ALLEGHENY COUNTY PLANNING DEPARTMENT
PITTSBURGH, PENNSYLVANIA

MONTOUR RUN WATERSHED STORMWATER MANAGEMENT PLAN

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I. INTRODUCTION

On October 4, 1978, with the passage of the Storm Water Management Act (Act 167) and its companion bill, the Flood Plain Management Act (Act 166), the Commonwealth of Pennsylvania embarked upon a significant new course to reduce flooding and the problems caused by inadequately controlled stormwater runoff. Recognizing the repeated threats to public health and safety, the legislature mandated a comprehensive approach to planning and managing excess stormwater runoff. The Storm Water Management Act sets up a program for managing accelerated runoff so that it does not lead to flooding. The Flood Plain Act provides for the preservation and restoration of floodplains, which are natural stormwater storage areas.

Since the early 1900s, substantial portions of Pennsylvania's landscape have changed dramatically. With the advent of the automobile, residential, commercial, and industrial development spread across the countryside, transforming it from farms and rural villages to sprawling urban-suburban communities. The alteration of natural surface contours through the construction of buildings, streets, and large parking areas has modified rainfall/runoff patterns to such an extent that local flooding problems now plague communities throughout the Commonwealth.

In some areas, these problems occur on a house-to-house basis where runoff from one or more lots in a single development damages walls or driveways or ends up as a pond on a neighbor's lot. In others, runoff from streets and storm sewers in one residential development or from a large commercial development causes flooding of lands and buildings farther downstream. The cumulative effect of development has resulted in the flooding of both small and large streams, with property damage running into the millions of dollars and even causing loss of life.

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. It says:

> "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.
>
> 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."

In the past, stormwater management was oriented primarily toward a single site or development. Good stormwater management was getting the water off the site as quickly as possible and into the nearest stream or river. Minimal attention was given to the effects on downstream locations (frequently because they were in another municipality) or to designing stormwater controls within the context of the entire watershed.

Act 167 changes this approach by instituting a comprehensive program of stormwater planning and management. The act requires counties to prepare and adopt watershed stormwater management plans for each watershed located in the county, as designated by the Pennsylvania Department of Environmental Resources (PaDER). These plans are to be prepared in consultation with the municipalities located in the watershed working through a Watershed Plan Advisory Committee.

The analysis of Act 167 assisted in the technical work by clarifying the purposes and intent of the act and the basic standards established by the act for stormwater management. The legal analysis also provided a basis for determining the types and nature of regulatory measures that could and should be applied to implement the Montour Run Stormwater Management Plan. This is an important consideration because Act 167 requires local governments to adopt and enforce necessary land use and development controls to implement the plan.

This management plan includes proposals for ordinance provisions designed to implement the recommended technical measures. These ordinance standards are intended to provide a guide for the municipalities in enacting or amending their existing ordinances. The model ordinance provisions that are provided with this plan can be used as the basis for preparing specific ordinance language for each municipality within the watershed.

The stormwater plans cannot be implemented effectively on a piecemeal basis. A watershed management approach and intergovernmental cooperation is required. Therefore, this study identifies several approaches that the municipalities, counties, and state can take to implement a workable stormwater management system. The system should be capable of performing various required functions, including planning, construction, operation and maintenance, regulation, and financing. The management system finally selected for each watershed will vary depending upon the physical, economic, and development characteristics of the watershed. The local officials and residents of each watershed will have to determine the system that will function most effectively and economically in their specific area.

Contents of the Plan

This Montour Run Stormwater Management Plan 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 management and regulatory responsibilities are identified as they relate to developers and local, county, and state agencies. It also contains a scale (1/2 inch = 2000 feet) release rate percentage map showing the location of existing obstructions and identified problem areas. Copies of the computer model prints and hand calculations are on file with the Allegheny County Planning Department.

A separate Executive Summary is available. The summary highlights the key technical findings and recommendations of the watershed study. It also outlines watershed management alternatives, as well as required additions and changes to municipal land use and development regulations to implement the watershed plan.

II. ACT 167 WATERSHED-LEVEL STORMWATER MANAGEMENT PLANNING AND IMPLEMENTATION

An analysis of stormwater management would not be complete without some discussion of the law that created the stormwater management program, along with the other laws that relate to its implementation. It is appropriate to undertake a more in-depth analysis of the state statutes that govern stormwater-related activities. This is particularly true in the case of the Storm Water Management Act (Act 167) for which there are no administrative regulations or case law to interpret its meaning and provisions.

This is an area of law that is not widely understood by local officials, developers, and property owners. Pennsylvania common law relating to drainage rights has developed over decades into a very complex system, and 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. Many municipal officials, engineers, and developers are not well informed on other laws that relate to stormwater development regulation and government liabilities.

In addition to the Storm Water Management Act, there are four other laws which collectively provide the legal powers and mandates to implement a comprehensive stormwater management plan. They are the following:

- Dam Safety and Encroachments Act (Act 325-1978)
- Clean Streams Law (specifically, the erosion and sedimentation regulations adopted pursuant to the law)

specific ordinance language for each municipality within the watershed.

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- Flood Plain Management Act (Act 166-1978)
- Pennsylvania Municipalities Planning Code (Act 247, as amended)

Key provisions of each of the five primary statutes are presented here. Highlighted are the elements that are most pertinent to the watershed stormwater plans and management programs. A brief overview on governmental immunities is included because it is helpful for the municipalities to understand their potential liabilities.

It should be noted that the comments on these acts are not intended to be official legal opinions nor are they to constitute advice on any specific issue or case. Instead, this chapter is provided to assist in a general understanding of the legal framework for stormwater management.

Storm Water Management Act (Act 167-1978)

There are two key sections of this act: Section 5, which sets up the watershed stormwater planning programs, and Section 13, which establishes the basic standard for managing stormwater runoff to prevent problems resulting from uncontrolled runoff, including flooding, erosion and sedimentation, landslides, and pollution and debris often carried by storm runoff. A secondary intent is the elimination or correction of existing stormwater and flooding problems.

Watershed Stormwater Plans. As discussed in the preceding section, one of the act's innovative features is the creation of a public stormwater planning, management, and control system at the watershed level. These plans are to be prepared for each watershed delineated by PaDER.

The counties that are responsible for preparing the plans must organize a watershed advisory committee 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 PaDER after public review and comment. The completed plans must be consistent with local land use plans and state plans, such as the regional water quality plan, 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 and major land developments, highways and transportation facilities, facilities for the provision of public utilities, and facilities owned and financed in whole or in part by the Commonwealth (including PennDOT) shall be conducted in a manner consistent with the plan. This provision gives the stormwater plan a definite legal status. Unlike municipal comprehensive plans, which are only advisory documents, watershed stormwater plans will be legally binding.

Also, within six months of the approval of the watershed stormwater management plan, each municipality in the watershed must adopt the land use and development ordinances to implement the plan. These regulations must be consistent with the plan as well as with the standards of the Storm Water Management Act.

Failure to adopt and implement the necessary ordinances could result in the state's withholding monies from the General Fund for which the municipality might otherwise be eligible.

Basic Standard for Stormwater Management. The basic premise of the act is that those whose activities will generate additional runoff, increase its velocity, or change the direction of its flow should be responsible for controlling and managing it, so that these changes will not cause harm to other persons or property 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. It will not allow them to shift the burden of runoff management to the public and to downstream property owners.

Section 13 of Act 167 defines the legal duties owed by 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 its signing (October 4, 1978). These new standards essentially replace prior common law drainage rules. Common law rules, however, will still apply to all developments and land alterations occurring prior to October 4, 1978.

Section 13 provides:

> 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 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;

(2) to manage the quantity, velocity, and direction of resulting stormwater runoff in a manner which 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. When, for example, public agencies build storm sewers, roads, buildings, or utility lines, they must implement runoff control measures that comply with Section 13 standards. With this coverage, Section 13 is a truly comprehensive standard for stormwater control.

Section 13's primary measure of sound stormwater management is the taking of reasonable steps 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 "bottom line" for stormwater management is: Do not cause harm. The section prescribes two alternatives [Sections 13(1) and 13(2)] for meeting this basic objective.

Further, when Section 13 is read in conjunction with other portions of the act, it becomes apparent that the intent of the act is to apply the standard to protect persons and property not only immediately adjacent to the site but also downstream of the site being altered. In other words, Section 13 is not spatially limited; it applies not only as runoff leaves a 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 the watershed plans contain provisions to manage stormwater so that an activity in one municipality does not have adverse effect on persons or property in another municipality in the watershed to which the watershed is a tributary. Therefore, it is clear that the stormwater plans and management activities must consider the impact of land alteration activities on the watershed and runoff controls must be designed to prevent reasonably foreseeable harm from the boundary of the site 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. Indeed, if this were the case, where would the line be drawn?

The language "runoff characteristics" is not a spatially limited term. 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 or harm, or both.

Section 13(1). Section 13(1) requires that any land alteration not cause an increase in the "maximum rate" of stormwater runoff; that is, the maximum (peak) rate of runoff after development for any level storm may not be higher than the peak rate that would have been generated from the site before development. By using the terminology of 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 predevelopment maximum rate of flow will not be exceeded. This is an important point because it would only be possible to meet a standard that did not permit any increase in volume at sites 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 "maximum rate" means only for the site as a whole or for any point where runoff was discharged from the site before development. However, 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 predevelopment discharge point. This interpretation seems necessary to control runoff from large developments in a manner that 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.

Summary. Section 13(1) means 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 watershed is a tributary. The cutoff point for purposes of Section 13(1) seems to be the foreseeability of harm. Where it is reasonably possible for the developer to foresee a higher peak rate resulting from 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, including increased runoff rates, 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.

Prior to the adoption of a watershed plan, the availability of the more flexible Section 13(2) alternative standard will not necessarily result in the implementation of the best runoff management solutions. Neither will it necessarily avoid over-regulation.

Particularly when projects are small, it may not be economically feasible for developers to do the detailed watershed-level hydrological and engineering analysis necessary to determine that increasing the rate of runoff from their development will not cause harm, now or in the future. This usually will require an analysis of the watershed as a whole.

In most instances, it seems that deciding when Section 13(2) permits increased runoff rates can be done only within the context of a watershed plan. The watershed plan should identify those areas where increasing runoff rates will not cause harm or will be beneficial. Thus, the watershed plans will result in a more defined and, therefore, a more usable Section 13(2) standard.

Implementation of a watershed plan may also expand the areas to which the Section 13(2) standard can be applied. For example, increased runoff could be permitted as a result of the installation of regional stormwater retention systems, either upstream or downstream, that reduce existing or potential runoff. The adoption of ordinances that regulate runoff throughout a watershed will limit the maximum possible future runoff. This, in turn, will limit the range of possible future peak rates and allow developers and municipal officials to identify additional areas where increasing the peak rate will not cause harm. One of the purposes of the watershed stormwater management planning process is to identify when and how the strict Section 13(1) standard can and should be modified. Once this analysis is completed, implementing ordinances can be based on the Section 13(2) standard.

Violations, Penalties, Remedies. Section 15 of the Storm Water Management Act makes any violation of the provisions of the act or of the watershed stormwater plan a public nuisance. A public nuisance is a nuisance *per se*. This means it is a nuisance by its very existence and, therefore, it is not necessary to wait and see if damage results. Any aggrieved person, county, affected municipality, or PaDER can institute an action to restrain or abate violations of a watershed plan or of ordinances or regulations adopted under the act. Any person injured by the conduct of a person developing land in violation of the watershed plan and ordinances may recover damages from the responsible party.

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

Dam Safety and Encroachments Act (Act 325-1978)

Act 325 replaces several older state statutes dealing with dam safety, water obstructions, and encroachments. This act is the primary source of regulation for dams*, existing and new

*In some cases, larger retention/detention facilities may qualify as dams under the definition of the act and regulations and, therefore, require a permit from PaDER.

obstructions, encroachments, fill in floodplains, culverts, bridges, retaining walls, and outfalls (e.g., of storm sewers) in a stream or a (100 year) floodplain. 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 PaDER pursuant to the act and regulations (25 Pa. Code Chapter 105).

Because it includes new and existing structures, the Dam Safety and Encroachments Act is quite broad in its coverage. It also requires permittees and owners of obstructions to inspect, maintain, and repair the 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 so 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.

PaDER is the prime agency responsible for administering the act. It must adopt regulations to implement the act and it is the permit issuing agency. The regulations [Section 105.14[a)(9)] require PaDER, when approving permits, to consider the project's consistency with state and local floodplain and stormwater management programs. 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, PaDER must review obstruction permits in light of the plan's standards and criteria. Also, municipalities should not issue local building permits until any necessary obstruction permits are obtained.

Violations of the act are treated as public nuisances. 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, PaDER can issue orders to permittees and landowners to correct a violation of the act or 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 PaDER does not sue to correct the violation of the act, an "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's 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. Its original scope was limited to regulating discharges of sewage and industrial wastes. Since its original enactment, its scope and duties have expanded substantially. In 1972, PaDER determined that sediment constitutes a water pollutant under the provisions of the law and promulgated regulations for the control of erosion and sedimentation caused by earthmoving activities (25 Pa. Code, Chapter 102).

The general requirement of the erosion/sedimentation regulations is that earthmoving 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 earthmoving activities must prepare erosion/sedimentation control plans for the site.

These plans must be available on the site at all times. Sites 24 acres or larger must obtain an erosion/sedimentation permit prior to commencing any activity. As with obstructions and floodplain permits, local building permits should not be issued prior to receiving the erosion/sedimentation permit, if required. In Allegheny County, PaDER has delegated the administration of the regulations to the County Conservation District which reviews plans for permits.

The erosion plans must consider all factors that 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. Because many of these temporary facilities can also serve as permanent stormwater runoff control measures, it is important that erosion/sedimentation and stormwater management controls be designed and reviewed as a package.

The adequate enforcement of erosion control plans will be critical if stormwater controls are to function as designed. If culverts, storm sewers, detention ponds, or other control measures are filled with silt, they cannot function properly to control stormwater flows. The planning study found that problems of localized flooding often are caused by structures filled with sediment and debris. Implementing adequate erosion controls will reduce the need and costs for maintenance of structures.

Because the Clean Streams Law antedates the Storm Water Management Act, it does not mention the Storm Water Management Act. However, it can be assumed that erosion/sedimentation controls should be consistent with the Storm Water Management Act and an approved watershed stormwater plan. Because they could affect stormwater runoff management for a site, they would have to comply with Act 167 standards. Also, the Dam 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.

PaDER has major administrative and regulatory responsibilities for implementing the Clean Streams Law. PaDER may issue enforcement orders. Failure to comply with an order is a nuisance and exposes the violator to abatement actions as well as civil and criminal penalties.

PaDER or an affected municipality may sue to abate or restrain a violation of the law (i.e., erosion regulations). Again, a municipality can act in the name of the Commonwealth after due notice to the attorney general.

It is important to note that private parties and municipalities may be subject to abatement actions. For example, PaDER or a neighboring municipality may sue a municipal violator to compel action. When performing proprietary functions (e.g., construction of 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, at least, 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 any necessary obstruction and erosion/sedimentation permits. Of course, building permits should not be issued unless the proposed activity complies with the stormwater management regulations that have been adopted by the municipality.

Through this interrelated permitting process, the Flood Plain Management Act assures control of all activities in a

floodplain. It assures compatibility among the actions governed by the different laws.

As noted earlier, preservation of natural floodplains and a comprehensive program of floodplain management are a key part of effective overall stormwater management. Natural flood areas should be maintained as part of a watershed's natural stormwater control system. Similarly, effective future stormwater management will help to preserve floodplain areas and assure that properties not now subject to flooding do not become so in the future.

Pennsylvania Municipalities Planning Code (Act 247, as Amended)

The Pennsylvania Municipalities Planning Code (MPC) is related to stormwater management because of the authorities it grants to municipalities and counties*. The MPC enables communities to prepare comprehensive and land use plans and capital facilities programs. It also empowers them to prepare and adopt zoning (including regional 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.

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*The MPC excludes first and second class cities and counties, including Allegheny County and the city of Pittsburgh; these both draw their land and development powers from their respective municipal codes.

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 specification of these ordinances by Section 11 implies that the municipalities are supposed to utilize the land use and development authorities granted by the MPC.

It is necessary to understand that these 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, zoning for example, and simply include the items and controls covered by the other types of regulations. In other words, a community cannot regulate land usage or lot size (a zoning power) in a subdivision and land development ordinance, nor can it establish structural standards for building construction (a building code regulation) in a subdivision and land development ordinance, and so forth. In most cases, a comprehensive development regulation system requires the utilization of all three types of ordinances.

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 codes' powers in the municipal codes, then the applicable stormwater controls should be included in the proper ordinance. 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, subdivision/land development, and building codes. Also, the preamble of a separate stormwater ordinance should indicate that it is being adopted pursuant to the Pennsylvania Municipalities Planning Code, the Storm Water Management Act, and applicable sections of the municipal code.

With either approach, when a development activity is within the scope of the MPC, the municipality should be sure to follow the various plan review processes and other administrative procedures prescribed in the MPC, including procedures for enacting and amending zoning and development 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 applications, the stormwater reviews should adhere to the procedures required in the respective ordinances.

Governmental Tort Immunity

Municipal immunity is becoming a concern to local communities and officials who will be adopting and implementing stormwater management regulations. Also, Pennsylvania and municipal immunity statutes have been subject to recent changes and litigation. This last section identifies the laws dealing specifically 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) Political Subdivision Tort 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. At 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 Commonwealth when the common law of England was adopted after independence. 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" (Russel v. Men of Devon, 100 Eng. Rep. 359). After independence, the federal and state governments became sovereign and invested themselves with the king's immunity.

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. Finally, the Pennsylvania Supreme Court abolished the doctrine in Maybe v. Pennsylvania Department of Highways, 479 Pa. 384 (1978).

Maybe 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, most of which go to negligent failure to enforce adequately state statutes and regulations. The statute also limits the amounts that 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 PaDER.

Municipal Immunity. The second level of government tort immunity which developed at 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 or judicial decision. The Pennsylvania

Supreme Court first limited the doctrine by holding that it applied only to torts arising out of governmental functions (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 carried on by private corporations, such as owning and operating utilities).

Finally, in 1973, the court abolished the municipal immunity doctrine in Ayala v. Philadelphia Board 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 (i.e., the same degree of liability to which private persons and corporations have always been exposed) for their 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. The result of this legislation is that since its effective date (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 at 42 Pa. C.S. 38501 et. seq.)

The Political Subdivision Tort Claims Act applies to municipalities, municipal authorities (e.g., sewer and stormwater 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 (see Section 8542):

a. Damages would be recoverable under common law or a statute, if the defendant was not a municipality.

b. The injury was caused by the negligence of the municipality or its officer, employee, or agents operating within the scope of his or her office or employments.

c. The negligent acts or omissions by a local agency or its officer or employer falls within eight specified categories of activity. The specified categories are:

(1) operation of a motor vehicle;

(2) care, custody, and control of personal property of others;

(3) care, custody, and control of real property in the possession of the local agency;

(4) dangerous condition of trees, traffic signs, lights, or other traffic controls under care, custody, or control of the local agency;

(5) dangerous condition of stream, sewer, water, gas, or electric systems owned by the local agency;

apply. Thus, if an official intentionally (knowingly) fails to enforce a regulation, he/she may be held personally liable to the extent of all of his/her private assets for any damage that his/her act causes. However, as noted above, the municipality is not liable.

