E. A court of competent jurisdiction, upon petition, may grant an order of stay, upon cause shown, tolling the per diem fine pending a final adjudication of the violation and judgment.

F. Nothing contained in this section shall be construed or interpreted to grant to any person or entity other than the municipality the right to commence any action for enforcement pursuant to this section.

Section 1305 - Additional Remedies

In addition to the above remedies, the municipality may also seek remedies and penalties under applicable Pennsylvania statutes, or regulations adopted pursuant thereto, including but not limited to the Storm Water Management Act (32 P.S. Section 693.1-693.27) and the Erosion and Sedimentation Regulations (25 Pennsylvania Code, Chapter 102). Any activity conducted in violation of this ordinance or any Pennsylvania approved watershed stormwater management plan is declared a public nuisance by the municipality and abatable as such.

Appendix B
Model Stormwater Management Ordinance for Subdivision/Land Development Ordinance

This model stormwater management ordinance contains a number of articles or sections that contain recommendations relative to content and language. Much of the model ordinance is presented as guidance to the municipalities and can be modified to comply with local preferences and current practices. However, in order to accomplish the goals of Act 167 and the watershed stormwater management plan, it is important that the specific language of the following key sections of the model ordinance be adopted essentially verbatim:

- **General Provisions**
- **Stormwater Management Performance Standards**
- **Stormwater Plan Requirements - General Exemptions**
- **Stormwater Plan Requirements - Exemptions**
-

The portions of the model ordinance listed define the types of activities for which stormwater controls are required and define the specific stormwater control standards to be met. The general content of the other portions of the model ordinance should be included in the municipalities' ordinances; however, there is a greater opportunity for customizing these sections to satisfy local preferences and procedures while accomplishing the overall goals of this plan.

MODEL STORMWATER MANAGEMENT PROVISIONS FOR MUNICIPAL SUBDIVISION/LAND DEVELOPMENT ORDINANCE

Article ____, Stormwater Management

Section 101 - General Provisions

A. Purpose

These regulations have the following general purposes and objectives:

1. To assure safe management of stormwater runoff resulting from land alteration and disturbance activities in accordance with watershed stormwater management plans adopted pursuant to the Pennsylvania Storm Water Management Act (Act 167 of 1978, as amended).

2. To utilize and preserve the existing natural drainage systems and to preserve the flood-carrying capacity of streams.

3. To encourage natural infiltration of rainfall to preserve groundwater supplies and stream flows.

4. To provide for adequate maintenance of all permanent stormwater management structures in the municipality.

B. Statutory Authority

The municipality is empowered to regulate land use activities that affect runoff by the authority of the Act of October 4, 1978, P.L. 864 (Act 167), The "Storm Water Management Act" as amended by Act 63 and the Pennsylvania Municipalities Planning Code, Act 247 of 1968, as amended.

C. Applicability

The following activities involving alteration or development of land are deemed to have possible effects upon storm water runoff characteristics and are included within the scope of this ordinance:

1. Subdivision

2. Land Development

3. Construction of new or additional impervious or surfaces with reduced permeability (driveways, parking lots, etc.)

4. Diversion or piping of any natural or man-made stream channel

5. Installation, replacement or substantial repair of storm water systems or appurtenances

D. Repealer

This ordinance shall repeal all other ordinances, or parts thereof, which are contrary to or conflict with the provisions of this ordinance to the extent necessary to give this ordinance full force and effect.

E. Severability

Should any section or provision of this ordinance be declared invalid by a court of competent jurisdiction, such decision shall not affect the validity of this ordinance as a whole or any other part hereof; the parts or sections remaining shall remain in effect as if the part of the section declared unconstitutional had never been a part of this ordinance.

F. Liability Disclaimer

1. Neither the granting nor the denial of any approval nor the compliance with the provisions of this ordinance or with any condition imposed by the municipality, its officials, employees, or designated representatives thereunder, shall relieve any person from any responsibility for damage to persons or property resulting therefrom, or as otherwise imposed by law, nor impose any liability upon the municipal officials, employees or its designated representatives to the maximum extent permitted by law.

2. Neither the granting nor the denial of any permit which includes any stormwater management requirements shall not constitute a representation, guarantee or warranty of any kind by the municipality, the municipal officials, employees, or designated representatives thereof of the practicability or safety of any stormwater structure or facility, use or other plan proposed, and shall create no liability or cause of action upon any municipal official, employee, or designated representative thereof for any damage that may result pursuant thereto to the maximum extent permitted by law.

Section 102 - Stormwater Management Performance Standards

A. General Standards

1. All proposed stormwater control measures shall be evaluated according to the following performance standard:

   a. Any landowner and any person engaged in the alteration or development of land which may affect stormwater runoff

characteristics shall implement such measures as are reasonably necessary to prevent injury to health, safety or other property. Such measures shall include such actions as are required:

(1) To assure that the maximum rate of stormwater runoff is no greater after development than prior to development activities; or

(2) To manage the quantity, velocity and direction of resulting stormwater runoff in a manner which otherwise adequately protects health and property from possible injury.

2. The stormwater management plan for the development site shall consider all the stormwater runoff flowing over the site.

3. No discharge of toxic materials shall be permitted into any stormwater management system. Where required by federal and state regulation, the landowner or developer shall be responsible for obtaining and NPDES permit for stormwater discharges.

4. All land disturbance activities shall be conducted in such a way as to minimize accelerated erosion and sedimentation. Measures to control erosion shall at a minimum meet the standards of the County Conservation District and the rules and regulation of the Pennsylvania Department of Environmental Protection.

B. Stormwater Runoff Quantity Control Standards

1. Runoff Rates: There shall be no increase in the peak rate of stormwater runoff discharge from any activity covered by this Ordinance following the completion of the activity (post-development conditions) over the rate that would have occurred from the land prior to the activity (pre-development conditions). This criteria shall apply to the total activity even if the activity is to take place in stages.

a. Off site areas which drain through a proposed development site are not subject to the control standard when determining allowable peak runoff rates. However, on-site drainage facilities shall be designed to safely convey off-site flows through the development site.

b. Where the site area to be impacted through a proposed development activity differs significantly from the total site area, only the proposed impact area shall be subject to the runoff criteria.