III. DESCRIPTION OF THE MONTOUR RUN WATERSHED

Watershed

The 36.6-square-mile Montour Run Watershed is situated entirely in the western portion of Allegheny County. It drains into the Ohio River. Major tributaries are South Fork Run, 2.63 square miles; North Fork Run, 2.29 square miles; McClarens Run, 6.53 square miles; Trout Run, 1.00 square mile; and Meeks Run, 2.40 square miles.

Topography

Elevations in the study area vary from a low of 720 feet adjacent to the Ohio River to a high of 1340 feet along Route 22 in North Fayette Township. The hilltops are generally rounded and approximately 1000 feet across. Valleys along the small tributaries are very narrow, but the valley along Montour Run's main channel varies in width up to 1000 feet. Slopes can vary from very mild up to those in excess of 25 percent.

Wetlands are a constraint to development and may impact available land for development. Wetlands in the study area are generally confined to the valley floors. Grading the Greater Pittsburgh International Airport has materially affected the topography in the McClarens Run Subshed. To a lesser extent, grading for Route 60, U.S. 22/30, and the proposed Southern Expressway has altered or will alter the topography.

Geology

Rock strata encountered in the Montour Run Watershed are in the upper Conemaugh and Lower Monongahela formations. In the Conemaugh, the Morgantown, Connellsville, and Little Pittsburgh members are generally encountered. In the Monongahela, the Pittsburgh and Lower Redstone members are generally encountered. The Pittsburgh Coal seam is encountered at elevations which vary from 1200± feet near Route 60 in the northern portion of the watershed to 1100± feet in an area along U.S. 22/30 in the southern portion. The area has been extensively strip-mined and deep-mined. Typical strip-mine topography is evident along U.S. 30.

Soil Characteristics

In areas that have not been strip-mined, the soils are residual. They are the result of in-place weathering of bedrock. In the study area, the SCS soil classification system was used to classify the runoff potential of the soils. Three soil classes are represented in the Montour Run Watershed.

Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well-drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist 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. These soils have a very low rate of water transmission (0-0.05 in/hr).

In the undisturbed areas of the watershed, there are large areas of Dormont, Gilipin, and Wharton silt loams. A large portion of the area has been regraded and is accordingly classed as urbanized land.

Climate and Precipitation

The climate in the Montour Run Watershed is characterized by mild summer temperatures, cold winters, and moderate rainfall. Of the daylight hours in a year, 47% are sunny. Temperatures range from below -10°F in the winter to over 90°F in the summer. An average of 36 inches of rainfall is somewhat evenly distributed throughout the year. There are over 40 in. of snowfall during a typical winter. Prevailing winds are generally from the southwest.

Land Use

About 38 percent of the watershed is impacted by Greater Pittsburgh International Airport, which consists of high runoff areas (aprons, buildings, taxiways, runways, and roads) and low runoff areas (infields, flat cut slopes, and undeveloped land). Other existing development in the study area has generally occurred between the airport and the Ohio River. In addition, development has occurred along Route 60 in Robinson Township between the Airport Parkway and I-79 and is currently occurring along both sides of the Airport Parkway from Montour Run to Route 60. With the exception of the older communities of Clinton, Imperial, and Enlow, Findlay Township remains largely undeveloped.

The area between U.S. 22/30 and Montour Run, North Fayette Township, is largely residential with some light industrial and commercial development.

Existing Development

Existing development is located primarily to the northeast, southeast, and near south of the airport. As a result, much more vacant land is currently available to the west and the southwest.

Driven by the transportation hub of the airport, land use in this watershed is rapidly changing. Moon Township and Robinson Township are developing rapidly. Areas along the Airport Parkway are being developed for commercial use. Findlay Township and North Fayette Township have considerable developable vacant land and future residential, commercial, and light industrial development there appears likely.

IV. LAND USE

Existing Land Use

The existing use of land in the Montour Run Watershed is shown in Figure 4-1; a breakdown by categories and area is listed in Table 4-1.

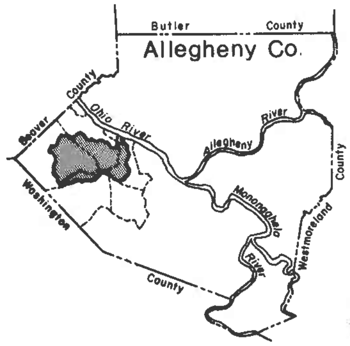
Table 4-1

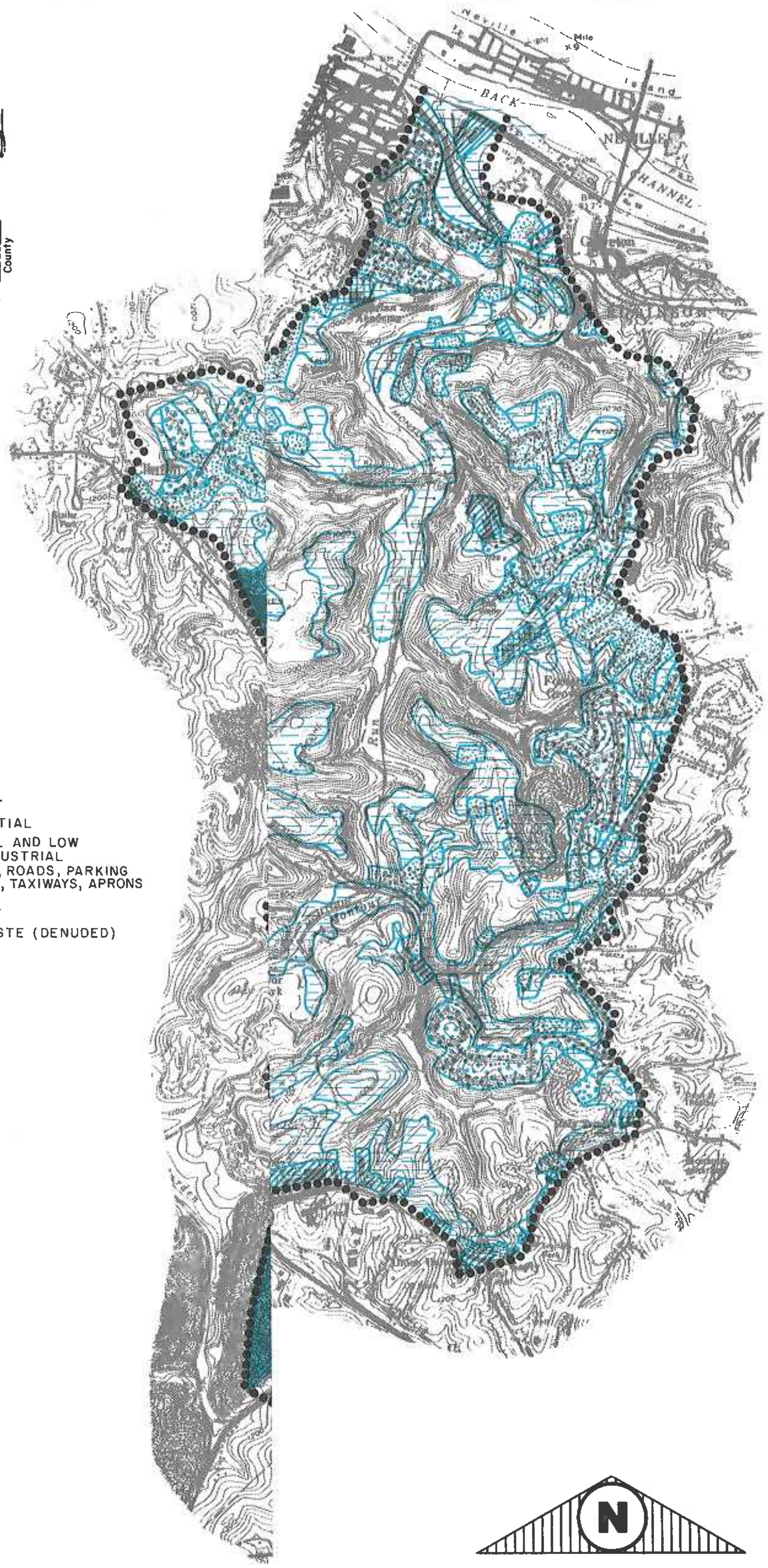
LAND USE BY AREA
MONTOUR RUN WATERSHED

Category	Percent of Watershed	Acres
Low-Density Residential	8	1,760
Medium-Density Residential	7	1,660
High-Density Residential, Industrial and Low Density Commercial	3	640
Public and Institutional	1	120
High-Density Commercial, Roads, Parking Lots, and Airport Runways, Taxiways, Aprons	7	1,780
Woods and Brush	39	9,194
Grass and Agriculture[1]	33	7,770
Strip Mines and Coal Waste (Denuded)	2	400
Total	100%	23,324

[1]Includes about 200 acres of active farmland, parks, cemeteries, and golf courses.

Note: Public and Institutional Land is classified in the same hydrologic group as High-Density Residential, Industrial, and Low-Density Commercial.





LEGEND

- WATERSHED BOUNDARY
- MUNICIPAL BOUNDARY
- LOW DENSITY RESIDENTIAL
- MEDIUM DENSITY RESIDENTIAL
- HIGH DENSITY RESIDENTIAL AND LOW DENSITY COMMERCIAL / INDUSTRIAL
- HIGH DENSITY COMMERCIAL, ROADS, PARKING LOTS, AND AIRPORT RUNWAYS, TAXIWAYS, APRONS
- PUBLIC AND INSTITUTIONAL
- STRIP MINES AND COAL WASTE (DENUDED)
- GRASS AND AGRICULTURE
- WOODS AND BRUSH

2000' 0 2000' 4000'

Scale in Feet

FIGURE 4-1

Existing Land

MONTOUR RUN WATERSH

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Land use in the watershed is dominated by the presence of the Greater Pittsburgh International Airport (GPIA). Of a total of 23,324 acres of land in the basin, 8,755 acres (37.5 percent) are GPIA property owned by Allegheny County. About 1,780 acres are currently in aviation use as runways, aprons, hangers, cargo areas, the terminal, and military facilities. The remaining area is in open space uses, including a mix of forest, field, and brush cover.

Urban development elsewhere includes substantial commercial activity in these areas:

- along Carnot-Beers School Road and Beaver Grade Road in Moon Township;
- in and around the village of Imperial in Findlay Township;
- at the intersection of the Airport Parkway and U.S. 22/30 and along Route 60 in Robinson Township;
- along the Old Stuebenville Pike in North Fayette Township.

As reflected in Figure 4-1, residential development is found closely associated with the Carnot-Beers School Road, Beaver Grade Road, and Imperial commercial areas. Elsewhere, residential development usually has been located on flat hilltops or flat ridge lines.

Light industrial uses in the watershed are primarily clustered around the Montour Run Interchange of the Airport Parkway, with a total of 24 industries occupying most of the 355 acres in the Regional Industrial Development Corporation's (RIDC)

Park West complex. Other industry and offices are found just downstream of the intersection along Montour Run.

In the upper part of the watershed, along the western and southern boundaries, extensive strip-mining of the Pittsburgh Coal seam has scarred the landscape. Bare ground, brush, fields and scrub timber predominate here. Most of the mainstem of Montour Run, between the Airport Parkway and its mouth on the Ohio River, is entrenched between steep, tree-covered hillsides, with several large sections of floodplain.

Land Jurisdiction

Table 4-2 identifies governmental land jurisdiction in the watershed.

Table 4-2

GOVERNMENT JURISDICTION OF LAND
MONTOUR RUN WATERSHED

Governmental Unit	(Acres in GPIA)	Jurisdiction Acres	(Sq. Miles)	Watershed
Borough of Coraopolis		138	(0.2)	0.6%
Findlay Township	(6,522)	3,100	(4.8)	13.3%
Moon Township	(2,233)	5,124	(8.0)	22.0%
North Fayette Township		3,209	(5.0)	13.8%
Robinson Township		2,998	(4.7)	12.8%
GPIA		8,755	(13.7)	37.5%
Total		23,324	36.4	100%

Land use control is in municipal jurisdiction for all areas which are not within the GPIA boundary. However, Allegheny County, through the Department of Aviation, exercises primary land use control of the airport property, including 6,522 acres of Findlay Township territory and 2,233 acres of Moon Township territory. These municipalities still have inspection capabilities over sewer and water facilities on GPIA property and also have a zoning review process.

Future Land Use

The area surrounding the GPIA, including most of the Montour Run Watershed, is expected to be one of the fastest growing areas of southwestern Pennsylvania over the next 25 years. Completion of the GPIA Midfield Terminal building, other GPIA facilities, and the Southern Expressway access road is expected to act as a catalyst for major urban growth in the area. Already, plans have been generated for two major shopping centers near the U.S. 22/30 and Route 60 Interchange with the Airport Parkway, an RIDC office park near the Montour Run Interchange, and a large number of residential developments in the surrounding township.

Figure 4-2 identifies projected development in the watershed during the decade 1988 to 1998. A breakdown of this development by governmental unit is found in Table 4-3.

As identified in the table, about 2,448 acres of the watershed's total 23,324 acres will be developed in the ten year period from 1988 to 1998. This acreage, which constitutes over 10 percent of the watershed area, will be covered with various percentages of new impervious surfaces, most of which will be served by storm sewers.

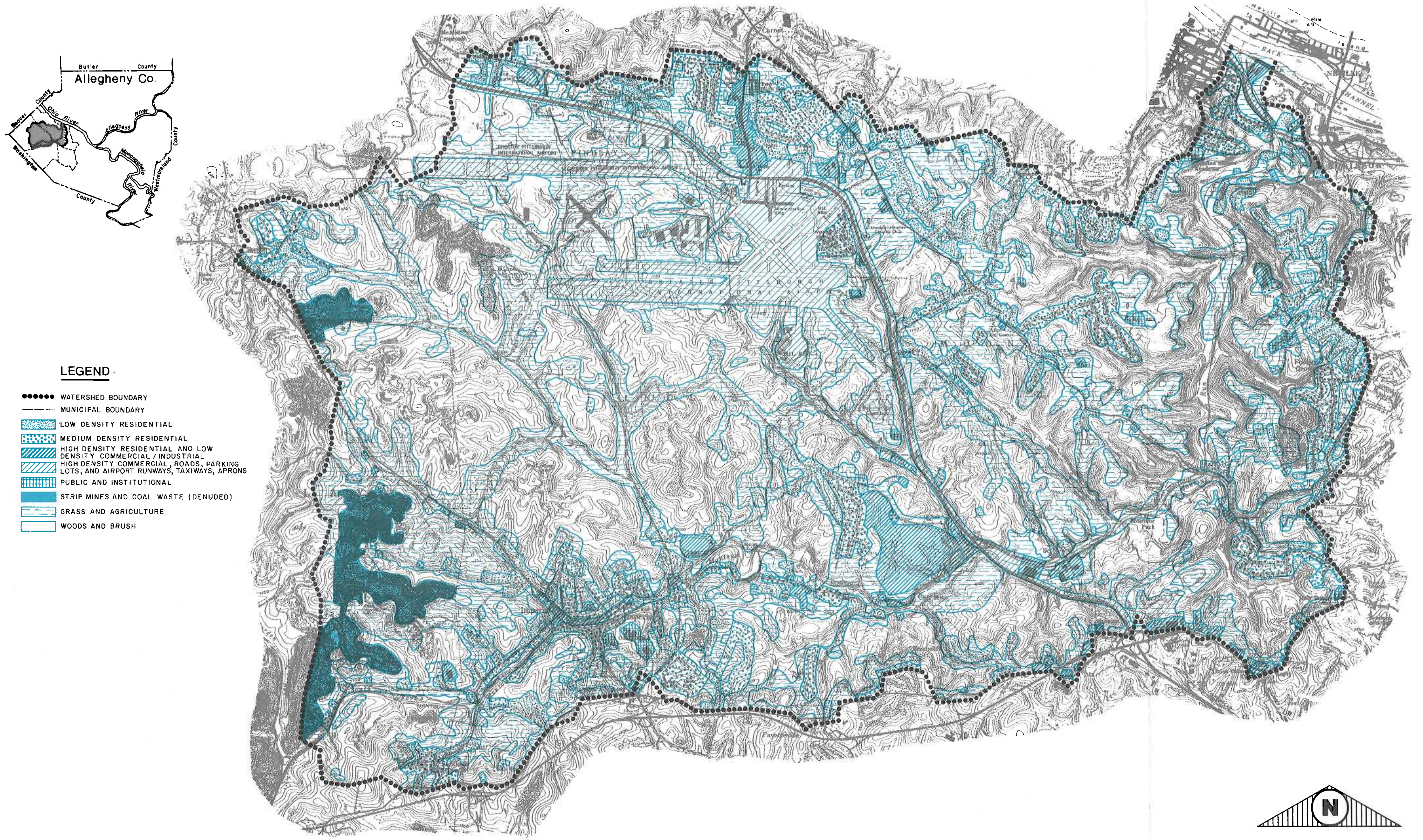

FIGURE 4-1

Existing Land Use

MONTOUR RUN WATERSHED STORMWATER MANAGEMENT PLAN

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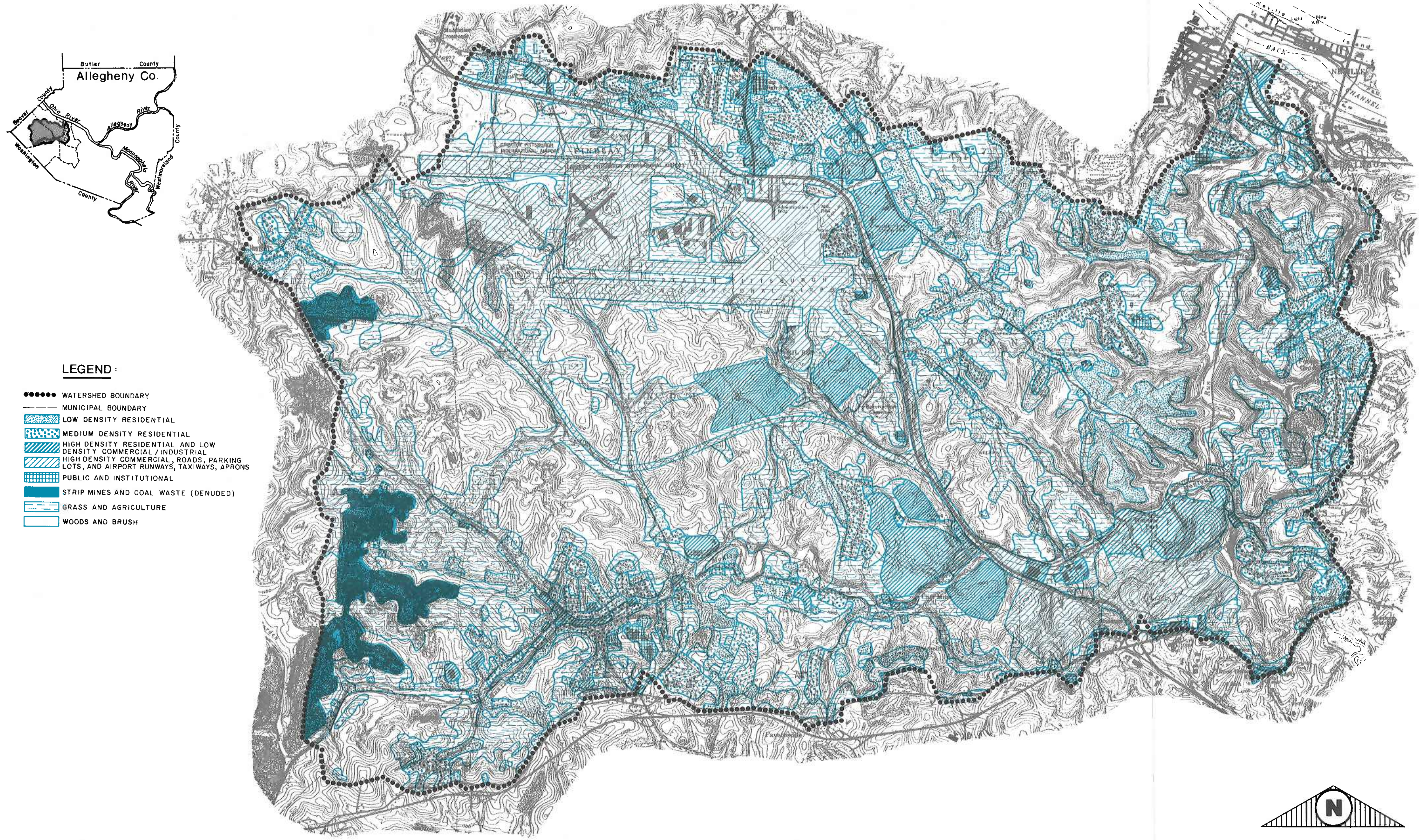

FIGURE 4-2

Future Land Use

MONTOUR RUN WATERSHED STORMWATER MANAGEMENT PLAN

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Table 4-3

PLANNED DEVELOPMENT 1988-1998
MONTOUR RUN WATERSHED

Governmental Jurisdiction	Airport and Roads (acres)	Commercial and Light Industrial (acres)	Residential (acres)	Sewered Total (acres)
Moon Township		146	315	461
Findlay Township		41	37	78
North Fayette Township		294	96	390
Robinson Township		507	50	557
Coraopolis Borough				0
GPIA - Airport Related	450			450
GPIA - Other[1]	135	250		385
Southern Expressway	127	—	—	127
Total	712	1238	498	2,448

Source: Compiled from building permit applications and plans submitted to watershed municipalities, from discussions with municipal officials and engineers, and from data in the "Airport Parkway-Southern Expressway Environmental Impact Statement Report" (Draft, 1988) and "Greater Pittsburgh International Airport Impact Area Study" (Draft, 1987).

[1]Computed from data in the "Greater Pittsburgh International Airport Expansion Program Land Use Master Plan, Working Paper 16." The figure includes the Working Paper 16 projected land conversion rate of 50 acres per year and assumes road access will be provided by 1993. (The land selected for conversion includes the sections which are closest to existing sewer and water trunk lines, have projected road access, and have land slopes of 15 percent or less.)

Existing and Projected Development in Flood-Prone Areas

The Montour Run Watershed is not as heavily impacted by flooding as some other watersheds. Only a few developed locations and structures have a history of flooding. Almost all of the main watercourse from the Airport Parkway north to its mouth on the Ohio River is in open spaces. Only a few scattered industrial, commercial, and residential structures are located on the floodplain, and very few of these are flood-prone. West of the Airport Parkway, the area in and around the village of Imperial is the only substantial urbanized area with potential for flooding. Table 4-4 identifies the areas that reportedly have experienced flooding; Figure 4-3 locates these areas.

Several future developments presently in the planning stage are to be located in areas that may have potential for flooding. A residential development along Meeks Run in Moon Township is adjacent to a stream. Robinson Town Center Mall in Robinson Township, which is scheduled for office or light industrial development, includes land adjacent to Montour Run. Two other residential developments are to be located on the Montour Run floodplain just east of Imperial in North Fayette Township. Proper site development can minimize the flood potential at all four locations.

Floodplain land from the mouth of the Montour Run to the Airport Parkway in Coraopolis Borough, Moon Township, and Robinson Township is zoned industrial. Much of this land is within the 100-year flood boundary (Figure 4-4). Several industrial and commercial uses are now located there and are

Table 4-4

DEVELOPMENT WITH A HISTORY OR POTENTIAL FOR FLOODING
MONTOUR RUN WATERSHED

Development	Type of Structure	Location	Municipality
Culverts Inc.	Industrial/ Commercial	Adjacent to Route 51 Bridge	Robinson Twp.
SCANIA Tank Cleaning Service	Commercial	Adjacent to Route 51 Bridge	Robinson Twp.
Groveton Park	Pavilion and Park Facilities	Adjacent to Route 51 Bridge	Robinson Twp.
Breslube Oil Company	Industrial/ Commercial	½-mile South of Route 51 Bridge	Coraopolis
Penn Inc.	Industrial	½-mile South of Route 51 Bridge	Coraopolis
3 Houses	Residential	½-mile South of Route 51 Bridge	Robinson Twp.
1 House	Residential	At Hanson Road Bridge	Moon Twp.
Marriott Hotel	Commercial	Airport Parkway-Montour Run Interchange	Moon Twp.
White Swan Park	Commercial	Airport Parkway-McClarens Run Interchange	Moon Twp.
1 Vacant Structure	---	½-mile East of Imperial	Findlay Twp.
Several Houses	Residential	Santiago Road	Findlay Twp.

Source: Interviews with municipal officials, municipal engineers, local residents, and company employees.

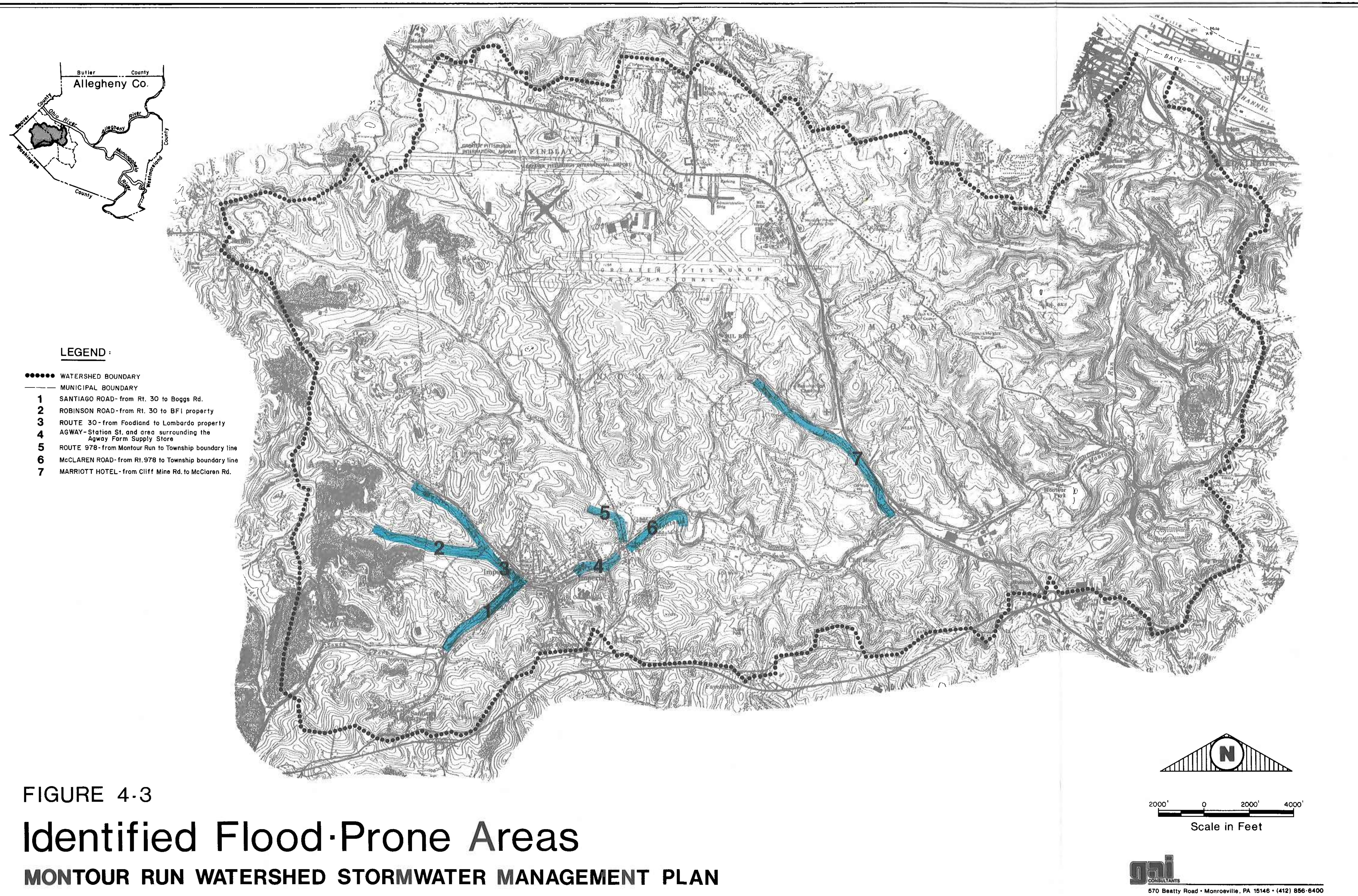

FIGURE 4-3

Identified Flood-Prone Areas

MONTOUR RUN WATERSHED STORMWATER MANAGEMENT PLAN

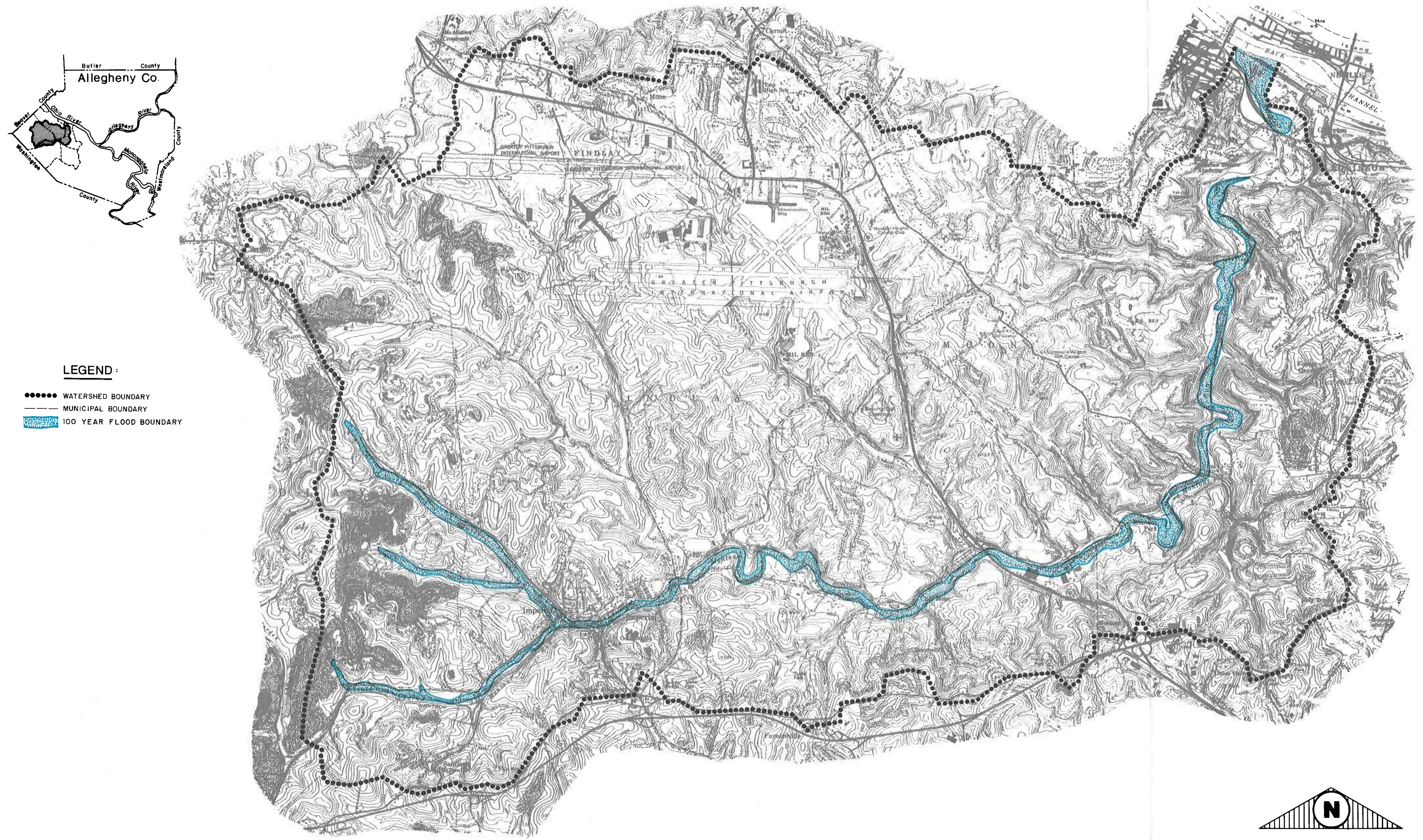

FIGURE 4-4

100-Year Flood Boundary

MONTOUR RUN WATERSHED STORMWATER MANAGEMENT PLAN

theoretically flood-prone. The intended use (by its zoning classification) requires that flood proofing or other alternatives be used when this land is developed.

West of the Airport Parkway, zoning of floodplains along the north side of Montour Run in Findlay Township is either in "Special" or Agricultural" classifications, while North Fayette's side is zoned primarily for multi-family residential uses.

Existing and Proposed Flood Control Projects

There are no existing or proposed federal, state, or local government flood control projects anywhere in the Montour Run Watershed, nor are there any plans or feasibility studies underway on such structures (See Appendix D for documentation letters).

Planning and Land Use Controls

All of the municipalities in the Montour Run Watershed have comprehensive land use plans to direct future growth. Moon is presently updating their plan. Findlay's plan was completed in 1982. North Fayette's plan is part of the "Action Plan" prepared for communities in the Chartiers Valley Council of Governments (plan undated). The joint plan for Robinson Township and the Borough of Coraopolis was compiled in 1966.

An Allegheny County financed report entitled "Greater Pittsburgh International Airport Impact Area Study" was completed in 1988 and details land use, environmental factors, and infrastructure affecting development near the GPIA. All of the watershed area is included in this report. Also, the

Southwestern Pennsylvania Regional Planning Commission has recently begun a corridor study of the Penn-Lincoln Parkway West that will help prepare adjacent municipalities for expected growth. Portions of the Montour Run Watershed are included.

The Socioeconomic, Land Use, and Aesthetics Technical Basis Report (Draft, 1987) dealing with construction of the Airport Parkway-Southern Expressway also provides detailed information on land development in the area. Finally, at the GPIA, as many as 23 working papers and 21 schematic design reports dealing with construction of the Midfield Terminal, development of GPIA non-aviation lands, and impacts on surrounding municipalities add to the overall planning base of the area.

Together, all of these planning reports give the Montour Run Watershed a large data base for planning purposes. These land use studies generally project large amounts of growth to occur both short-term and over the next several decades near the GPIA, much of it within the watershed.

Table 4-5 identifies the current land use ordinances in watershed municipalities to control this anticipated growth.

Several municipalities, including Findlay Township, Moon Township, and Robinson Township, are presently revising their zoning ordinances to accommodate the anticipated growth and airport development.

Areas to be Served by Stormwater Facilities in the Next 10 Years

About 2,448 acres of land are expected to be converted from open space to urban uses served by storm sewers during the ten years from 1988 to 1998 (Figure 4-2). This total does not include construction of single residential structures or subdivisions of several houses, so this estimate may slightly underpredict the total amount of impervious surface that may occur. However, these very small developments are usually not served by storm sewers and, thus, do not create the major problems associated with large amounts of impervious surface tied to highly efficient storm sewer systems, such as are found in connection with the larger developments.

Table 4-5

LAND USE ORDINANCES AND CODES

Controls	Moon Township	Findlay Township	North Fayette Township	Robinson Township	Coraopolis Borough
Zoning Ordinance	X	X	X	X	X
Subdivision Regulations	X	X		X	X
PUD Ordinance[1]	X	X	X	X	
Housing Code	X		X	X	
Building Code	X	X	X	X	
Plumbing Code[2]	X	X	X	X	X
Stormwater Ord.	#	X			

Source: Municipal Survey, February, 1988

1PUD:Planned Unit Development
2Includes coverage using County BOCA Code
#Stormwater controls in subdivision ordinance

About 127 of the 2,448 acres in "larger developments" are part of the Southern Expressway. The GPIA Midfield Terminal complex will generate about 450 highly impervious developed acres. Hanger construction will generate 135 acres more, and shopping plazas near the U.S. 22/30 and Route 60 Intersection with the Airport Parkway will generate an additional 697 acres.

Light industrial and office development is expected in and as an extension to the RIDC Park West (135 acres). Similar development is expected in the non-aviation GPIA property near the Pennsylvania Air National Guard facility (250 acres) and near the Thorn Run Road Intersection with the Airport Parkway (146 acres).

Residential construction is expected primarily along Beaver Grade Road in Moon Township (268 acres) and in the Imperial area of Findlay and North Fayette townships (133 acres). Other smaller commercial and residential projects in the watershed will total about 107 acres.

Financing

Traditionally, the financing of new stormwater facilities is the responsibility of the developer. All of the major developments projected in the watershed over the next ten years will likely have stormwater facilities financed and built by the site developer. Several areas require additional comment. The RIDC will generate storm sewer systems for both their Park West area and their new Office Park. Also, the GPIA will likely provide a sewer system for the 250 acres of non-aviation land expected to be developed for offices and light industry.

Costs and Scheduling 1988-1998

Only general costs for stormwater facilities can be assigned for ten-year projected development. These estimated costs and the probable schedules for construction are identified in Table 4-6.

Operation and Maintenance

Most of the stormwater control systems in the watershed are owned by the municipality or, if they are located on GPIA property, owned by Allegheny County. Sewer systems for residential areas and small commercial/industrial sites are normally built by the developer, inspected by the municipality, and dedicated to the municipality along with the roads when the construction is complete. Large commercial and industrial sites are the exception, since these stormwater systems remain in private ownership.

Two watershed municipalities, Moon Township and Findlay Township, have stormwater management regulations. Detention ponds, the most common stormwater management facility used locally, remain in private ownership in Findlay Township. In Moon Township, detention ponds protecting residential areas are dedicated to the municipality for ownership and maintenance; however, ponds for commercial developments remain in private control.

Table 4-6

PROJECTED STORMWATER FACILITIES - COST AND SCHEDULE
MONTOUR RUN WATERSHED

Development	Size (acres)	Governmental Jurisdiction	Estimated Cost Stormwater Facilities	Construction Schedule Start	Construction Schedule End
Southern Expressway[3]	127	GPIA	$5,020,000	1989	1993
GPIA Midfield Terminal[2]	450	GPIA	3,375,000	1988	1991
GPIA Hanger Construction[2]	135	GPIA	1,012,500	1989	1998
GPIA Commercial[1] Development	250	GPIA	1,250,000	1993	1998
Robinson Town[2] Centre Mall	507	Robinson Twp.	3,802,500	1988	1991
Mall in North Fayette Twp[2]	190	North Fayette Township	1,425,000	1989	1992
RIDC Park West[1] Office Park	135	Findlay/North Fayette Twp.	675,000	1988	1995
Cherrington Center[1] (Office Buildings)	92	Moon Township	460,000	1988	1993
Hidden Brook[4] (Residential)	161	Moon Township	644,000	1989	1998
Cherrington Manor[4] (Residential)	107	Moon Township	428,000	1989	1998
Other Residential[4] Developments	230	Watershed Area	920,000	1988	1998
Other Commercial/[1] Industrial Developments	64	Watershed Area	470,000	1988	1998
Total Stormwater Facility Cost			$19,482,000		

[1]Estimated at $5,000/acre, based on the experiences of the RIDC Park West.
[2]Estimated at $7,500/acre, based on GAI's experience in mall development and intensive use development.
[3]The 1987 cost estimate by the project engineer.
[4]Estimated at $4,000 per acre based on GAI's experience in residential development.