2. Storm Frequencies. Stormwater management facilities on all development sites shall control the peak stormwater discharge for the 2-, 10-, 25- and

100-year storm frequencies. The USDA NRCS 24-hour, Type II Rainfall Distribution shall be used for analyzing stormwater runoff for both pre- and post-development conditions. The 24-hour total rainfall for these storm frequencies in the watershed are:

Storm Frequency	Rainfall Depth (inches)
2-year	2.6
10-year	3.8
25-year	4.6
100-year	6.1

5. Calculation Methods

a. Development Sites: For the purpose of computing peak flow rates and runoff hydrographs from development sites, calculations shall be performed using one of the following: USDA NRCS publications, Technical Release (TR) 55 or 20, HEC I or Penn State Runoff Model (PSRM) or Modified Rational Method. Under special circumstances other computation methods may be used subject to the approval of the municipality.

b. Stormwater Collection/Conveyance Facilities: For the purposes of designing storm sewers, open swales and other stormwater runoff collection and conveyance facilities, the Rational Method or other method as approved by the municipality may be applied. Rainfall intensities for design should be obtained from the Pennsylvania Department of Transportation rainfall charts.

c. Routing of hydrographs through detention / retention facilities for the purpose of designing those facilities shall be accomplished using the Modified-Puls Method or other recognized reservoir routing method subject to the approval of the municipality.

d. Predevelopment Conditions: Predevelopment conditions shall be assumed to be those which exist on any site prior to commencing any development activities. SCS runoff curve numbers selected for use in the calculations shall accurately reflect existing conditions subject to the approval of the municipality. At its discretion, the municipality may direct that hydrologic conditions for all areas with pervious cover (i.e., fields, woods, lawn areas, pastures, cropland, etc.) shall be assumed to be in "good" condition, and the lowest recommended SCS runoff curve number (CN) shall be applied for all pervious land uses within the respective range for each land use and hydrologic soil group. Impervious cover shall include, but not be limited to, any roof, parking, or driveway areas, and any new streets and sidewalks. Any areas designed to initially be gravel or crushed stone shall be assumed to be impervious for the purposes of these criteria. The Municipality has

the authority to require that computed existing runoff rates be reconciled with field observations and conditions. If the designer can substantiate through actual physical calibration that more appropriate runoff values should be used at a particular site, then appropriate variations may be made upon review and recommendations of the municipal engineer. Calibration shall require detailed gauge and rainfall data for the particular site in question.

C. Stormwater Quality Management Requirements

1. Applicability

In addition to the performance standards and design criteria requirements of Article III of this Ordinance, the land developer shall implement the following water quality requirements of this Article unless otherwise exempted by the provisions of this ordinance.

2. Water Quality Requirements

a. No discharge materials, toxic or otherwise, shall be permitted into any stormwater management system except as may be permitted by applicable laws of the Commonwealth of Pennsylvania or United States. Where required by federal and state regulation, the landowner or developer shall be responsible for obtaining an NPDES permit for stormwater discharges.

(Note: The following water quality management requirements are recommended for incorporation into the overall stormwater management requirements. However, they are presented as a suggestion - not as a required element of this plan.)

b. In addition to the quantity requirements of this ordinance, the land developer shall:

(1) Design stormwater detention / retention basins so that the outlet of the basin shall, in addition to any other stormwater requirements imposed by the municipal stormwater regulations, discharge the 1 year, 24 hour storm over a 24 hour period.

(2) As an alternative to subsection 102.C.2.b.(1), above, the water quality objectives may be achieved through a combination of best management practices (BMPs) including, but not limited to, infiltration structures, detention / retention basins, vegetation filter strips and buffers. The combination of BMPs shall be designed according to the

requirements listed under Section 102.C3. and in consultation with the municipal engineer.

(3) In lieu of (1) and (2) above, the land developer may submit original and innovative designs to the municipal engineer for review and approval.

3. BMP Selection Criteria

a. In selecting the appropriate BMP's or combinations thereof, the land developer shall consider the following:

(1) Total contributing area
(2) Permeability and infiltration rate of the site soils
(3) Slope and depth to bedrock
(4) Seasonal high water table
(5) Proximity to building foundations and well heads
(6) Erodibility of soils
(7) Land availability and configuration of the topography

b. The following additional factors should be considered when evaluating the suitability of the BMPs used to control water quality at a given development site.

(1) Peak discharge and required volume control
(2) Streambank erosion
(3) Efficiency of the BMPs to mitigate potential water quality problems
(4) The volume of runoff that will be effectively treated
(5) The nature of the pollutant(s) being removed
(6) Maintenance requirements
(7) Recreation value
(8) Enhancement of aesthetics and property values

Section 103 - Design criteria for stormwater management controls

A. General criteria

1. Applicants may select runoff control techniques, or a combination of techniques, which are most suitable to control stormwater runoff from the development site. All controls shall be subject to approval of the municipal engineer. The municipal engineer may request specific information on design and/or operating features of the proposed stormwater controls in order to determine their suitability and adequacy in terms of the standards of this ordinance.

2. The applicant should consider the effect of the proposed stormwater management techniques on any special soil conditions or geological

hazards which may exist on the development site. In the event such conditions are identified on the site, the municipal engineer may require in-depth studies by a competent geotechnical engineer. Not all stormwater control methods may be advisable or allowable at a particular development site.

3. In developing a stormwater management plan for a particular site, stormwater controls shall be selected according to the following order of preference:

   a. infiltration of runoff on-site

   b. flow attenuation by use of open vegetated swales and natural depressions

   c. stormwater detention/retention structures

4. Infiltration practices shall be used to the extent practicable to reduce volume increases and promote groundwater recharge. A combination of successive practices may be used to achieve the applicable minimum control requirements. Justification shall be provided by the applicant for rejecting each of the preferred practices based on actual site conditions.

B. Criteria for infiltration systems

1. Infiltration systems shall be sized and designed based upon local soil and ground water conditions.

2. Infiltration systems greater than three (3) feet deep shall be located at least ten (10) feet from basement walls.

3. Infiltration systems shall not be used to handle runoff from commercial or industrial working or parking areas. This prohibition does not extend to roof areas which are demonstrated to be suitably protected from the effects of the commercial/industrial activities.