Ownership, operation, and maintenance responsibilities for stormwater facilities built in the next ten years are likely to remain as at present. All of the storm sewer systems and stormwater management facilities at the GPIA should remain in Allegheny County ownership. A large detention basin is presently being built by the County on-site to protect the Midfield Terminal construction. It will also provide incidental runoff control to part of the non-aviation construction expected.

Elsewhere, future residential storm sewers can be expected to be dedicated to the municipalities, while facilities at large commercial and industrial sites will likely remain in private ownership. The responsibility for stormwater management facilities, in part, will be determined by the reaction to this plan, which calls for all residential area detention basins to be owned and maintained by the municipalities in which they are located.

V. MONTOUR RUN WATERSHED PENN STATE RUNOFF MODEL

Introduction

The technical work program for the Montour Run Watershed Study included the hydrologic simulation modeling of the watershed for the evaluation of the storm runoff characteristics under "Existing Conditions" (March 1988) and under "Future Conditions" (1998). The Penn State Runoff Model (PSRM), 1988 version, was adopted for use in modeling the watershed. The methodology used in the 1988 (Lehigh County) version of the Release Rate PSRM was used to aid in the development of release rates. The Pennsylvania Department of Environmental Resources has accepted the use of the PSRM for the preparation of watershed stormwater management plans under the Storm Water Management Act. The following paragraphs describe the development of the PSRM hydrologic models for "Existing" and "Future" conditions and their potential use by the communities or by a regional authority in the management of stormwater flows in the future.

Penn State Runoff Model

The PSRM provides a means of predicting flood flows over time (flood hydrograph), which may result from a storm event. The PSRM utilizes physical and hydrologic data to develop the runoff characteristics of a watershed that, in turn, help determine the general shape of a flood hydrograph.

The data required for the PSRM consists of land use, hydrologic soil group (a measure of the soil's infiltration potential), overland runoff path lengths and slopes, percentage of impervious land cover, drainage capacities of streams and culverts, and precipitation.

The PSRM produces flood hydrographs for individual portions (subsheds) of a watershed, which are then routed and combined in a manner corresponding to the network of streams that the watershed comprises. The effect of an individual upstream subshed upon a downstream subshed can be analyzed, and the comparative benefits of various stormwater management measures may then be evaluated. In addition, the computer output can be used to develop a set of flow values (release rates) which can aid in determining the impact of a proposed development upon downstream areas. Thus, a reviewing agency will not need to perform detailed computer analyses to evaluate the effect of each individual proposed development. The release rates are provided on a watershed map to facilitate the review process (as will be further discussed in the section entitled "Release Rates"). The Montour Run Watershed Boundary Map is Figure 5-1.

Development of the PSRM for the Montour Run Watershed

Development of the PSRM for the Montour Run Watershed consisted of the following steps:

- selection of the standard design storm, which is defined by the total rainfall amount and the rainfall distribution;

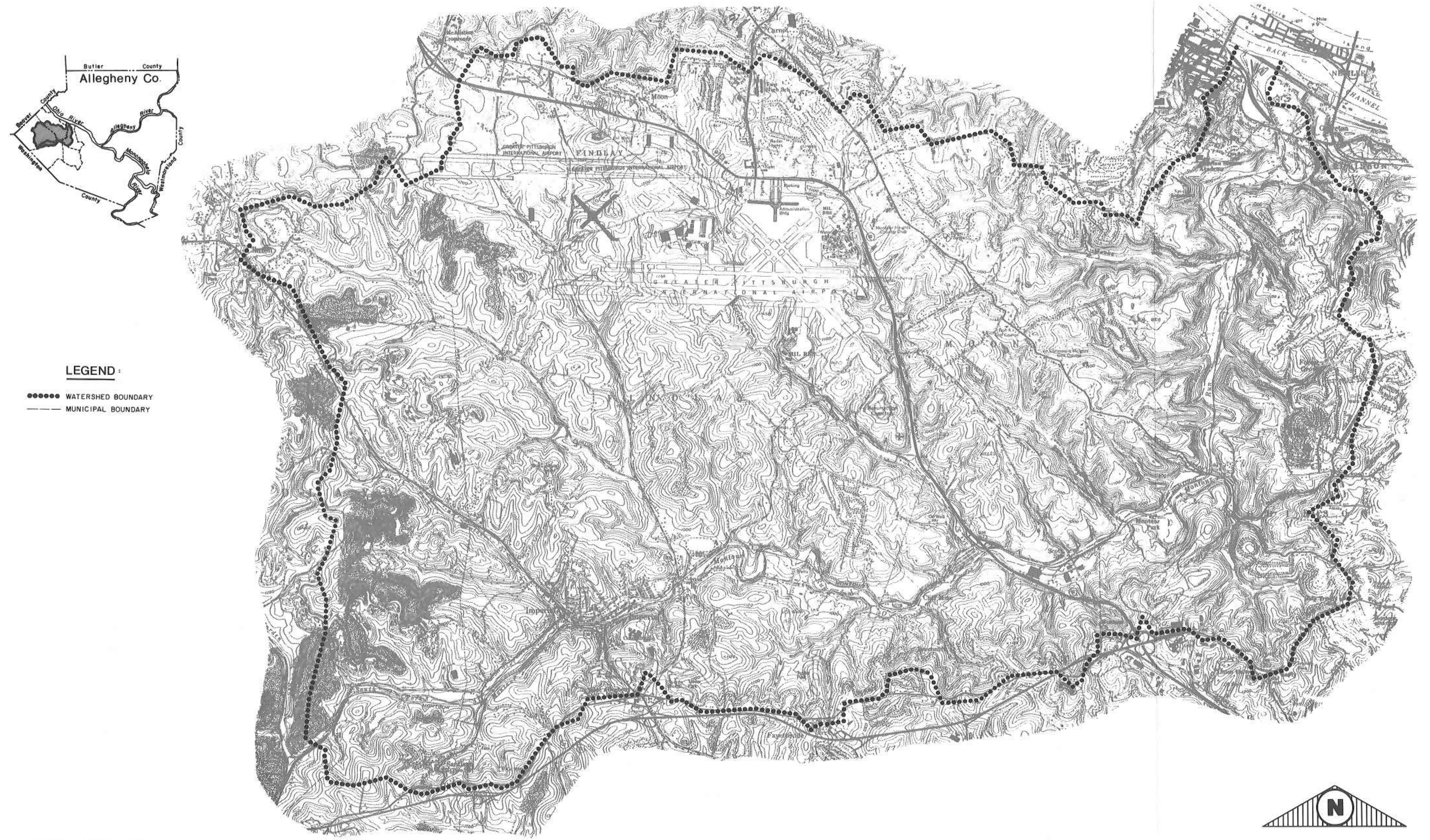

FIGURE 5-1

Watershed Boundary

MONTOUR RUN WATERSHED STORMWATER MANAGEMENT PLAN

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- identification of the current land uses in the watershed and the changes in land use projected for the next 10 years;
- division of the watershed into subsheds, which provides a more detailed description of the rainfall-to-runoff process;
- identification of the hydrologic soil groups in the watershed and correlation with the various land uses to develop the watershed runoff potential (expressed as the SCS curve number);
- determination of representative values for the length and slope of the overland runoff paths in each subshed;
- measurement of the drainage areas of each of the subsheds;
- estimation of the flow capacities of the channels, bridges, and culverts in the model subsheds which indicate flooding in the floodplains;
- estimation of the roughness coefficients for the pervious and impervious surfaces;
- calibration of the "Existing Conditions" PSRM using available data to validate the model;
- running of the model for "Existing Conditions" and "Future Conditions" for each design storm;
- development of the release rates for the individual subsheds to satisfy the purpose and intent of Act 167; and

- development and evaluation of various stormwater management measures that are appropriate and applicable to the Montour Run Watershed.

A more detailed description of these tasks is presented below.

Design Storm

The Soil Conservation Service (SCS) Type II 24-hour-duration storm was selected as the appropriate design rainfall distribution. According to the SCS, the Type II storm is appropriate for western Pennsylvania. The 24-hour duration adopted herein is the most commonly used duration for the analysis of stormwater runoff in southwestern Pennsylvania. Use of this storm type establishes a consistent basis for the design and the evaluation of stormwater control measures of future development. Figure 5-2 shows the distribution of rainfall for the SCS Type II 24-hour storm.

Several storm magnitudes (frequencies) were analyzed as design storms. The 2-, 5-, 10-, 25-, and 100-year storm events, corresponding to a probability of exceedence in each year of 50, 20, 10, 4, and 1 percent, respectively, were analyzed under both "Existing" and "Future" conditions. Table 5-1 summarizes the rainfall associated with each storm magnitude. For comparison, a listing of recent storms in the watershed and the rainfall associated with them is presented in Table 5-2.

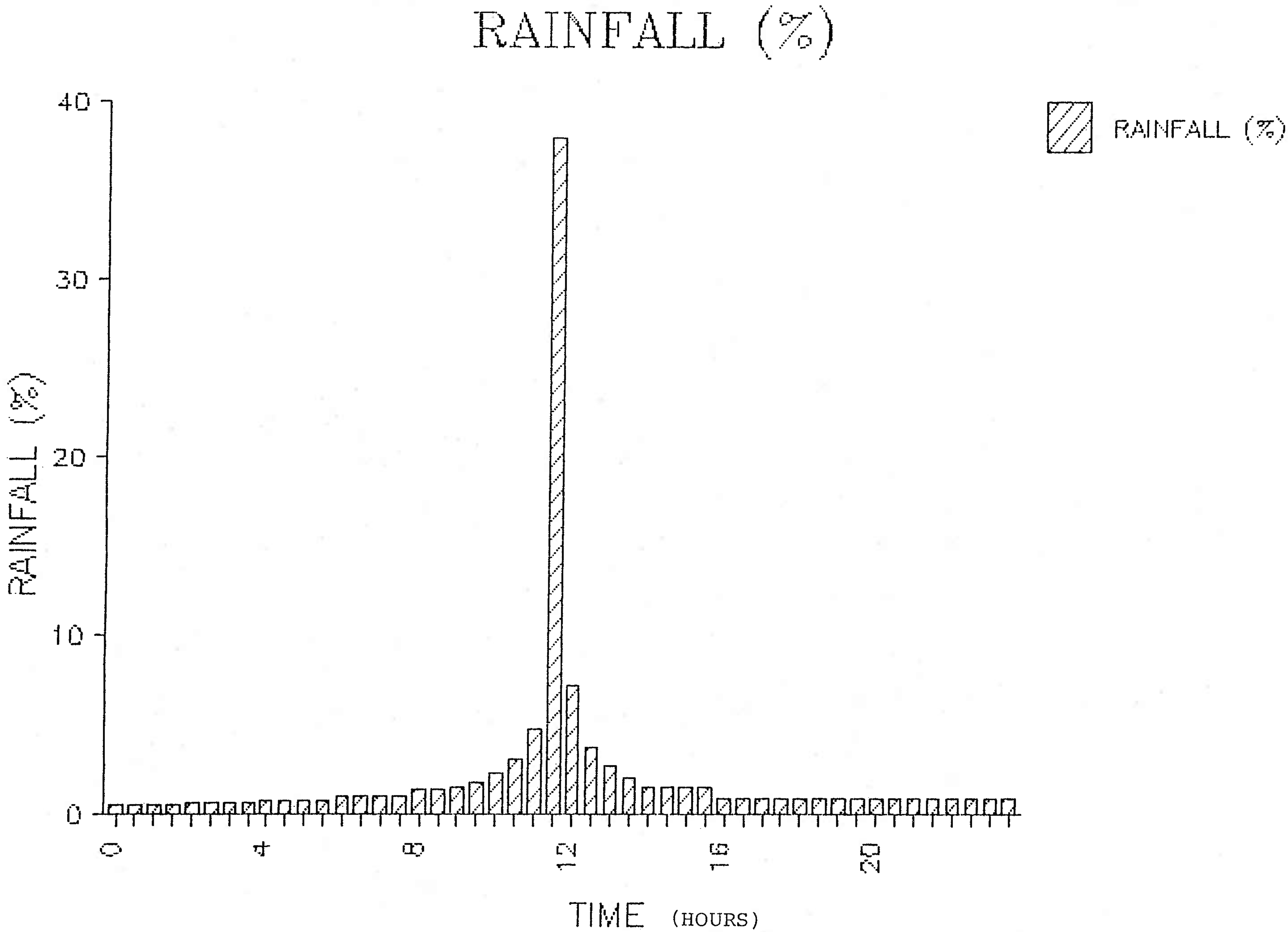

Figure 5-2

S.C.S. TYPE II STORM - DISTRIBUTION OF RAINFALL

Table 5-1

RAINFALL FOR SELECTED STORM MAGNITUDES
SCS TYPE II 24-HOUR STORM

Return Period	Probability of Exceedence	Rainfall (inches)
2-year	50%	2.6
5-year	20%	3.3
10-year	10%	3.8
25-year	4%	4.4
100-year	1%	5.0

Note:
1. Probability of exceedence of a storm indicates the probability of that size storm or a larger storm occurring in any given year.
2. Rainfall amounts taken from "Urban Hydrology for Small Watersheds", SCS Technical Report No. 55 (TR-55), Appendix B, June 1986.

Table 5-2

LISTING OF MAJOR RECENT STORMS IN THE MONTOUR RUN WATERSHED

Year	Month and Date		Rainfall (inches)	
1972	June	20-24	4.14*	Tropical Storm "Agnes"
	September	12-13	2.50	
1973	May	24	2.31	
	October	28-29	2.18	
1974	May	11-12	2.13	
1975	February	23-24	2.75	
	July	8-9	2.40	
	September	23-24	2.26	
1978	December	8-9	2.00	
1980	May	12-13	2.38	
	July	8	2.27	
	May	1-2	1.95	
	November	3-4	3.30	
	November	15-16	1.97	
1986	June	5-6	2.83	
	July	8-9	2.55	
1987	June	20	2.96	
	August	4-5	2.88	

Source: NWS Raingage, Greater Pittsburgh International Airport, Local Climatological Data, NOAA, except as noted.
*Measured at the NWS raingage at the Federal Building, Pittsburgh.

Land Use Categories

Nine land use categories were adopted to describe the Montour Run Watershed under both "Existing" and "Future" conditions. These categories were selected based upon field surveys of the watershed, published reports, aerial photography, USGS topographic quadrangles, information received from local officials, and conversations with the Allegheny County Planning Department. The nine land use categories are:

- low-density residential - residential areas in which the average lot size is greater than one-half acre;
- medium-density residential - residential areas in which the average lot size is between one-eighth and one-half acre;
- high-density residential, industrial, and low-density commercial - residential areas in which the lot size is less than one-eighth acre (includes multi-family units), industrial areas, and smaller, isolated commercial areas;
- high-density commercial - large commercial areas, such as shopping centers and downtown business districts, plus airport runways, taxiways, terminals, and parking areas;
- woods - wooded or heavily brushed areas;
- grass-covered - unutilized farmland, natural grassed areas and meadows, utility right-of-ways;
- agricultural areas - active farm crop or pasture land;

- o strip mine - active or abandoned (but not revegetated), also includes dumps, gravel quarries, and clay pits;
- o parks, cemeteries, and golf courses.

The above categories were selected to provide a hydrologically correct representation of the land uses in the watershed. Small amounts of land with slightly different cover conditions were judged to be hydrologically equivalent to one of the categories listed above. The land uses were identified on the Montour Run Watershed maps for existing and future conditions (Figures 4-1 and 4-2). The mapped land uses were then laid onto a 10-acre element grid for transfer to a computer database. More detailed discussion of the land uses in the Montour Run Watershed is contained in Chapter 4.

Subshed Delineation

The Montour Run Watershed was subdivided into twenty-seven subsheds. The subshed boundaries were established to model adequately hydrologically significant features, such as major tributaries, significant obstructions (culverts or bridges), areas with a history of flooding (damage centers), and land use. Figure 5-3 shows the Montour Run Watershed subshed boundaries. Upstream of the Regional Industrial Development Corporation (RIDC) Park, which is located at the confluence of McClarens Run and Montour Run, hydrologic data was available from the "GPIA Proposed Midfield Terminal, Major Site Drainage and Stormwater Management" reports, Volumes I and II (both parts), by Tasso Katselas Associates, Inc., and Michael Baker Jr., Inc.,

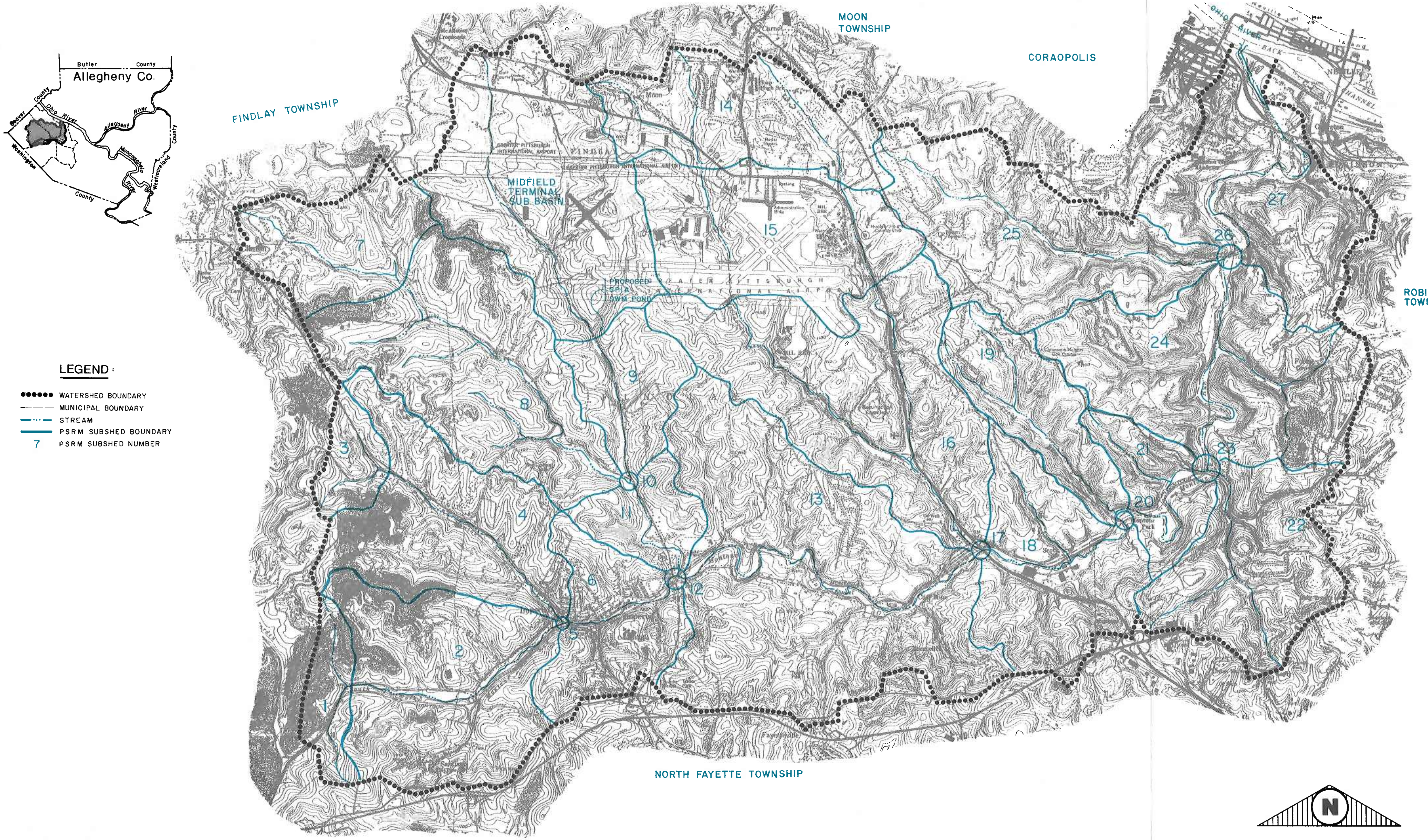

FIGURE 5-3

Subshed Boundaries

MONTOUR RUN WATERSHED STORMWATER MANAGEMENT PLAN

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October 1983. Hydrologic data and analyses performed for that project were modified for the specific purposes of this study. The watershed subdivisions used in the Midfield Terminal Subbasin and the Montour Run Watershed to RIDC Park were adopted directly for incorporation into this study. The Midfield Terminal Subbasin was input as an external hydrograph to Subshed 9 of the PSRM model for the Montour Run Watershed. This allowed the detailed analysis of this airport area, performed by Tasso Ketslas Associates and Michael Baker, Jr., to be utilized in this study.

Hydrologic Soil Group Classification

Hydrologic soil group (HSG) is an indication of the infiltration potential of a soil. There are four of these soil groups: A, B, C, and D. HSG A soils have the highest infiltration rates and lowest runoff potential, and HSG D soils have the lowest infiltration rates and greatest runoff potential. The Montour Run Watershed was mapped according to the four hydrologic soil groups on the 10-acre element grid and included in the data base for the study.

Physical Runoff Characteristics

The physical runoff characteristics of the individual subsheds in the PSRM are described by the overland runoff path length and slope. The overland runoff path length is the representative distance from the divide to a major drainage system (usually the stream) in the subshed. The overland runoff slope is the ratio of elevation change to distance along the selected overland runoff path. These parameters are used in the model to compute the overland flow width and depth.

Drainage Area and Channel Capacities

The drainage area of each subshed was measured, and the flow capacities of their significant hydraulic structures (major bridges and culverts) and streams were estimated. Dimensions, slopes, and lengths of the hydraulic structures were measured during a field survey in January 1988. Channel capacities were based upon field surveys taken from the Flood Insurance Study for Robinson Township, the January 1988 survey, and a subsequent field check made in March 1988. For each subshed, the drainage area and the limiting flow capacity were determined for the PSRM. Tables 5-3 and 5-4 include tabulations of these parameters for the Midfield Terminal Subbasin and the Montour Run Watershed.

Runoff Coefficients

Additional information required by the model for each subshed were the roughness coefficients for runoff on pervious and impervious surfaces, the initial abstraction (rainfall loss that occurs before runoff begins), and additional depression storage. These parameters were assigned values based on watershed characteristics, the previous GPIA reports, and engineering judgment.

A summary of the PSRM data parameters and values is provided on Tables 5-3 and 5-4 for the Midfield Terminal Subbasin and the Montour Run Watershed, respectively.

Table 5-3

SUMMARY OF SUBSHED HYDROLOGIC INPUT DATA
MIDFIELD TERMINAL SUBBASIN -- EXISTING CONDITIONS

Subshed ID	Drainage Area (ac)	Runoff Length (ft)	Runoff Slope (ft/ft)	Curve Number	Channel Capacity (cfs)	Travel Time (min)
1	68	740	.150	77	295	9.1
2	201	1459	.100	77	679	2.5
3	55	428	.050	75	658	7.3
4	32	581	.140	77	1000	3.9
5	96	804	.120	77	1000	13.7
6	42	610	.120	77	1000	.6
7	1	109	.050	77	1000	3.9
8	32	996	.125	77	910	6.0
9	120	1136	.150	77	1000	.5
10	137	932	.140	77	488	6.0
11	268	2162	.150	77	1310	12.8
12	230	1336	.080	77	1000	.6
13	1	109	.050	77	1000	2.6
14	134	1668	.140	77	3100	8.1
15	102	926	.140	77	5000	.6
16	137	806	.040	77	465	6.2
17	70	635	.080	77	5000	.6
18	1	109	.050	77	5000	10.0

Note: The above data taken from "GPIA Midfield Terminal, Major Site Drainage and Stormwater Management", Volumes I and II, October 1983, and "GPIA Midfield Terminal, Stormwater Management Pond", May 1987. (Michael Baker Jr., Inc.)

Note: The Midfield Terminal subsheds for existing conditions are different from the subsheds for future conditions, due to the proposed airport work.

Note: Travel time is the time it takes flow exiting one subshed to travel through the next downstream subshed (see also Figure 5-4).

Table 5-4

SUMMARY OF SUBSHED HYDROLOGIC INPUT DATA
MONTOUR RUN WATERSHED

Subshed ID	Drainage Area (ac)	Runoff Length (ft)	Runoff Slope (ft/ft)	Curve Number Exist	Curve Number Future	Channel Capacity (cfs)	Travel Time (min)	Average Channel Velocity (fps)	Stream Length (ft)
1	275	800	.16	76	76	260	32.6	5	4,810
2	1,415	800	.20	73	73	3,000	.7	7.5	10,190
3	235	700	.15	73	73	200	30.7	5	4,430
4	1,220	950	.18	74	74	3,000	.7	7.5	9,840
5	1	100	.10	91	91	3,000	20.0	7.5	200
6	740	500	.25	73	74	1,375	.7	7.5	5,830
7	690	700	.14	72	74	500	45.7	5	8,120
8	1,660	900	.12	70	73	450	.7	7.5	14,500
9	500	900	.16	71	71	1,450	.7	7.5	6,190
10	1	100	.10	71	71	450	20.0	7.5	200
11	370	1,000	.10	70	71	1,375	.7	7.5	5,600
12	1	100	.10	81	81	2,750	60.0	7.5	200
13	2,750	900	.14	74	76	900	.7	7.5	19,120
14	1,050	900	.11	80	82	370	17.3	5	6,720
15	1,270	2,700	.03	91	92	670	52.0	7.5	5,770
16	1,885	800	.19	75	78	970	.7	7.5	16,000
17	1	100	.10	98	98	1,700	13.8	9	200
18	1,060	800	.25	74	83	4,110	.7	9	7,430
19	640	900	.19	72	74	1,300	.7	5	11,460
20	1	100	.10	71	91	4,110	14.7	10	200
21	430	800	.20	69	83	4,470	.7	10	8,810
22	1,045	900	.18	71	77	750	.7	5	9,520
23	1	100	.10	79	79	4,470	18.3	10	200
24	1,670	1,100	.15	72	74	6,860	.7	10	10,990
25	1,470	900	.19	73	74	750	.7	5	16,510
26	1	100	.10	58	58	6,860	23.1	11	200
27	1,265	1,100	.17	71	71	20,000	5.0	11	15,220

Note: Travel time is the time it takes flow exiting one subshed to travel through the next downstream subshed (see Figure 5-5).

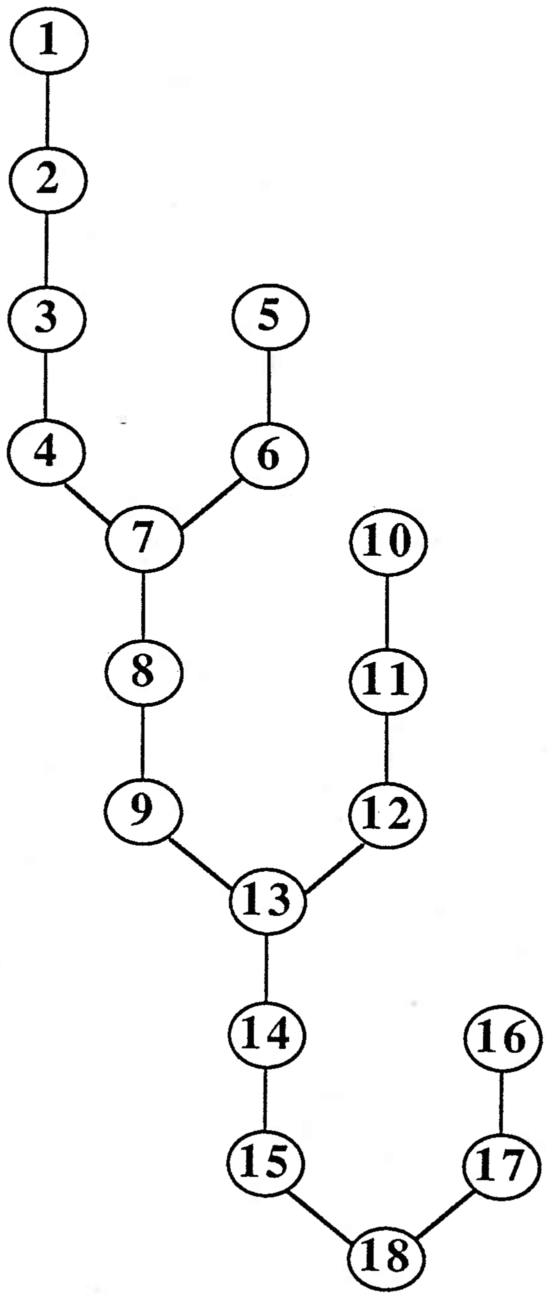

Figure 5-4

SCHEMATIC OF PSRM
MIDFIELD TERMINAL AREA EXISTING CONDITIONS

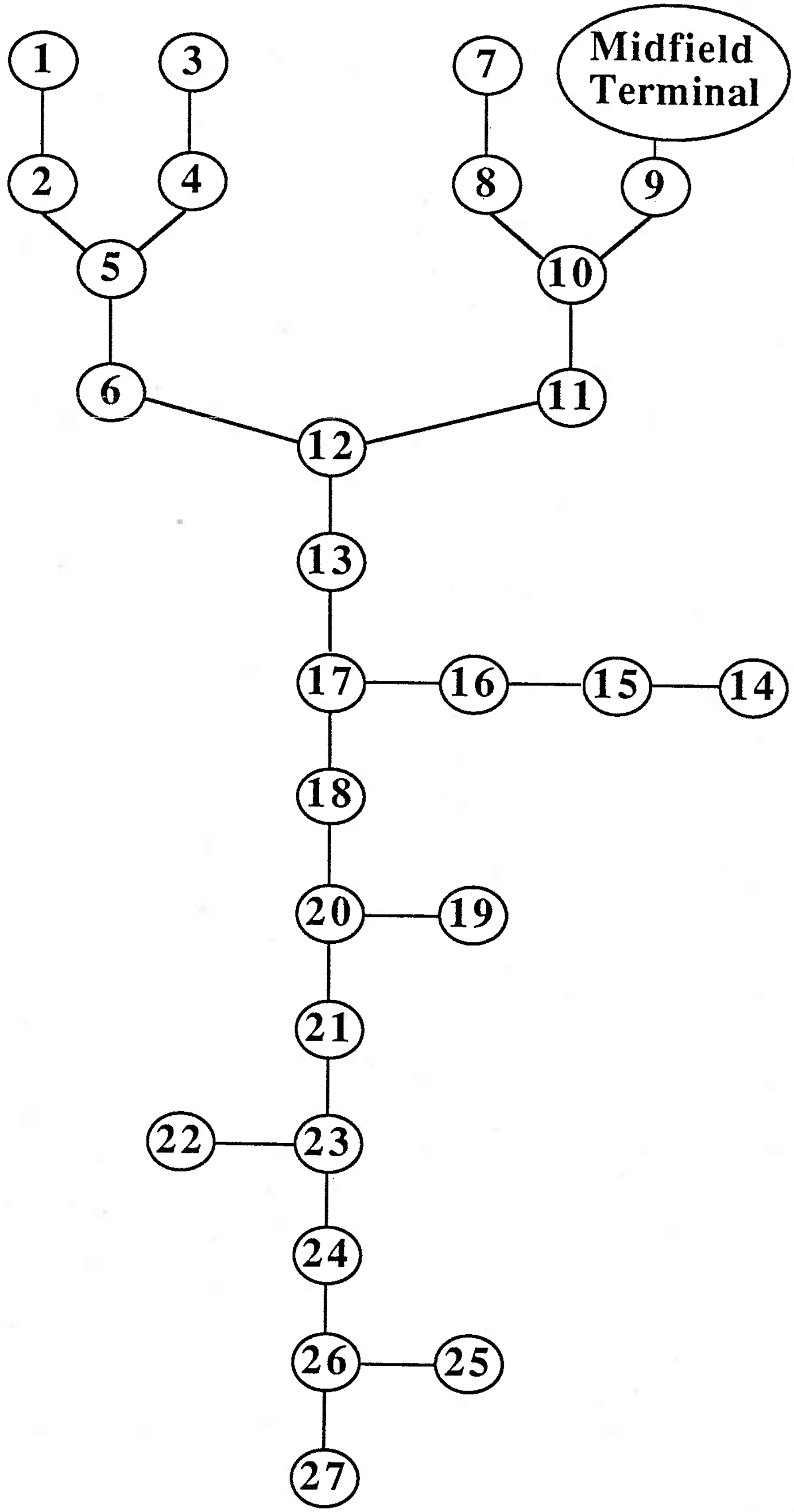

Figure 5-5

SCHEMATIC OF PSRM
MONTOUR RUN WATERSHED EXISTING CONDITIONS

VI. CALIBRATION OF THE PSRM

Calibration of the PSRM was achieved by correlating past flood events with the results of the model. Rainfall data was available from the National Weather Services (NWS) gage at the GPIA. A review of USGS Water Resources Data and the Flood Insurance Studies for Townships of Robinson, Moon, and North Fayette revealed no high water marks associated with a significant storm event. A recent report of flooding, June 20, 1987, at the Marriott Hotel along McClarens Run was investigated. Although no visible evidence was present, witness reports indicate that the hotel parking lots were flooded and that the flood crested near the level of the first floor. A field survey was made to obtain data needed to compute the peak flow rate. Comparison of this computed estimate (using Manning's equation) and the PSRM-predicted flow for McClarens Run gave good agreement (within 5%). Accordingly, no calibration adjustment to the PSRM was required.

Reliable high water marks were not available to check the other portions of the model. Therefore, regression equations were used to compute flows for the 10-year and 100-year events. These equations were developed by the Pittsburgh District of the U.S. Army Corps of Engineers (COE) and were used in the flood insurance study for the townships of Robinson and North Fayette. Again, relatively good agreement was obtained between the PSRM results and the flows predicted by the regression equations (±10%). Based on the calibration and check performed, it was determined that the PSRM for the Montour Run Watershed was satisfactory for this study. Table 6-1 summarizes the results of the calibration process.

Table 6-1

SUMMARY OF PSRM "EXISTING CONDITIONS" CALIBRATION

Event	Method	Flow (cfs)
At the Marriott Hotel:		
20 June 1987	Reported High Water Mark HWM with Manning Equation*	3,500
20 June 1987	PSRM	3,330
At the mouth:		
10-yr design event	PSRM	6,660
	COE	6,000
100-yr design event	PSRM	10,300
	COE	10,700

*HWM (high water mark) and Manning Equation used to calculate channel capacity.

Existing Conditions PSRM

The calibrated "Existing Conditions" PSRM was developed to obtain the base hydrologic conditions in the watershed. Schematics of the PSRM analyses for the Midfield Terminal Subbasin and the Montour Run Watershed are presented as Figures 5-4 and 5-5, respectively. These schematics depict graphically the network of areas (subsheds) which make up the watershed and subbasin. The Midfield Terminal Subbasin "Existing Conditions" PSRM was from data developed by Michael Baker, Jr., Inc., and the results were inserted as data in the Montour Run Watershed PSRM. The results of the Montour Run PSRM were found to be reasonable and were thus established as the base hydrologic conditions. The timing and the peak flood flows were analyzed, and the critical subsheds were noted. Critical subsheds are considered to be those subsheds which contribute significantly to downstream flood peaks. It is particularly desirable to control runoff from these subsheds, as will be discussed in the "Release Rates" section. Table 6-2 summarizes the results of the "Existing Conditions" PSRM for the Montour Run Watershed.

Future Conditions PSRM

The "Future Conditions" PSRM for Montour Run was developed by incorporating the Midfield Terminal GPIA development with the other development projected for the watershed. The "2020" (year) Conditions: PSRM for the Midfield Terminal Subbasin, as developed by Michael Baker Jr., Inc., and presented in the GPIA reports, was modified as necessary to include projected development outside the airport area. Figures 6-1 and 6-2 show the PSRM schematics for the Montour Run and Midfield Terminal modeling under "Future Conditions." The PSRM schematic for Montour Run is identical to that for "Existing Conditions." The results of this computer analysis were then routed through the proposed stormwater management (SWM) pond in the manner described in "GPIA Midfield Terminal, Proposed Stormwater Management Pond Report", Tasso Katselas Associates, Inc., & Michael Baker Jr., Inc., May 1987. To be consistent with the previous study, the routing was performed using the U.S. Army Corps of Engineers HEC-1 (Hydrologic Engineering Center) "Flood Hydrograph Package."

Table 6-2

MONTOUR RUN WATERSHED
EXISTING CONDITIONS
PREDICTED PEAK FLOOD FLOWS

Subshed	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
1	80	170	248	351	427	468
2	308	720	1,094	1,608	2,013	2,224
3	51	119	181	265	325	359
4	258	594	903	1,326	1,637	1,810
5	556	1,180	1,861	2,832	3,551	3,927
6	686	1,494	2,275	3,363	3,880	4,103
7	128	311	484	722	893	981
8	274	592	888	1,280	1,636	1,824
9	437	748	996	1,308	1,514	1,617
10	710	1,320	1,815	2,476	2,882	3,081
11	713	1,364	1,891	2,529	2,929	3,126
12	1,256	2,414	3,358	4,710	5,905	6,562
13	1,475	2,769	3,710	5,182	6,245	6,804
14	493	867	1,186	1,606	1,902	2,054
15	1,374	1,950	2,401	2,958	3,343	3,540
16	1,604	2,299	2,828	3,478	3,923	4,149
17	2,945	4,876	6,102	7,738	9,092	9,799
18	3,018	4,996	6,255	7,878	9,234	9,945
19	111	272	425	639	795	876
20	3,055	5,063	6,345	7,961	9,305	10,014
21	2,977	5,073	6,368	7,985	9,292	9,988
22	154	395	630	965	1,212	1,340
23	3,020	5,148	6,465	8,094	9,396	10,093
24	3,078	5,186	6,494	8,205	9,384	10,037
25	290	686	1,055	1,563	1,928	2,117
26	3,134	5,285	6,609	8,343	9,528	10,185
27	3,150	5,314	6,657	8,368	9,616	10,296

Notes: 1. The SCS Type II 24-hour design storm is used in the PSRM analyses.