4. Infiltration systems may not receive runoff until the entire drainage area to the system has received final stabilization.

5. The stormwater infiltration facility design shall provide an overflow system with measures to provide a non-erosive velocity of flow along its length and at the outfall.

C. Criteria for flow attenuation facilities

1. If flow attenuation facilities are employed to assist in the control of peak rates of discharge, their effects must be quantified using the SCS Technical Release (TR) 55 Urban Hydrology for Small Watersheds or other approved

method. The effects of the flow attenuation facilities on travel time should be reflected in the calculations.

2. Flow attenuation facilities such as swales and natural depressions should be properly graded to ensure positive drainage and avoid prolonged ponding of water.

3. Swales shall be properly vegetatively stabilized or otherwise lined to prevent erosion.

4. Swales shall be designed according to the recommendations contained in the Commonwealth of Pennsylvania Erosion and Sediment Pollution Control Program Manual.

D. Criteria for stormwater detention facilities

1. All detention facilities shall be equipped with outlet structures to provide discharge control for the four (4) designated storm frequencies. Provisions shall also be made to safely pass the post-development 100-year storm runoff without damaging (i.e., impairing the continued function of the facilities). Should any stormwater management facilities qualify as a dam under PA DEP Chapter 105, the facility shall be designed in accordance with those regulations and meet the regulations concerning dam safety.

2. Shared-storage facilities which provide detention of runoff for more than one development site within a single subarea are encouraged wherever feasible and provided such facilities meet the criteria contained in this section. In addition, runoff from the development sites involved shall be conveyed to the facility in a manner that avoids adverse impacts (such as flooding or erosion) to channels and properties located between the development site and the shared-storage facilities.

3. Where detention facilities will be utilized, multiple use facilities, such as wetlands, lakes, ballfields or similar recreational/open space uses are encouraged wherever feasible, subject to the approval of the municipality and Pennsylvania Department of Environmental Resources' Chapter 105 regulations.

4. Other considerations which should be incorporated into the design of the detention facilities include:

   a. Inflow and outflow structures shall be designed and installed to prevent erosion and bottoms of impoundment type structures should be protected from soil erosion.

   b. Control and removal of debris both in the storage structure and in all inlet or outlet devices shall be a design consideration.

c. Inflow and outflow structures, pumping stations, and other structures shall be designed and protected to minimize safety hazards.

d. The water depth at the perimeter of a storage pond should be limited to that which is safe for children. Restriction of access (fence, walls, etc.) may be necessary depending on the location of the facility and the maximum depths of water.

e. Side slope of storage ponds shall not exceed a ration of two-and-one-half to one (2.5:1) horizontal to vertical dimension.

f. Landscaping shall be provided for the facility which harmonizes with the surrounding area.

g. Facility shall be located to facilitate maintenance, considering the frequency and type of equipment that will be required.

h. Bottoms of detention basins should be graded with sufficient slope to provide positive surface drainage. A subdrainage system may be required depending on the location of the pond bottom relative to groundwater levels.

i. Fencing shall be provided if required by the municipality.

E. Criteria for collection/conveyance facilities

(Note: The municipality should review the specific requirements of this section for consistency with its existing requirements and local preferences. Specific design and construction details suggested here may be modified upon recommendation of the municipal engineer in order to reflect the municipality's current standard practices, local conditions and preferences.)

1. All stormwater runoff collection or conveyance facilities, whether storm sewers or other open or closed channels, shall be designed in accordance with the following basic standards:

   a. All sites shall be graded to provide drainage away from and around the structure in order to prevent any potential flooding damage.

   b. Lots located on the high side of streets shall extend roof and french drains to the curb line storm sewer (if applicable). Low side lots shall extend roof and french drains to a stormwater collection/conveyance/control system or natural watercourse in accordance with the approved stormwater management plan for the development site.

c. Collection/conveyance facilities should not be installed parallel and close to the top or bottom of a major embankment to avoid the possibility of failing or causing the embankment to fail.

d. All collection/conveyance facilities shall be designed to convey the 25-year storm peak flow rate from the contributing drainage area and to carry it to the nearest suitable outlet such as a stormwater control facility, curbed street, storm sewer or natural watercourse without damage to the drainage structure or roadway, with runoff from the 25-year design storm at a minimum 1.0 foot of freeboard measured below the lowest point along the top of the roadway. Roadway crossings located within designated floodplain areas must be able to convey runoff from a 100-year design storm with a minimum of 1.0 foot freeboard measured below the lowest point along the top of the roadway.

When it can be shown that, due to topographic conditions, natural darainage ways on the site cannot adequately provide for drainage, open channels may be constructed conforming substantially to the lilne and grade of such natural drainage ways. Work within natural drainage ways shall be subject to approval by PAADEP through the Joint Permit Application process, or, where appropriate by PADEP, through the General Permit process.

e. Where drainage swales or open channels are used, they shall be suitably lined to prevent erosion and designed to avoid excessive velocities.

f. Stormwater drainage systems shall be provided in order to permit unimpeded flow along natural watercourses, except as modified by stormwater management facilities or open channels consistent with this Ordinance.

g. Existing points of concentrated drainage that discharge onto adjacent property shall not be altered without permission of the altered property owner(s) and shall be subject to any applicable discharge criteria specified in this Ordinance.

h. Areas of existing diffused drainage discharge shall be subject to any applicable discharge criteria in the general direction of existing discharge, whether proposed to be concentrated or maintained as diffused drainage areas, except as otherwise provided by this ordinance. If diffused flow is proposed to be concentrated and discharged onto adjacent property, the developer must document that adequate downstream conveyance facilities exist to safely transport the concentrated discharge, or otherwise prove that no erosion,

sedimentation, flooding, or other harm will result from the concentrated discharge.

i. Where a development site is traversed by watercourses, drainage eaasements shall be provided conforming to the line of such watercourses. The terms of the easements shall prohibit excavation, the placing of fill or structures, and any alterations that may adversely affect the flow of stormwater within any portion of the easement. Also maintenance, including mowing of vegetation within the easement shall be required, except as approved by the appropriate governing authority.

j. Any stormwater management facilities regulated by this Ordinance that would be located in or adjacent to waters of the Commonwealth of Pennsylvania or wetlands shall be subject to approval by PADEP through the Joint Permit Application process, or, where deemed appropriate by PADEP, the General Permit process. When there is a question whether wetlands may be involved, it is the responsibility of the Developer or his agent to show that the land in question cannot be classified as wetlands, otherwise approval to work in the area must be obtained by PADEP.

k. Any stormwater management facilities regulated by this Ordinance that would be located on State highway rights-of-way shall be subject to approval by the Pennsylvania.

l. In order to promote overland flow and infiltration/percolation of runoff where it is advantageous to do so, roof drains must not be connected to streets, sanitary or storm sewers, or roadside ditches. When it is more advantageous to connect directly to streets or storm seewers, then it shall be permitted on a case by case basis by the municipality.