2. "Existing Conditions" describes those conditions in the Montour Run Watershed as of March 1988. The proposed GPIA stormwater management (SWM) pond is not included in existing conditions.

The results of the HEC-1 analysis were then put into the "Future Conditions" PSRM for the Montour Run Watershed (see Figure 6-1). The results of the Montour Run "Future Conditions" PSRM are given in Table 6-3. A comparative summary of the "Existing" and "Future" conditions PSRM modeling is provided in Table 6-4.

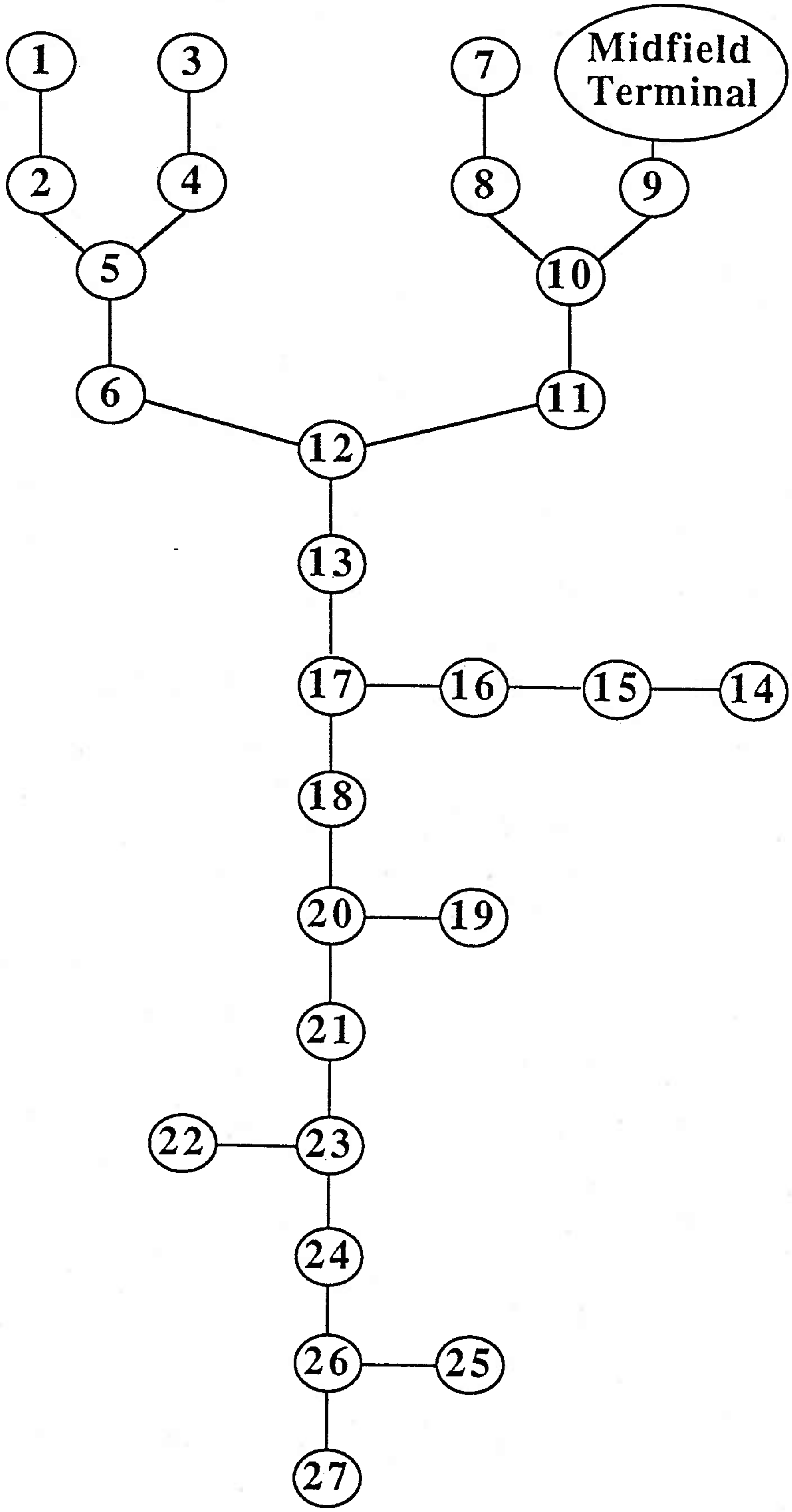

Figure 6-1

SCHEMATIC OF PSRM
MONTOUR RUN WATERSHED FUTURE CONDITIONS

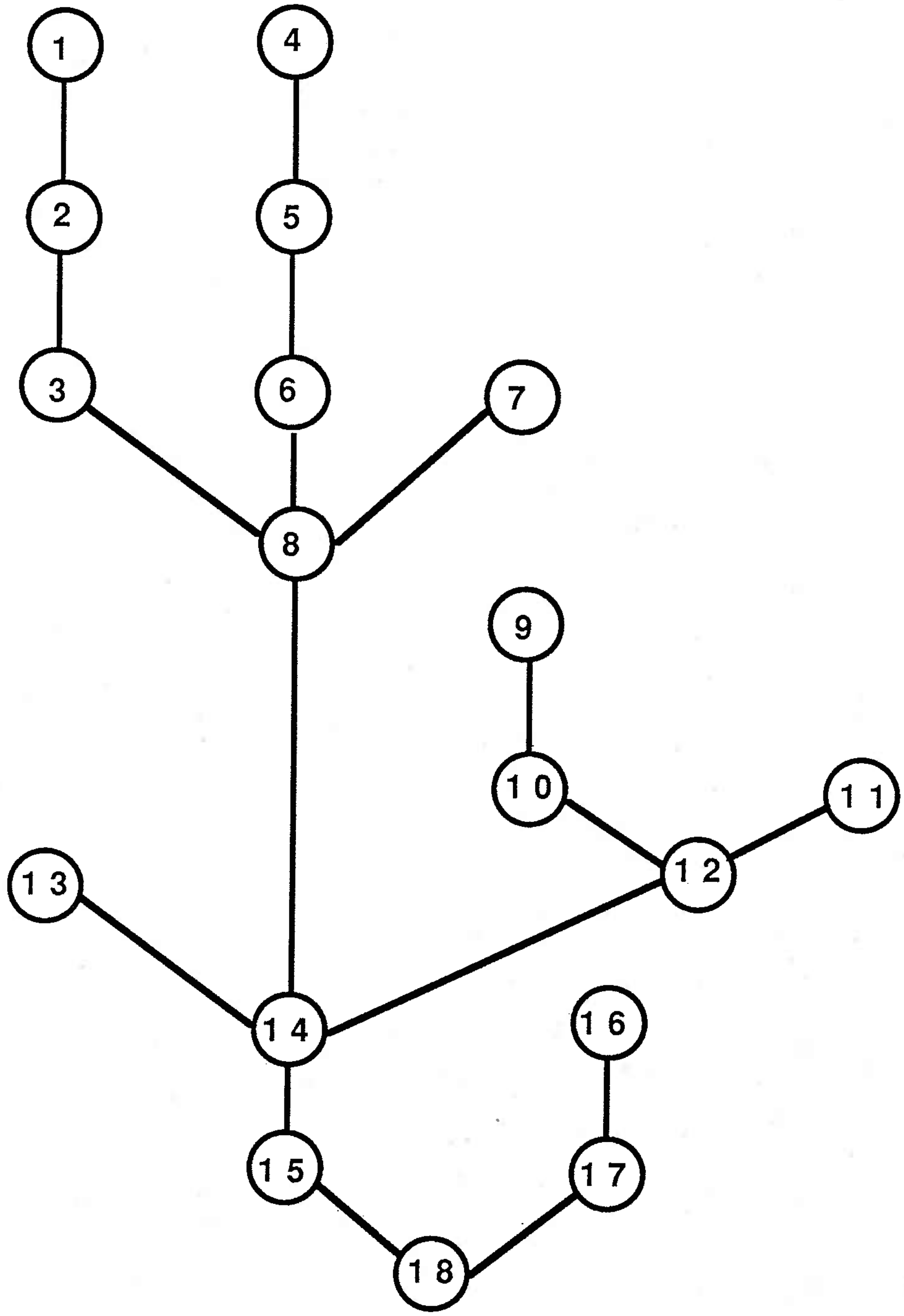

Figure 6-2

SCHEMATIC OF PSRM
MIDFIELD TERMINAL FUTURE CONDITIONS

Table 6-3

MONTOUR RUN WATERSHED
FUTURE CONDITIONS
PREDICTED PEAK FLOOD FLOWS

Subshed	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
1	80	170	248	351	427	468
2	308	720	1094	1608	2013	2224
3	51	119	181	265	325	359
4	258	594	903	1,326	1,637	1,810
5	556	1,180	1,861	2,832	3,551	3,927
6	694	1,512	2,293	3,380	3,897	4,120
7	165	374	561	812	993	1,094
8	356	730	1,044	1,574	1,963	2,165
9	281	373	474	706	962	1,082
10	636	1,086	1,443	2,062	2,573	2,845
11	666	1,119	1,498	2,132	2,598	2,840
12	1,280	2,419	3,436	4,745	5,877	6,506
13	1,538	2,883	3,832	5,302	6,378	6,933
14	568	974	1,311	1,746	2,050	2,205
15	1,400	1,991	2,450	3,030	3,442	3,650
16	1,671	2,383	2,920	3,576	4,027	4,255
17	3,132	5,143	6,344	7,975	9,347	10,054
18	3,254	5,303	6,530	8,148	9,523	10,235
19	143	327	495	722	884	968
20	3,302	5,378	6,622	8,238	9,604	10,317
21	3,302	5,416	6,664	8,287	9,621	10,327
22	326	677	978	1,373	1,660	1,814
23	3,376	5,522	6,788	8,423	9,754	10,462
24	3,479	5,568	6,816	8,552	9,776	10,455
25	329	752	1,137	1,659	2,031	2,222
26	3,542	5,670	6,934	8,696	9,926	10,609
27	3,496	5,678	7,021	8,679	9,953	10,648

Notes:

1. SCS Type II 24-hour design storm used in all PSRM analyses.
2. Future conditions describes those conditions which have been projected to occur by the year 1998 in the Montour Run Watershed. This includes the Midfield Terminal development, as described in the GPIA design reports.

Table 6-4

MONTOUR RUN WATERSHED PEAK FLOOD FLOWS FOR SELECTED STORM EVENTS
EXISTING AND FUTURE CONDITIONS

Subshed	Peak Flood Flows (cfs) by Subshed and Stormwater Return Period											
	2-Year		5-Year		10-Year		25-Year		50-Year		100-Year	
	Existing	Future	Existing	Future	Existing	Future	Existing	Future	Existing	Future	Existing	Future
1	80	80	170	170	248	248	351	351	427	427	468	468
2	308	308	720	720	1,094	1,094	1,608	1,608	2,013	2,013	2,224	2,224
3	51	51	119	119	181	181	265	265	325	325	359	359
4	258	258	594	594	903	903	1,326	1,326	1,637	1,637	1,810	1,810
5	556	556	1,180	1,180	1,861	1,861	2,832	2,832	3,551	3,551	3,927	3,927
6	686	694	1,494	1,512	2,275	2,293	3,363	3,380	3,880	3,897	4,103	4,120
7	128	165	311	374	484	561	722	812	893	993	981	1,094
8	274	356	592	730	888	1,044	1,280	1,574	1,636	1,963	1,824	2,165
9	437	281	748	373	996	474	1,308	706	1,514	962	1,617	1,082
10	710	636	1,320	1,086	1,815	1,443	2,476	2,062	2,882	2,573	3,081	2,845
11	713	666	1,364	1,119	1,891	1,498	2,529	2,132	2,929	2,598	3,126	2,840
12	1,256	1,280	2,414	2,419	3,358	3,436	4,710	4,745	5,905	5,877	6,562	6,506
13	1,475	1,538	2,769	2,883	3,710	3,832	5,182	5,302	6,245	6,378	6,804	6,933
14	493	568	867	974	1,186	1,311	1,606	1,746	1,902	2,050	2,054	2,205
15	1,374	1,400	1,950	1,981	2,401	2,450	2,958	3,030	3,343	3,442	3,540	3,650
16	1,604	1,671	2,299	2,383	2,828	2,920	3,478	3,576	3,923	4,027	4,149	4,255
17	2,945	3,132	4,876	5,143	6,102	6,344	7,738	7,975	9,092	9,347	9,799	10,054
18	3,018	3,254	4,996	5,303	6,255	6,530	7,878	8,148	9,234	9,523	9,945	10,235
19	111	143	272	327	425	495	639	722	795	884	876	968
20	3,055	3,302	5,063	5,378	6,345	6,622	7,961	8,238	9,305	9,604	10,014	10,317
21	2,977	3,302	5,073	5,416	6,368	6,664	7,985	8,287	9,292	9,621	9,988	10,327
22	154	326	395	677	630	978	965	1,373	1,212	1,660	1,340	1,814
23	3,020	3,376	5,148	5,522	6,465	6,788	8,094	8,423	9,396	9,754	10,093	10,462
24	3,078	3,479	5,186	5,568	6,494	6,816	8,205	8,552	9,384	9,776	10,037	10,455
25	290	329	686	752	1,055	1,137	1,563	1,659	1,928	2,031	2,117	2,222
26	3,134	3,542	5,285	5,670	6,609	6,934	8,343	8,696	9,528	9,926	10,185	10,609
27	3,150	3,496	5,314	5,678	6,657	7,021	8,368	8,679	9,616	9,953	10,296	10,648

Notes:

1. SCS Type II 24-hour design storm used in all PSRM analyses
2. Existing conditions describes the conditions which are known to exist in the Montour Run Watershed as of March 1988. The stormwater management (SWM) pond, as described in the design reports for the GPIA Midfield Terminal, is not included in the existing conditions.
3. Future conditions describes those conditions which have been projected to occur by the year 1998 in the Montour Run Watershed. This includes the Midfield Terminal development for the year 2020, as described in the GPIA design reports.
4. Future conditions flows shown do not reflect stormwater management.
5. Subsheds 1-5 have negligible projected development.

VII. RELEASE RATES

The concept of "release rates" is related to the proportion of stormwater flow that a subshed contributes to downstream flood flows. At any downstream location, an individual upstream subshed's contribution to the peak flow at the downstream subshed is divided by the upstream subshed's peak runoff flow. The number thus obtained, which is always less than or equal to 1, is then multiplied by 100 percent to obtain the release rate percentage of that (upstream) subshed to the point in question. An upstream subshed may have several such release rate percentages, one for each downstream subshed being evaluated. The lowest computed release rate percentage would be considered the controlling release rate percentage for the upstream subshed. This percentage is then applied to the peak runoff flow (existing conditions) to obtain the allowable release rate of the subshed for future development. If this value were to be exceeded by some proposed development, then the upstream subshed would increase the peak flow rate observed in downstream areas. This concept is illustrated in Figure 7-1.

The general methodology for computing the set of release rate percentages recommended for the Montour Run Watershed is based on that used in the Lehigh County version (1988) of the PSRM. A procedure was devised to utilize the initial set of release rates to develop more uniform release rates.

An analysis of the results of the PSRM runs under "Existing" and "Future" conditions yielded certain hydrologic characteristics of the watershed which permitted a simplified analysis.

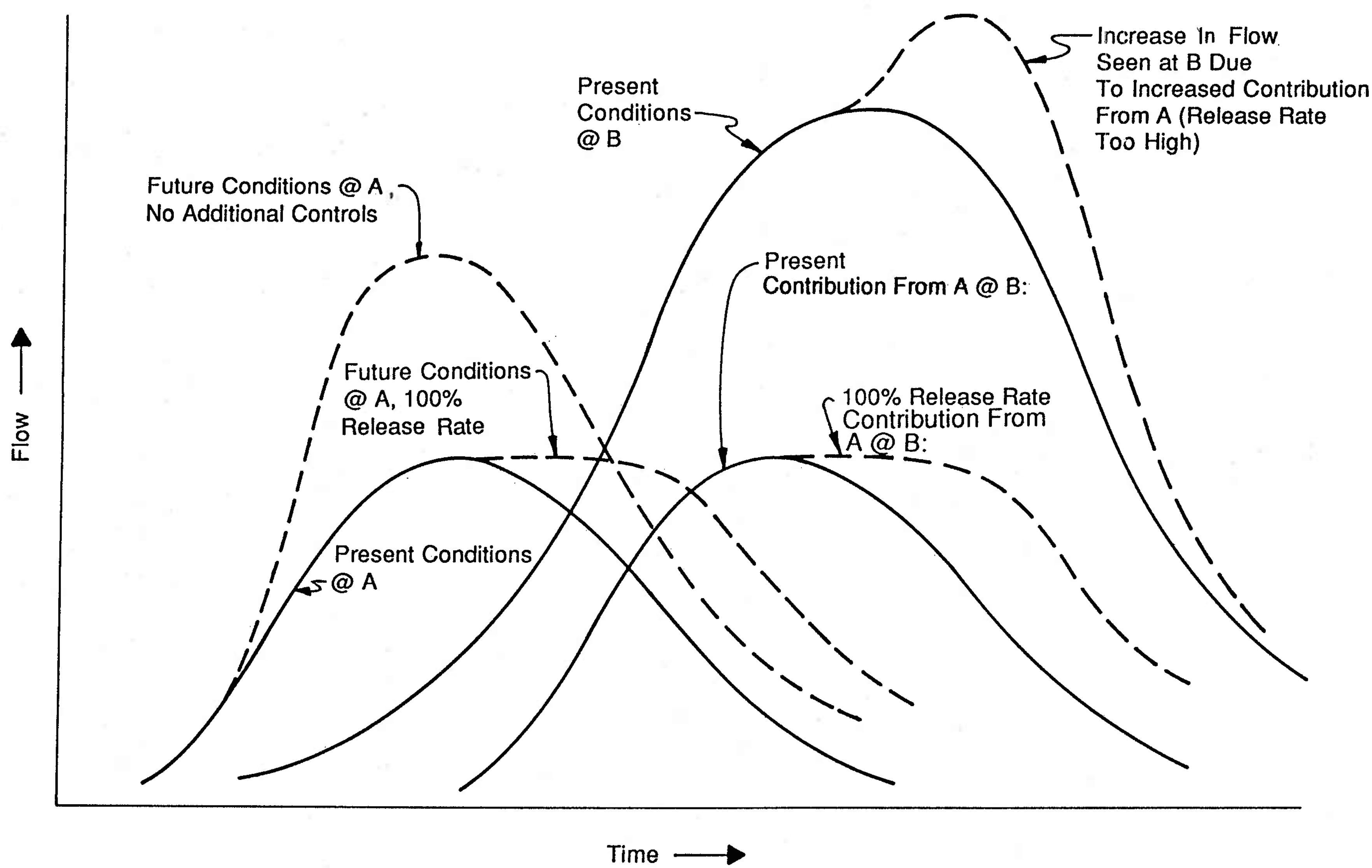

Figure 7-1

IMPACT OF RELEASE RATE CONTROL

These characteristics may be discerned from Figure 5-3, the Montour Run Subshed Boundaries Map. The shape and drainage pattern of the Montour Run Watershed indicated that the watershed may be divided into two relatively distinct portions. The division point was found to be Subshed 17, the confluence of McClarens Run and Montour Run, at the general site of the RIDC Park and the Montour Run exit of the Parkway West. The upper portion, Subsheds 1-17, collects runoff from roughly two-thirds (24.7 sq. miles) of the watershed. The McClarens Run peaks and the Montour Run peaks coincide at Subshed 17 to form a double-peaked flood hydrograph. This is shown on Figure 7-2 for the 100-year event under "Existing Conditions". Figure 7-2 shows the flow conditions which occur at the confluence, which is at Subshed 17. From this point downstream to the Ohio River, this flood hydrograph is translated along Montour Run by the PSRM.