2. Wherever storm sewers are proposed to be utilized, they shall comply with the following criteria:

a. Where practical, designed to traverse under seeded and planted areas. If constructed within ten (10) feet of road paving, walks or other surfaced areas, drains shall have a narrow trench and maximum compaction of backfill to prevent settlement of the superimposed surface or development.

b. Preferably installed after excavating and filling in the area to be traversed is completed, unless the drain is installed in the original ground with a minimum of three (3) feet cover and/or adequate protection during the fill construction.

c. Designed: (1) with cradle when traversing fill areas of indeterminate stability, (2) with anchors when gradient exceeds twenty (20) percent, and (3) with encasement or special backfill requirements when traversing under a paved area.

d. Designed to adequately handle the anticipated stormwater flow and be economical to construct and maintain. The minimum pipe size shall be fifteen (15) inches in diameter.

e. Drain pipe, trenching, bedding and backfilling requirements shall conform to the requirements of the municipality and/or applicable PennDOT Specifications, Form 408.

f. All corrugated metal pipe shall be polymer coated, and with asbestos bonding and paved inverts where prone to erode. Pipe within a municipal right-of-way shall be reinforced concrete pipe with a minimum diameter of 15 inches.

g. Storm inlets and structures shall be designed to be adequate, safe, self-cleaning and unobtrusive and consistent with municipal standards.

h. Appropriate grates shall be designed for all catch basins, stormwater inlets and other entrance appurtenances.

i. Manholes shall be designed so that the top shall be at finished grade and sloped to conform to the slope of the finished grade. Top castings of structures located in roads or parking areas shall be machined or installed to preclude "rattling."

j. Where proposed sewer connects with an existing storm sewer system, the applicant shall demonstrate that sufficient capacity exists in the downstream system to handle the additional flow.

k. Storm sewer outfalls shall be equipped with energy dissipation devices to prevent erosion and conform with applicable requirements of the Pennsylvania DEP for stream encroachments (Chapter 105 of Pennsylvania DEP Rules and Regulations).

Section 104 - Erosion and sedimentation controls

A. An erosion/sedimentation plan shall be prepared for each development site in accordance with the Pennsylvania Erosion/Sedimentation Regulations (25 PA Code, Chapter 102) and the standards and guidelines of the County Conservation District.

(Note: If the municipality has a grading or other ordinance which contains its erosion/sedimentation provisions, then it should be referenced here.)

Section 105 - Maintenance of stormwater management controls

A. Maintenance responsibilities

1. The maintenance plan for stormwater management facilities located on the development site shall establish responsibilities for the continuing operation and maintenance of all proposed stormwater control facilities, consistent with the following principles:

   a. If a development consists of structures or lots which are to be separately owned and in which streets, sewers and other public improvements are to be dedicated to the municipality, stormwater control facilities should also be dedicated to and maintained by the municipality.

   b. If a development site is to be maintained in single ownership or if sewers and other public improvements are to be privately owned and maintained, then the ownership and maintenance of stormwater control facilities should be the responsibility of the owner or private management entity.

2. The governing body, upon recommendation of the municipal engineer, shall make the final determination on the continuing maintenance responsibilities prior to final approval of the stormwater management plan. The governing body reserves the right to accept the ownership and operating responsibility for any or all of the stormwater management controls and to determine the terms and conditions under which it will accept ownership and operating responsibility.

B. Maintenance agreement for privately owned stormwater facilities

1. Prior to final approval of the site's stormwater management plan the applicant and municipality shall execute a maintenance agreement covering all stormwater control facilities which are to be privately owned. The maintenance agreement shall be recorded with the final subdivision/land development plan for the site. The agreement shall stipulate that:

   a. All facilities shall be maintained in accordance with the approved maintenance schedule and in a safe and attractive manner.

   b. Easements and or rights-of-way shall be conveyed to the municipality to assure access for periodic inspections by the municipality and maintenance if required.

   c. The name, address and telephone number of the person or company responsible for maintenance activities shall be filed with the

municipality. In the event of a change, new information will be submitted to the municipality within ten (10) days of the change.

d. If the facility owner fails to maintain the stormwater control facilities, the municipality may perform the necessary maintenance work or corrective work following due notice by the municipality to the facility owner to correct the problem(s). The facility owner shall reimburse the municipality for all costs.

2. Other items may be included in the agreement where determined necessary to guarantee the satisfactory maintenance of all facilities.

C. Municipal stormwater maintenance fund

(Note: This provision illustrates one way a municipality could establish a special fund to finance its maintenance and inspection activities for stormwater retention/detention facilities. It is an optional provision of the ordinance. If a municipality is interested in establishing such a fund, it is recommended that it consult with its solicitor for legal requirements and procedures.)

1. Persons installing stormwater storage facilities shall be required to pay a specified amount to the Municipal Stormwater Maintenance Fund to help defray costs of periodic inspections and maintenance expenses. The amount of the deposit shall be determined as follows:

a. If the storage facility is to be privately owned and maintained, the deposit shall cover the cost of periodic inspections performed by the municipality for a period of ten (10) years, as estimated by the municipal engineer. After that period of time, inspections will be performed at the expense of the municipality.

b. If the storage facility is to be owned and maintained by the municipality, the deposit shall cover the estimated costs for maintenance and inspections for ten (10) years. The municipal engineer will establish the estimated costs utilizing information submitted by the applicant.

c. The amount of the deposit to the fund shall be converted to present worth of the annual series values. The municipal engineer shall determine the present worth equivalents which shall be subject to the approval of the governing body.