The downstream portion of the Montour Run Watershed, Subsheds 18-27, consists of several tributary streams which feed Montour Run directly. The runoff collected in these streams is analogous to that collected in the uppermost subsheds of the Montour Run Watershed. However, since this runoff does not have to travel a long distance along McClarens Run or Montour Run itself, it possesses a "head start" on the other flows and accounts for the early peak shown on Figure 7-3 for Subshed 27, the mouth of Montour Run. The second peak results from the routed flood hydrographs of the upstream subsheds. This double peak characteristic of Montour Run is significant, since it points out the importance of the timing of the various subshed

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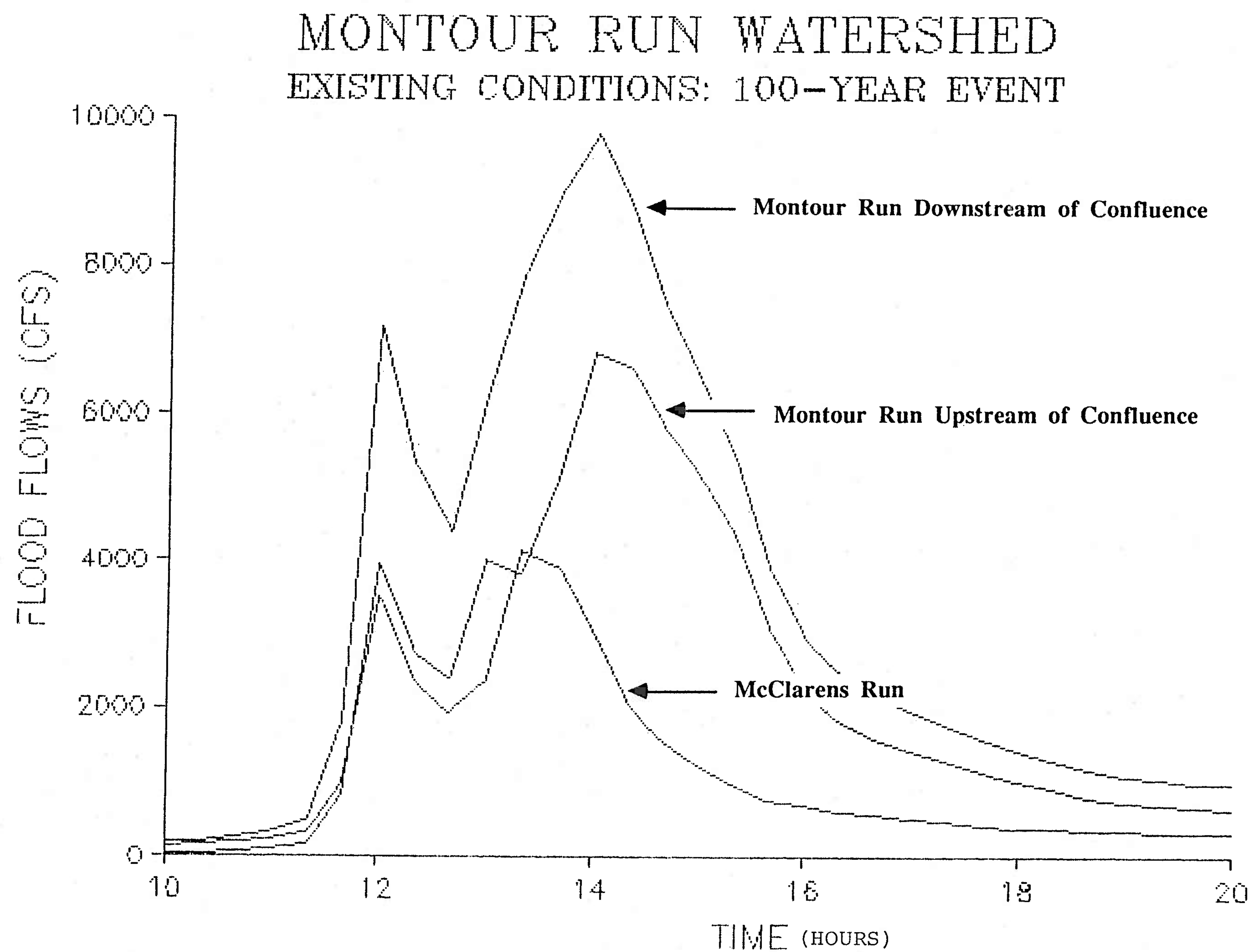

Figure 7-2

FLOOD HYDROGRAPH
AT THE CONFLUENCE OF MONTOUR RUN AND McCLARENS RUN

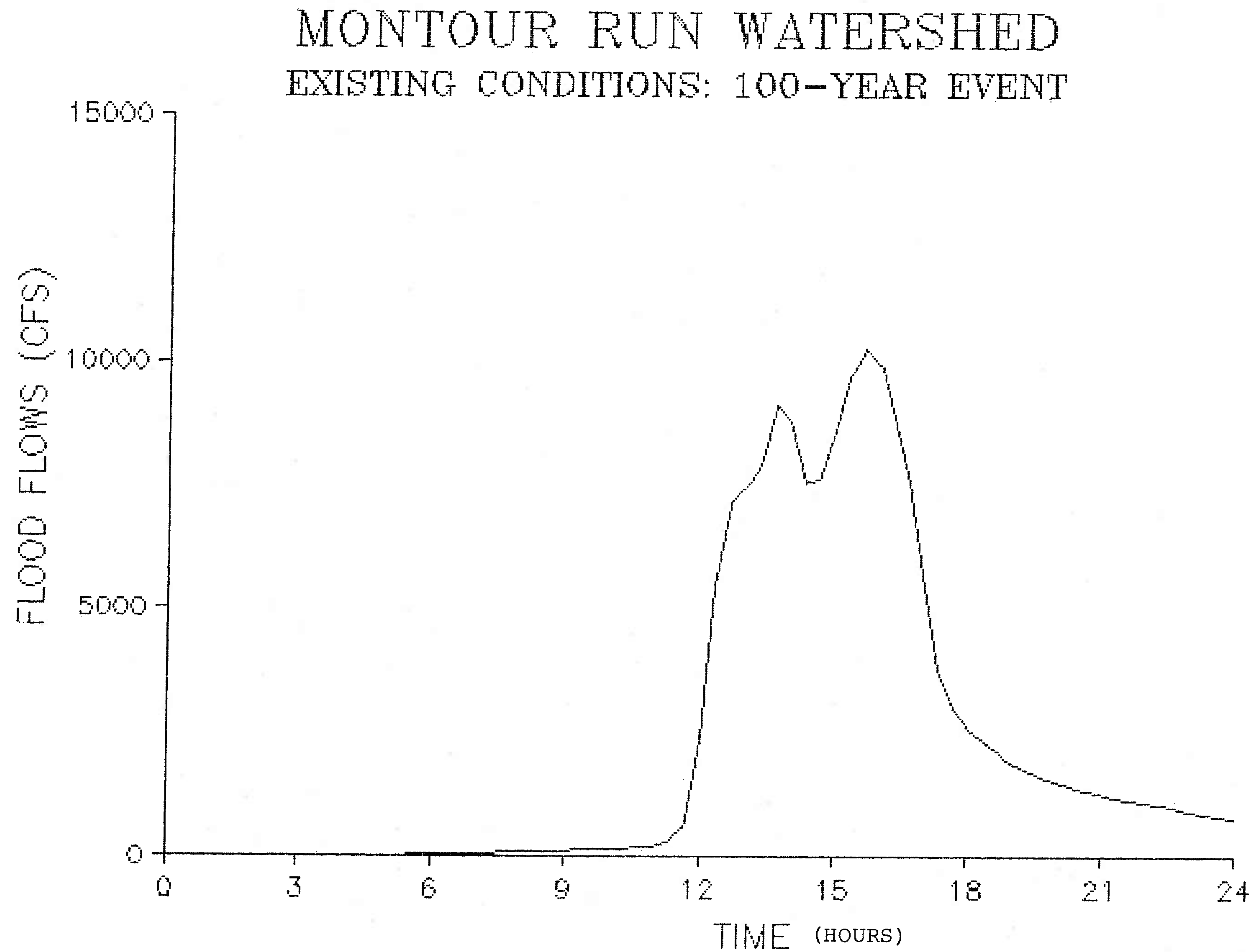

Figure 7-3

FLOOD HYDROGRAPH
AT THE MOUTH OF MONTOUR RUN

runoff peak flows. Indiscriminant development could alter the current timing of these flows, with serious effects on downstream flooding. Therefore, it was evident that certain subsheds would be more critical than others. One of the conclusions drawn from the PSRM analyses was that this multi-peak feature of the watershed should be preserved, or even enhanced, since it would be a key factor in preventing exacerbation of flood conditions along Montour Run.

In the development of the set of release rates proposed for the Montour Run Watershed, this hydrologic distinction was maintained. The downstream portion of the watershed was assigned a uniform maximum release rate percentage of 100%. Post-development peak flows may equal, but not exceed, existing peak flows. This would help maintain the early peaking characteristic of Montour Run, yet not result in increased flood problems.

The upstream portion of the watershed (Subsheds 1-17), would have reduced and nearly uniform release rate percentages. Using the procedure discussed earlier, it was determined that areas could be protected from additional damage by applying release rates of 70 to 100 percent to the upstream portion. Due to their locations, a few subsheds would require slightly more or less stringent rates. Table 7-1 presents the proposed set of release rates for the Montour Run Watershed. Figure 7-4, the Montour Run Release Rate Percentage Map, shows the release rate percentages proposed for the Montour Run Watershed.

Table 7-1

RELEASE RATES FOR MONTOUR RUN WATERSHED

Subshed	Release Rate (percent)
1	75
2	75
3	75
4	75
5	75
6	80
7	75
8	75
9	80
10	80
11	80
12	80
13	100
14	70
15	70
16	90
17	100
18	100
19	100
20	100
21	100
22	100
23	100
24	100
25	100
26	100
27	100
Midfield Terminal	100

Note: The above release rates apply to runoff conditions resulting from proposed (new) development in the subsheds and are applicable for all design events to be analyzed.

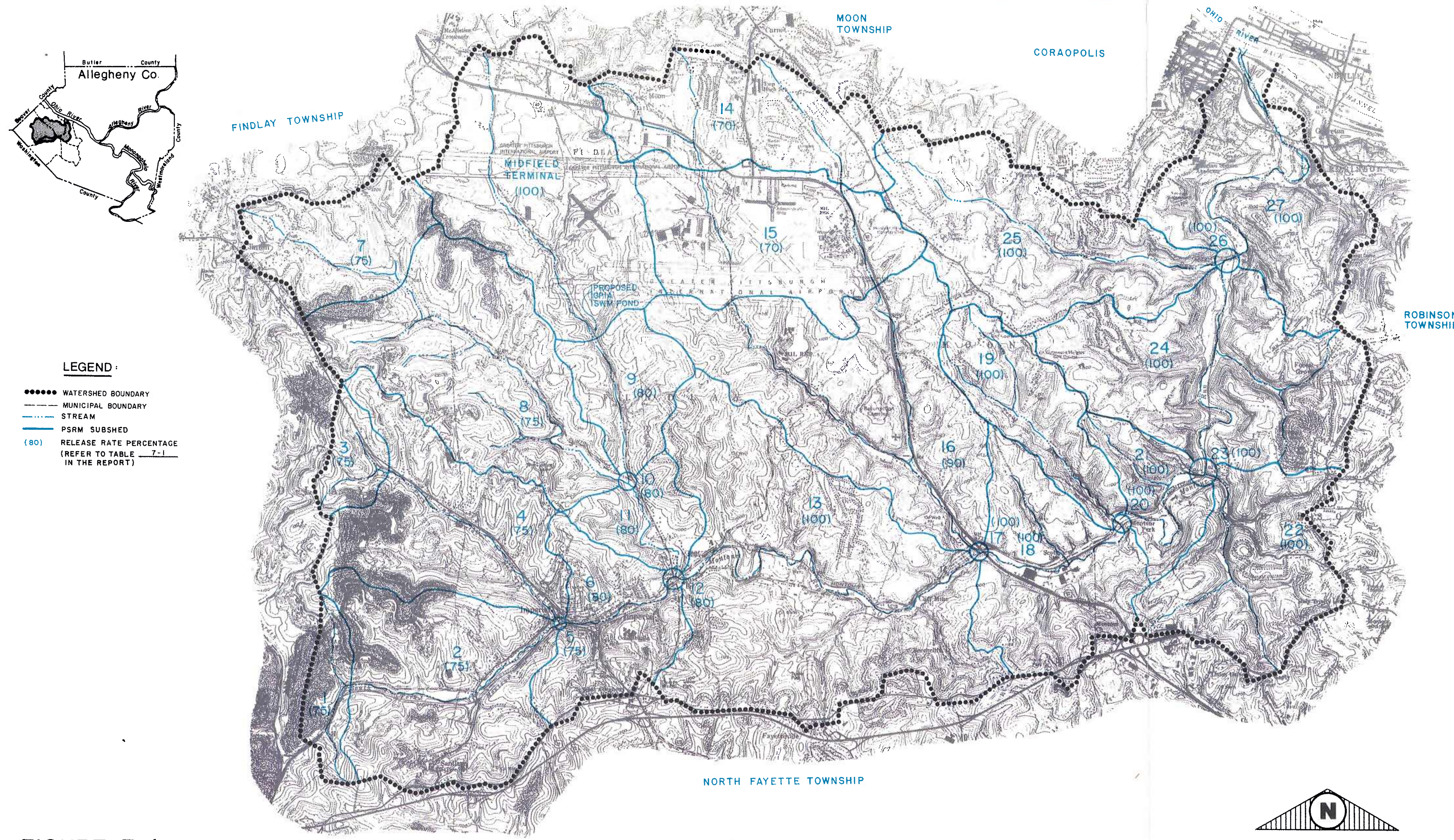

FIGURE 7-4

Release Rate Percentage Map

MONTOUR RUN WATERSHED STORMWATER MANAGEMENT PLAN

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Parking Lot Detention. Parking lot detention involves the design of pavement surface, curbing, and stormwater inlet structures to store and release stormwater runoff temporarily. Initial construction costs implementing these measures are only a small percentage above the cost of constructing conventional parking lots.

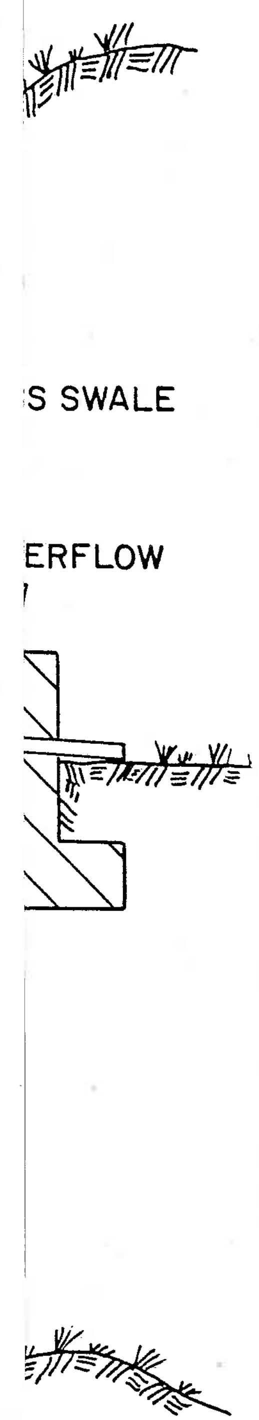
These measures should be designed specifically to control runoff from the particular parking area and avoid handling any additional runoff. The facility should be designed to drain completely and avoid the formation of ice.

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 preliminary design.

A hard-surfaced 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.

Grassed areas also can be landscaped to serve as small retention areas. Direct discharge from a pipe to these areas should be avoided.

Figure 8-7 shows some conceptual designs.



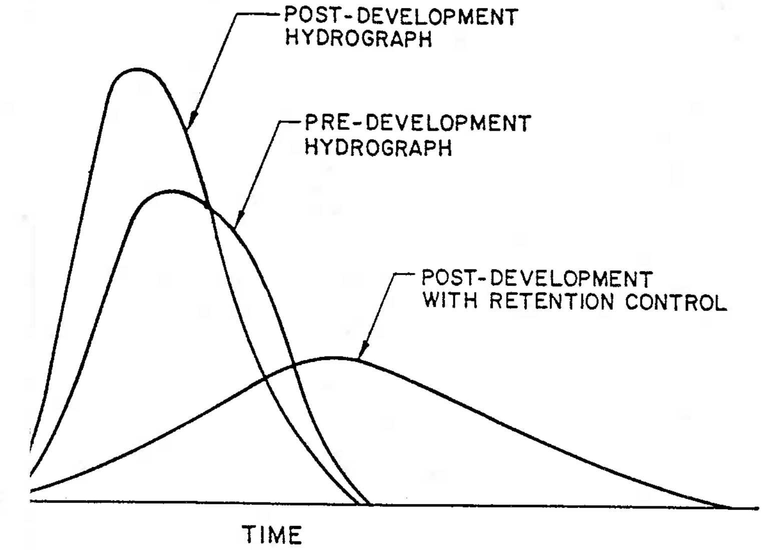


Figure 8-8

DETENTION BASIN HYDROGRAPH

of a detention basin must be coordinated with the
centage to ensure that flooding problems do not
ximum discharge rate from the subbasin is
me.

outlet structures must be used for all detention
to provide discharge control for different storm
. The objective is to control the
of the outflow rate so as to imitate the
of the pre-development runoff rate for the 2-,
d 100-year design storm. This can be
locating outlet structures at various elevations

shows a cross section of a typical detention
ation of Pipe A is set at the design height that
t is expected to reach in the basin, and Pipe B
00-year event. The drain pipe is designed for a
orm. The outlet flow discharge rate from the
in response to the design storm event entering

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A hard-surfaced 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.

Grassed areas also can be landscaped to serve as small retention areas. Direct discharge from a pipe to these areas should be avoided.