2. If a storage facility is proposed that also serves as a recreation facility (e.g., ballfield, lake), the municipality may reduce or waive the amount of the maintenance fund deposit based upon the value of the land for public recreation purposes.

3. If in the future a storage facility (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 the facility and connecting to the storm sewer system or other facility. Any amount of the deposit remaining after the costs of abandonment are paid will be returned to the depositor.

Section 106 - Stormwater plan requirements

A. General requirements

1. No final subdivision/land development plan be approved, no permit authorizing construction issued, or any clearing and grubbing, or earth moving or land disturbance activity initiated until the final stormwater management plan for the development site is approved in accordance with the provisions of this ordinance.

B. Exemptions

1. The following activities are exempt from the stormwater management plan preparation provisions of this Ordinance. Exemption shall not relieve the applicant from providing adequate stormwater management to meet the purpose of this Ordinance.

a. Any regulated activity that would create 5,000 square feet or less of impervious area. This criteria shall apply to the total development even if development is to take place in phases.

b. Land disturbance associated with existing one and two family dwellings.

c. Use of land for gardening for home consumption.

e. Agriculture when operated in accordance with a conservation plan or erosion and sedimentation control plan approved by the Conservation District. The agricultural activities such as growing crops, rotating crops, filling of soil and grazing animals and other such activities are specifically exempt from complying with the requirements of this Ordinance when such activities are conducted in accordance with a conservation plan prepared by the Blair County Conservation District. The construction of buildings, parking lots or any activity that may result in impervious surface which increases the rate and volume of stormwater runoff shall comply with the requirements of this Ordinance.

f. Forest management operations which are following the Department of Environmental Protection's management practices contained in its publication "Soil Erosion and Sedimentation Control Guidelines for

Forestry" and are operating under an erosion and sedimentation control plan.

C. Stormwater plan contents

1. General Format: The stormwater plan shall be drawn on sheets no larger than 16" X 22" with a graphic scale of not less than 1 inch = 200 feet. All sheets shall contain a title block with: Name and address of applicant and engineer, scale, north arrow, legend and date of preparation.

2. Existing and Proposed Features: The plan shall show the following under both pre-development and post-development conditions:

   a. Watershed location - Provide a key map showing the location of the development site within the watershed(s) and watershed subarea(s). On all site drawings, show the boundaries of the watershed(s) and subarea(s) as they are located on the development site and identify watershed names(s) and subarea number(s).

   b. Floodplain boundaries - Identify 100-year floodplains on the development site (as appropriate) based on the municipal Flood Insurance Study maps.

   c. Natural features - Show all bodies of water (natural or artificial), watercourses (permanent and intermittent), swales, wetlands and other natural drainage courses on the development site, or which will be affected by runoff form the development.

   d. Soils - Provide an overlay showing soil types and boundaries within the development site (consult county, SCS and U.S. Geological Survey for information).

   e. Contours - Show existing and final contours at intervals of two (2) feet; in areas with slopes greater than fifteen (15) percent, five (5) foot contour intervals may be used.

   f. Land cover - Show existing and final land cover classifications as necessary to support and illustrate the runoff calculations performed.

   g. Drainage area delineations - Show the boundaries of the drainage areas employed in the runoff calculations performed.

   h. Stormwater management controls - Show any existing stormwater management or drainage controls and/or structures, such as sanitary and storm sewers, swales, culverts, etc. which are located on the development site, or which are located off-site but will be affected by runoff from the development.

3. Professional certification: The stormwater management plan (including all calculations) shall be prepared and sealed by a registered professional engineer, surveyor or landscape architect with training and expertise in hydrology and hydraulics. Documentation of qualifications may be required by the municipality.

4. Runoff calculations: Calculations for determining pre- and post-development discharge rates and for designing proposed stormwater control facilities must be submitted with the stormwater management plan. All calculations shall be prepared using the methods and data prescribed by Section 102 of this Article.

5. Stormwater controls: All proposed stormwater runoff control measures must be shown on the plan including methods for collecting, conveying and storing stormwater runoff on-site, which are to be used both during and after construction. Erosion and sedimentation controls shall be shown in accordance with Section 104 of this Article. The plan shall provide information on the exact type, location, sizing, design and construction of all proposed facilities and relationship to the existing watershed drainage system. The plan shall include technical specifications for materials and methods to be used in the construction of the stormwater management facilities.

   a. If the development is to be constructed in stages, the applicant must demonstrate that stormwater facilities will be installed to manage stormwater runoff safely during each stage of development.

   b. A schedule for the installation of all temporary and permanent stormwater control measures and devices shall be submitted.

   c. If appropriate, a justification should be submitted as to why any preferred stormwater management techniques, as listed in Section 102 and 103, are not proposed for use.

6. Easements, rights-of-way, deed restrictions: All existing and proposed easements and rights-or-way for drainage and/or access to stormwater control facilities shall be shown along with any areas subject to special deed restrictions relative to or affecting stormwater management on the development site.

7. Other permits/approvals: A list of any approvals/permits relative to stormwater management that will be required from other governmental agencies (Pennsylvania DEP Chapter 105 and 106 permits and/or NPDES permit) and anticipated dates of submission/receipt should be included with the stormwater plan submission. Copies of permit applications may be requested by the municipality where they may be helpful for the plan review.

8. Maintenance program: The proposed maintenance plan for all stormwater control facilities shall:

   a. Identify the proposed ownership entity (e.g., municipality, property owner, private corporation, homeowner's association, or other entity).

   b. Identify the type of maintenance, probable frequencies, personnel and equipment requirements and estimated annual maintenance costs.

   c. Identify method of financing continuing operation and maintenance if the facility is to be owned by other than a governmental agency.

   d. Include copies of any legal agreements required to implement the maintenance program and, if applicable, copies of the maintenance agreement as required by Section 105 of this Article.

9. Financial guarantees: Submit financial guarantees in accordance with the provisions of Section 111 of this Article.

Section 107 - Plan review procedures

A. Pre-application phase

1. Before submitting the stormwater plan, applicants are urged to consult with the municipality on the applicable regulations and techniques for safely managing runoff from the development site. The municipality may also be helpful in providing necessary data for the stormwater management plan.

2. Applicants are encouraged to submit a sketch plan with a narrative description of the proposed stormwater management controls for general guidance and discussion with the municipality and other agencies.

3. The pre-application phase is not mandatory; any review comments provided by the municipality are advisory only and do not constitute any legally binding action on the part of the municipality.

B. Stormwater plan reviews

1. Submission of plans: Stormwater plan applications shall be submitted with the preliminary and final subdivision/land development applications.

2. Notification of affected municipalities: The applicant shall notify municipalities adjacent to the development site, which may be affected by the stormwater runoff and proposed controls for the site. Copies of the

plans will be made available to the municipalities upon request. Comments received from any affected municipality will be considered by the municipal engineer and county agencies in their reviews.

3. Municipal engineer's review: The municipal engineer shall recommend approval or disapproval of the stormwater management plan based on the requirements of the municipal ordinances, the standards and criteria of the watershed plan and good engineering practice. The engineer shall submit a written report, along with supporting documentation, stating their reasons for approval or disapproval.

(Note: 1) If the municipal Planning Commission has the final authority for approving plans, then this section should be changed as appropriate.)

5. Permits required from other governmental agencies: Where the proposed development requires an obstruction permit from the Pennsylvania DEP or an erosion/sedimentation permit from the County Conservation District, final stormwater management plan approval shall be granted subject to the receipt of such permits. No building permit shall be issued, nor construction started, until the permits are received and copies filed with the municipality.

Section 108 - Status of the stormwater plan after final approval

A. Upon final stormwater plan approval and receipt of all necessary permits, the applicant may commence to install or implement the approved stormwater management controls.

B. If site development or building construction does not begin within two years of the date of final approval of the stormwater management plan, then before doing so, the applicant shall resubmit the stormwater management plan to verify that no condition has changed within the watershed that would affect the feasibility or effectiveness of the previously approved stormwater management controls. Further, if for any reason development activities are suspended for two years or more, then the same requirement for resubmission of the stormwater management plan shall apply.

Section 109 - Stormwater plan modifications

A. If the request for a plan modification is initiated before construction begins, the stormwater plan must be resubmitted and reviewed according to the procedures contained in Section 107 above.

B. If the request for a plan modification is initiated after construction is underway, the municipal engineer shall recommend approval or disapproval of the modification based on field inspection provided: (1) the requested changes in stormwater controls do not result in any modifications to other approved municipal land

use/development requirements (e.g., building setbacks, yards, etc.) and (2) the performance standards in Section 102 are met. Notification of the engineer's action shall be sent to the governing body which may issue a stay of the plan modification within five (5) days and require the permittee to resubmit the plan modification for full stormwater plan review in accordance with Section 107 above.

Section 110 - Inspections of stormwater management controls

(Note: This section outlines an ideal schedule for inspecting stormwater controls during construction. However, the recommendations may have to be tailored to each municipality's needs and resources.)

A. The municipal engineer or a designated representative shall inspect the construction of the temporary and permanent stormwater management system for the development site. The permittee shall notify the engineer 48 hours in advance of the completion of the following key development phases:

1. At the completion of preliminary site preparation including stripping of vegetation, stockpiling of topsoil and construction of temporary stormwater management and erosion control facilities.

2. At the completion of rough grading but prior to placing topsoil, permanent drainage or other site development improvements and ground covers.

3. During construction of the permanent stormwater facilities at such times as specified by the municipal engineer.

4. Completion of permanent stormwater management facilities including established ground covers and plantings.

5. Completion of final grading, vegetative control measures or other site restoration work done in accordance with the approved plan and permit.

B. No work shall commence on any subsequent phase until the preceding one has been inspected and approved. If there are deficiencies in any phase, the municipal engineer shall issue a written description of the required corrections and stipulate the time by which they must be made.

C. If during construction, the contractor or permittee identifies any site condition, such as subsurface soil conditions, alterations in surface or subsurface drainage which could affect the feasibility of the approved stormwater facilities, he/she shall notify the municipal engineer within 24 hours of the discovery of such condition and request a field inspection. The municipal engineer shall determine if the condition requires a stormwater plan modification.

D. In cases where stormwater facilities are to be installed in areas of landslide-prone soils or other special site conditions exist, the municipality may require special

precautions such as soil tests and core borings, full-time inspectors and/or similar measures. All costs of any such measures shall be borne by the permittee.

Section 111 - Financial guarantees and dedication of public improvements

(Note: If these provisions are already included in another article of the subdivision/land development ordinance, they can simply be referenced here.)

A. Guarantee of completion: A completion guarantee in the form of a bond, cash deposit, certified check or other negotiable securities acceptable to the municipality, shall be filed. The guarantee shall cover all streets, sanitary sewers, stormwater management facilities, water systems, fire hydrants, sidewalks and other required improvements; it shall be in the amount and form prescribed by the Municipal Planning Code (Section 509).

B. Release of completion guarantee: The procedures for requesting and obtaining a release of the completion guarantee shall be in a manner prescribed by the Municipalities Planning Code (Section 510).

C. Default of completion guarantee: If improvements are not installed in accordance with the approved final plan, the governing body may enforce any corporate bond or other security by appropriate legal and equitable remedies. If proceeds of such bond or other security are insufficient to pay the cost of installing or making repairs or corrections to all the improvements covered by said security, the governing body may at its option install part of such improvements in all or part of the development and may institute appropriate legal or equitable action to recover the moneys necessary to complete the remainder of the improvements. All proceeds, whether resulting from the security or from the security or from any legal or equitable action brought against the developer, or both, shall be used solely for the installation of the improvements covered by such security and not for any other municipal purpose.

D. Dedication of public improvements:

1. When streets, sanitary sewers, stormwater management facilities, water lines or other required improvements in the development have been completed in accordance with the final approved plan, such improvements shall be deemed private until such time as they have been offered for dedication to the municipality and accepted by separate ordinance or resolution or until they have been condemned for use as a public facility.

2. Prior to acceptance of any improvements or facilities, the municipal engineer shall inspect it to ensure that it is constructed in accordance with the approved plan and is functioning properly. In the case of any stormwater control facility, it must be free of sediment and debris.

3. The owner shall submit as-built plans for all facilities proposed for dedication.

E. Maintenance guarantee: Prior to acceptance of any improvements or facilities, the applicant shall provide a financial security to secure the structural integrity and functioning of the improvements. The security shall: (1) be in the form of a bond, cash, certified check or other negotiable securities acceptable to the municipality, (2) be for a term of 18 months, and (3) be in an amount equal to 15 percent of the actual cost of the improvements and facilities so dedicated.

Section 112 - Fee Schedule

The municipal governing body may adopt by resolution from time to time a reasonable schedule of fees to cover the cost of plan reviews, inspections and other activities necessary to administer the provisions of this ordinance. All fees shall be set in accordance with the applicable provisions of the Municipalities Planning Code and any dispute over the fee amount shall be resolved in the manner prescribed by the Planning Code.

Section 113 - Enforcement procedures and remedies

(Note: This section is drafted to be consistent with the Planning Code for enforcing a municipal subdivision and land development ordinance. If the municipality adopts a separate, single-purpose stormwater management ordinance, then this section should be modified as appropriate to meet the provisions of the municipal codes.)

A. Right of entry: Upon presentation of proper credentials, duly authorized representatives of the municipality may enter at reasonable times upon any property to investigate or ascertain the condition of the subject property in regard to an aspect regulated by this ordinance.

B. Notification: In the event that the applicant, developer, owner or his/her agent fails to comply with the requirements of this ordinance or fails to conform to the requirements of any permit, a written notice of violation shall be issued. Such notification shall set forth the nature of the violations(s) and establish a time limit for correction of the violation(s). Upon failure to comply within the time specified, unless otherwise extended by the municipality, the applicant, developer, owner or his/her agent shall be subject to the enforcement remedies of this ordinance.

C. Preventive remedies:

1. In addition to other remedies, the municipality may institute and maintain appropriate actions at law or in equity to restrain, correct or abate a violation, to prevent unlawful construction, to recover damages and to prevent illegal occupancy of a building or premises.

2. In accordance with the Planning Code (Sec. 515.1), the municipality may refuse to issue any permit or grant approval to further improve or develop any property which has been developed in violation of this chapter.

D. Enforcement remedies

1. Any person, who has violated or permitted the violation of the provisions of this Ordinance shall, upon being found liable therefor in a civil enforcement proceeding commenced by the municipality, pay a fine of not less than $_____ and not more than $_____ plus court costs, including reasonable attorney fees and engineers and other expert witness fees incurred by the municipality. No judgment shall commence or be imposed, levied or be payable until the date of the determination of a violation by a court of competent jurisdiction.

2. If the defendant neither pays nor timely appeals the judgment, the municipality may enforce the judgment pursuant to applicable rules of civil procedure.

3. Each day that a violation continues shall constitute a separate violation unless the court of competent jurisdiction further determines that there was a good faith basis for the person violating the ordinance to have believed that there was no such violation. In such case there shall be deemed to have been only one such violation until the fifth day following the date of the initial determination of a violation; thereafter each day that a violation continues shall constitute a separate violation.

4. All judgments, costs and reasonable attorney fees collected for the violation of this Ordinance shall be paid over to the municipality.

5. A court of competent jurisdiction, upon petition, may grant an order of stay, upon cause shown, tolling the per diem fine pending a final adjudication of the violation and judgment.

6. Nothing contained in this section shall be construed or interpreted to grant to any person or entity other than the municipality the right to commence any action for enforcement pursuant to this section.

E. Additional remedies: In addition to the above remedies, the municipality may also seek remedies and penalties under applicable Pennsylvania statutes, or regulations adopted pursuant thereto, including but not limited to the Storm Water Management Act (32 P.S. Section 693.1-693.27) and the Erosion and Sedimentation Regulations (25 Pennsylvania Code, Chapter 102). Any activity conducted in violation of this ordinance or any Pennsylvania approved watershed stormwater management plan is declared a public nuisance by the municipality and abatable as such.

Section 114 - Definitions

Act: The Storm Water Management Act (Act of October 4, 1978, P.L. 864 No. 167; 32 P.S. Sections 680.1-680.17, as amended by Act of May 24, 1984, No. 63).

Applicant: A landowner or developer who has filed an application for development including his/her heirs, successors and assigns.

Channel: A perceptible natural or artificial waterway which periodically or continuously contains moving water or which forms a connecting link between two bodies of water. It has a definite bed and banks which confine the water.

Conservation District: The Blair County Conservation District.

County: Blair County, Pennsylvania

Culvert: A closed conduit for the free passage of surface drainage under a highway, railroad, canal or other embankment.

Design criteria: (1) Engineering guidelines specifying construction details and materials. (2) Objectives, results, or limits which must be met by a facility, structure, or process in performance of its intended functions.

Design storm: (see storm frequency)

Detention: The slowing, dampening or attenuating of runoff flows entering the natural drainage pattern or storm drainage system by temporarily holding water on a surface area in a detention basin or within the drainage system.

Detention pond or basin: An basin or reservoir, usually small, constructed to impound or retard surface runoff temporarily.

Developer: The person, persons, or any corporation, partnership, association, or other entity or any responsible person therein or agent therefor that undertakes the activities associated with changes in land use. The term "developer" is intended to include by not necessarily be limited to the term "subdivider", "owner", and "builder" even though the individuals involved in successive stages of a project may vary.

Development: Any activity, construction, alteration, change in land use or practice that affects stormwater runoff characteristics.

Discharge: The flow or rate of flow from a canal, conduit, channel or other hydraulic structure.

Drainage: (1) In general, the removal of surface water from a given area. Commonly applied to surface water and ground water.

Drainage Area: (1) The area of a drainage basin or watershed, expressed in acres, square miles, or other unit of area. Also called catchment area, watershed, river basin. (2) The area served by a sewer system receiving storm and surface water, or by a watercourse.

Encroachment: Any structure or activity which in any manner changes, expands or diminishes, the course, current or cross section of any watercourse, floodway or body of water.

Erosion: Wearing away of the lands by running water, glaciers, winds and waves.

Erosion control: The application of measures to reduce erosion of land surfaces.

Ground Cover: Materials covering the ground surface,

Ground Water: Subsurface water occupying the saturation zone, from which wells and springs are fed.

Ground Water Recharge: Replenishment of ground water naturally by precipitation or runoff or artificially by spreading or injection.

Impervious: Not allowing or allowing only with great difficulty the movement of water; impermeable.

Infiltration: (1) The flow or movement of water through the interstices or pores of a soil or other porous medium. (2) The absorption of liquid by the soil.

Land Development: Any of the following activities:

> (1) the improvement of one lot or two or more contiguous lots, tracts or parcels or land for any purpose involving: (a) a group of two or more residential or non-residential buildings, whether proposed initially or cumulatively, or a single non-residential building on a lot or lots regardless of the number of occupants or tenure; or (b) the division or allocation of land or space, whether initially or cumulatively, between or among two or more existing or prospective occupants by means of, or for the purpose of streets, common areas, leaseholds, condominiums, building groups or other features;
>
> (2) a subdivision of land.

Land Disturbance: Any activity involving the changing, grading, transportation, fill and any other activity which causes land to be exposed to the danger of erosion.

Maintenance: The upkeep necessary for efficient operation of physical properties.

Municipality: (name of municipality)

Municipal engineer: A professional engineer licensed in the Commonwealth of Pennsylvania, duly appointed by the (name of municipality).

Natural Stormwater Runoff Regime: A watershed where natural surface configurations, runoff characteristics and defined drainage conveyances have attained the conditions of equilibrium.

Outfall: (1) The point, location or structure where drainage discharges from a sewer, drain or other conduit. (2) The conduit leading to the ultimate discharge point.

Outlet Control Structure: The means of controlling the relationship between the headwater elevation and the discharge, placed at the outlet or downstream end of any structure through which water may flow.

Performance Standard: A standard which establishes an end result or outcome which is to be achieved but does not prescribe specific means for achieving it.

Peak Flow: Maximum flow.

Pennsylvania DEP: Pennsylvania Department of Environmental Protection.

Release Rate Percentage: The watershed factor determined by comparing the maximum rate of runoff from a subbasin to the contributing rate of runoff to the watershed peak rate at specific points of interest.

Retention Pond: A basin, usually enclosed by artificial dikes, that is used to retard stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate.

Return Period: The average interval in years over which an event of a given magnitude can be expected to recur.

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

Runoff Characteristics: The surface components of any watershed which affect the rate, amount, and direction of stormwater runoff. These may include but are not limited to: vegetation, soils, slopes and man-made landscape alterations.

SCS: U.S. Department of Agriculture Soil Conservation Service.

Sediment: Mineral or organic solid material that is being transported or has been moved from its site of origin by air, water or ice and has come to rest.

Sedimentation: The process by which mineral or organic matter is accumulated or deposited by moving water, wind or gravity.

Storage Facility: (See detention pond and retention pond).

Storm Frequency: The average interval in years over which a storm event of a given precipitation volume can be expected to occur.

Storm Sewer: A sewer that carries intercepted surface runoff, street water and other drainage but excludes domestic sewage and industrial waste.

Stormwater: That portion of precipitation which runs over the land.

Stormwater Collection System: Natural or man-made structures that collect and transport stormwater through or from a drainage area to the point of final outlet including, but not limited to, any of the following: conduits and appurtenant features, canals, channels, ditches, streams, culverts, streets, and pumping stations.

Stormwater Management Plan: The plan for managing stormwater runoff adopted by Blair County as required by the Storm Water Management Act.

Subdivision: The division or redivision of a lot, tract or parcel of land by any means into two or more lots, tracts, parcels or other divisions of land including changes in existing lot lines for the purpose, whether immediate or future, of lease, partition by the court for distribution to heirs or devisees, transfer of ownership or building or lot development, provided, however, that the subdivision by lease of land for agricultural purposes into parcels of more than 10 acres, not involving any new street or easement of access or any residential dwelling shall be exempted.

Swale: A low-lying stretch of land which gathers or carries surface water runoff.

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

Watershed: The entire region or area drained by a river or other body of water whether natural or artificial. A "designated watershed" is an area delineated by the Pennsylvania DEP and approved by the Environmental Quality Board for which counties are required to develop watershed stormwater management plans.

Watershed Stormwater Management Plan: The plan for managing stormwater runoff throughout a designated watershed adopted by Blair County as required by the Pennsylvania Storm Water Management Act.

MODEL STORMWATER MANAGEMENT PROVISIONS FOR THE MUNICIPAL ZONING ORDINANCE

(Note: The following section should be added to the Supplementary Provisions of the municipality's existing zoning ordinance. This provision assures that stormwater management standards apply to all types of land uses in the municipality)

Section _____, Stormwater Management

A. All uses or lots in all zoning districts shall comply with the applicable requirements and standards for managing stormwater runoff in accordance with the municipal subdivision and land development ordinance.

(Note: The following language should be included if the municipality permits any of the following land use activities under its zoning district regulations.)

B. Agricultural activities, nurseries and forestry management operations, where permitted by this ordinance, shall be required to provide for the safe management of stormwater runoff in accordance with the requirements of the subdivision/land development ordinance. However, the submission and approval of a stormwater management plan shall be waived when:

1. agricultural activities are operated in accordance with a conservation plan or erosion and sedimentation control plan approved by the Blair County Conservation District;

2. forestry management operations are following Pennsylvania DEP management practices contained in its publication Soil Erosion and Sedimentation Control Guidelines for Forestry and are operating under an erosion and sedimentation control plan.

C. Strip mining where permitted by this ordinance shall have a plan for control of erosion and sedimentation and stormwater runoff which is approved by the Pennsylvania DEP. If the strip mining operation is located within a watershed(s) for which a stormwater management plan has bee approved in accordance with the requirements of the Storm Water Management Act, then the erosion/sedimentation plan and any permanent stormwater runoff controls shall be consistent with the standards and criteria of the watershed stormwater management plan. A copy of the state-approved erosion/sedimentation plan shall be filed with the municipality prior to commencing mining operations.