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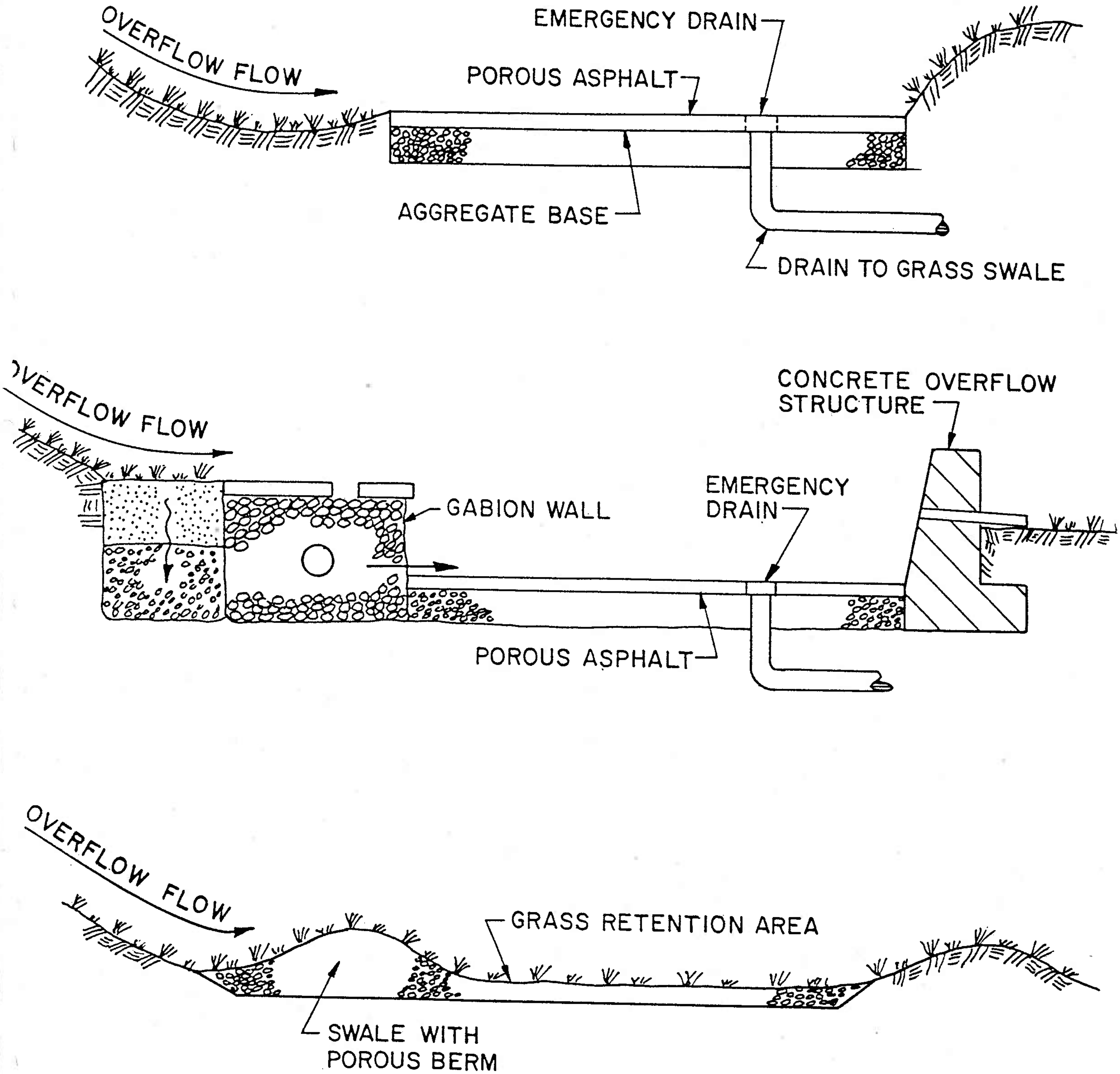

Figure 8-7

IMPOUNDMENT AREAS

Detention Basins. Detention basins are dry impoundments designed to store a portion of the stormwater runoff during a storm event and then release the stored volume slowly. Typically, they are used in areas where runoff volume has been increased and it is desirable to reduce the runoff rate. Three design elements must be calculated:

- the inflow rate, which is the rate of stormwater runoff entering the basin;
- the outflow rate, which is the runoff rate released from the basin;
- the storage capacity of the basin computed in acre-feet by water elevation in the basin. A basin two acres in area, for example, has two acre-feet of storage for each foot of depth in the basin.

Figure 8-8 represents a typical example of detention basin storage. As can be seen, the post-development discharge with no detention storage is greater than the pre-development value. Detention storage is then used to reduce the discharge to an allowable quantity. The horizontal line for the post-development curve with detention storage represents that period when the outlet flow rate is at a maximum and the detention basin is filling to its maximum elevation. As the inflow rate into the basin reduces to less than the outflow rate, the basin begins to drain.

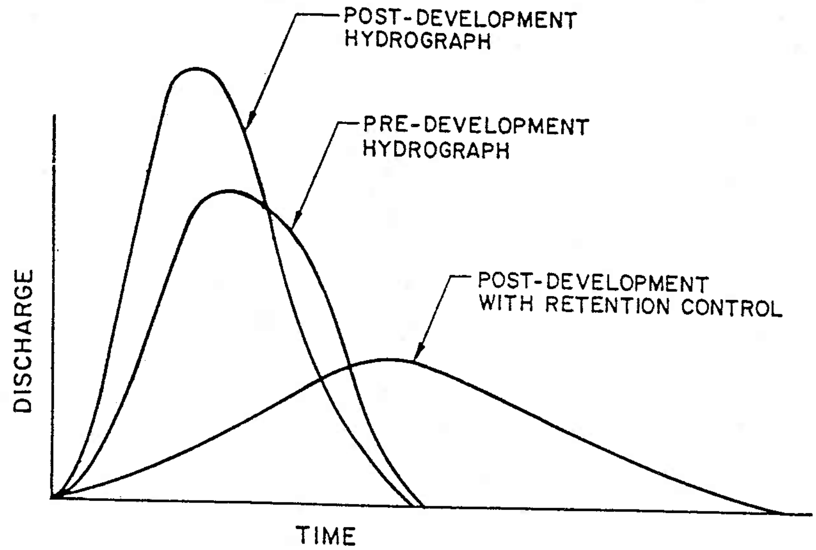

Figure 8-8

DETENTION BASIN HYDROGRAPH

The design of a detention basin must be coordinated with the release rate percentage to ensure that flooding problems do not result as the maximum discharge rate from the subbasin is extended over time.

Multistage outlet structures must be used for all detention basins in order to provide discharge control for different storm frequency events. The objective is to control the characteristics of the outflow rate so as to imitate the characteristics of the pre-development runoff rate for the 2-, 5-, 10-, 25-, and 100-year design storm. This can be accomplished by locating outlet structures at various elevations in the basin.

Figure 8-9 shows a cross section of a typical detention basin. The elevation of Pipe A is set at the design height that the 10-year event is expected to reach in the basin, and Pipe B is set for the 100-year event. The drain pipe is designed for a 2-year design storm. The outlet flow discharge rate from the basin will vary in response to the design storm event entering the inflow.

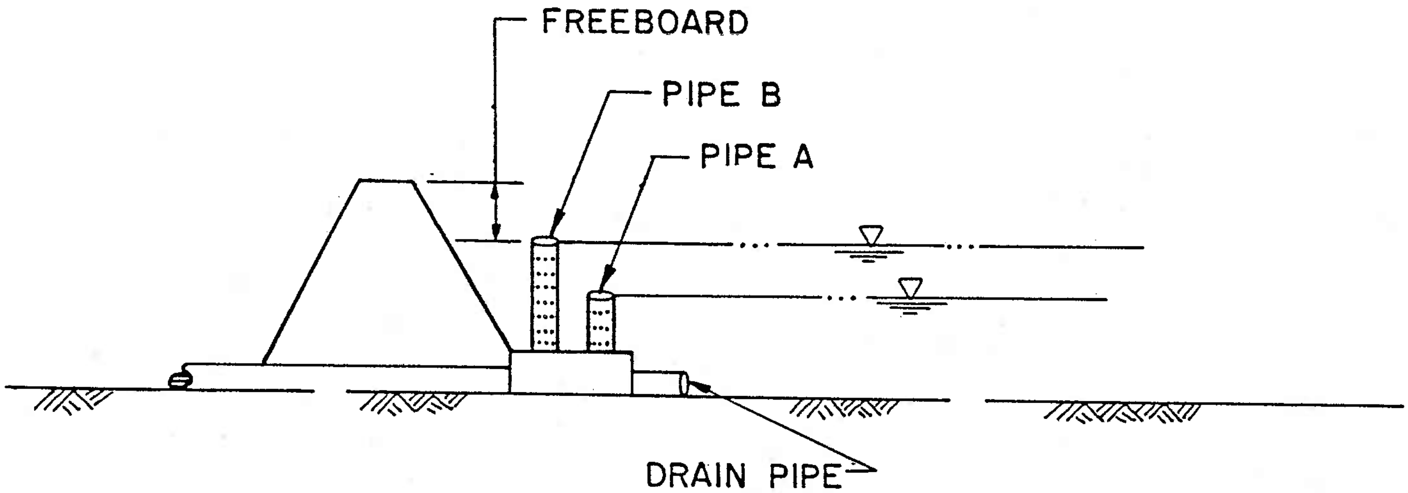

Figure 8-9

TYPICAL CROSS SECTION - DETENTION BASIN

Permanent Ponds. Permanent ponds may be designed to function as detention/retention structures by providing an elevation difference between the principal and emergency spillways. This elevation difference, above normal pond levels, must provide adequate storage volume for detention capacity. These ponds are unquestionably more aesthetically appealing than a typical dry impoundment basin. In addition, the pond can be designed to provide some recreational benefits.

Underground Detention/Retention Tanks. In areas where land is of very high value, these tanks can serve the same function as basins but also conserve land. This method is very expensive because of high costs of materials for construction and possible pumping requirements.

Retention Basins. These structures 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 when compared with the outflow period of a detention basin. This requires large storage capacity for detaining stormwater for periods greater than 24 hours (Figure 8-10).

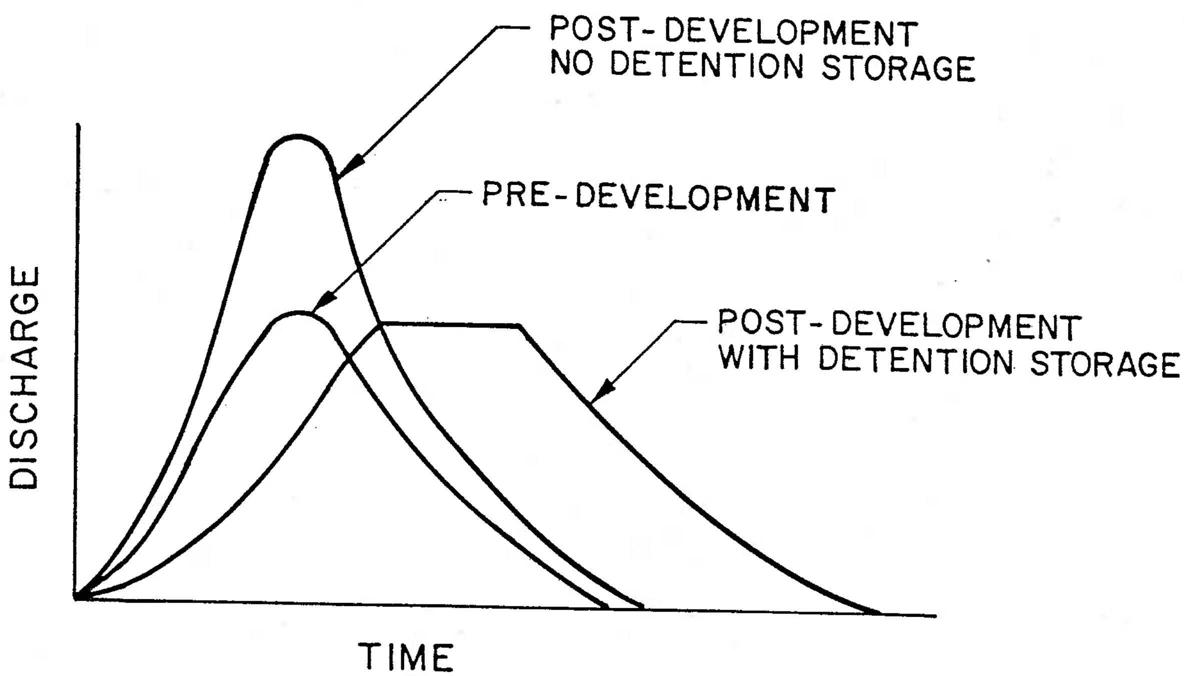

Figure 8-10

RETENTION BASIN HYDROGRAPH

Table 8-3 summarizes some of the management considerations relevant to the selection and design of detention and retention techniques. The table highlights key elements that should be evaluated during the design process. Additional elements for consideration will exist for each site to reflect the individual characteristics of the area.

Summary. Tables 8-4 and 8-5 highlight the advantages/ disadvantages and operation and maintenance considerations for the stormwater management techniques described above. As noted previously, no one technique is uniquely suited to a particular runoff problem; rather, a combination of techniques will result in an effective stormwater management system for the site.

For example, in a development consisting of homes built on quarter-acre lots, the residential streets and parking areas could be porous pavement. The roof downspout could lead to a dutch drain which also could be a grassed waterway picking up overflow from other controls. Mulch planting could be located beside lattice sidewalks. The excess runoff from all these controls would be collected either by a detention pond or a seepage basin at the lowest downslope area of the development.

Each internal technique would provide a portion of the required stormwater runoff control with the drainage routed overland from each facility to the detention pond or seepage basin. Storage would be provided by the detention pond or seepage basin. Some additional storage, plus induced infiltration, would be provided by the areas of porous pavement, mulch

	Land Acquistion (1)	Excavation and Fill	Erosion Protection	Fencing (2)	Pumping Facility	Piping	Inlet Structure	Hydrology Control Device (Outlet)	Spillway Structure (Outfall)	Multi-Purpose Use	Modification of Existing Features (3)	Modification of Existing Structures (4)	Landscaping (5)	Engineering and Site Design	Operation and Maintenance	Financing	Easement/Access
Detention/ Retention Basins	X	X	X	X			X	X	X	X			X	X	X	X	X
Detention/ Retention Tanks		X			X	X			X					X	X	X	X
Permanent Ponds	X	X	X					X	X	X	X		X	X	X	X	X
Parking Lot Detention			X				X	X	X	X		X		X	X	X	
Roof-Top Detention								X	X			X		X	X	X	
Open Space Detention			X				X	X	X	X	X		X	X	X	X	X
Road Embankment Detention			X	X					X		X			X	X	X	X

Table 8-3

SUMMARY OF MANAGEMENT CONSIDERATIONS RELEVANT TO THE SELECTION AND DESIGN OF DETENSION AND RETENTION TECHNIQUES

Table 8-4

ADVANTAGES/DISADVANTAGES OF ON-SITE CONTROL METHODS

Method	Advantages	Disadvantages
Reduction of Runoff/Infiltration Storage		
Dutch Drains	o Reduce the total volume of runoff. o Reduce the peak runoff discharge rates. o Enhance the ground-water supply. o Provide additional water for vegetation in the area. o Reduce the size of downslope stormwater control facilities.	o Loses efficiency if intensive storms follow in rapid succession. o Subject to clogging by sediment. o Limited to application for small sources of runoff only, i.e., roof drains, small parking lots, tennis courts. o Maintenance is difficult when the facility becomes clogged. o Limited application in poor infiltration soils.
Porous Pavement	o Reduces the total volume of runoff. o Reduces the peak runoff discharge rates. o Enhances the ground-water supply. o Provides additional water for vegetation in the area. o Reduces the size of downslope stormwater control facilities. o Less costly than conventional pavements for most applications. o Safety features - superior skid resistance and visibility of pavement markings. o Provides pavement drainage without contouring. o Prevents puddling on the surface.	o More prone to water stripping than conventional mixtures. o Subject to clogging by sediment. o Water freezing within the pores takes longer to thaw and limits infiltration. o Motor oil drippings and gasoline spillage may pollute ground water. o Limited application in poor infiltration soils. o Recent studies suggest that porous pavement's advantages will diminish with time.

(Continued)

Table 8-4
(Continued)

Method	Advantages	Disadvantages
Seepage/Recharge Basins	o Reduce the total volume of runoff. o Reduce the peak runoff discharge rates. o Enhance the ground-water supply. o Construction borrow pits often can be converted to a large seepage basin to serve multiple areas.	o Must be fenced and regularly maintained. o If porosity is greatly reduced, it may be necessary to bore seepage holes or pits in the base. o No filtering supplied by the topsoil. o Usefulness limited in poor infiltration soils.
Seepage Pits	o Reduce the total volume of runoff. o Reduce the peak runoff discharge rates. o Enhance the ground-water supply. o Provide additional water for vegetation in the area. o Reduce the size of downslope stormwater control facilities.	o Loses efficiency if intensive storms follow in rapid succession. o Subject to clogging by sediment. o Maintenance is difficult when the facility becomes clogged. o Limited utility in poor infiltration soils.
Seepage Beds/Ditches	o Reduce the total volume of runoff. o Reduce the peak runoff discharge rates. o Enhance ground-water supply o Reduce the size of downslope stormwater control facilities. Distribute stormwater over a larger area than other infiltration techniques. o May be placed under paved areas if the bearing capacity of the paved area is not affected. o Safer than seepage or recharge basins.	o More expensive than other infiltration techniques. o Replacement of entire system necessary if clogging by sediment should occur. o Maintenance of sediment traps must be frequent and consequently they are more expensive. o Limited utility in poor infiltration soils.

(Continued)

Table 8-4
(Continued)

Method	Advantages	Disadvantages
Terraces, Diversions, Runoff Spreaders, Grassed Waterways, and Contoured Landscapes	o Increase the overland flow time, increasing the time of concentration and allowing for increased infiltration. o Vegetative swales are less expensive than curb and gutter systems.	o On poorly drained soils, these techniques may leave ground waterlogged for extended periods after storms. o Vegetative channels may require more maintenance than curb and gutter systems. o Roadside swales become less feasible as the number of driveway entrances requiring culverts increase.
<u>Delay of Runoff</u>		
Rooftop Retention	o No additional land requirements. o Not unsightly or a safety hazard. o May be adapted to existing structures.	o Leaks may cause damage to buildings and contents. o 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	o Adaptable to both existing and proposed parking facilities. o Parking lot storage is usually easy to incorporate into parking lot design and construction.	o May cause an inconvenience to people. o Ponding areas are prone to icing, requiring more frequent maintenance.
Multiple-Use Impoundment Area	o Serves more than one purpose.	o Difficult to maintain the porosity of multi-use areas.

(Continued)

Table 8-4
(Continued)

Method	Advantages	Disadvantages
Multiple-Use Impoundment Areas (Continued)	o Where the surface is grass, a certain amount of stormwater will infiltrate and improve the quantity of water recharged by natural filtering processes. o If porous pavement is used on basketball or tennis courts, additional infiltration will be provided.	o Can be a safety hazard.
Detention/Retention Basins	o Offer design flexibility for adapting to a variety of uses. o Construction of ponds is relatively simple. o May allow significant reduction in the size of downslope stormwater management facilities. o May have some recreational and aesthetic benefits if runoff is not carrying heavy sediment loads. o Reduce downstream litter and debris.	o Facilities that empty out completely can have an unsightly nature and be a detriment to the developments. o Difficulty in establishing a regular maintenance program. o In a residential development it may be difficult to determine whose responsibility it is to pay for the maintenance program. o Consumes land area which could be used for other purposes.
Permanent Ponds	o Will provide both a reduction in peak runoff rates and a source of recreation in any residential area. o Only minor modifications are required to adapt an existing pond for use as a permanent stormwater management facility.	o 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.

(Continued)

Table 8-4
(Continued)

Method	Advantages	Disadvantages
Underground Retention/ Detention Tanks	o Minimal interference with traffic or people. o Can be used in existing as well as newly developed areas. o Potential for using stormwater for non-potable uses.	o Subsurface excavation could be extremely expensive depending upon the type and amount of rock encountered.

	Dredging	Debris/Sediment Removal	Weed Control	Insect Control	Mechanical Maintenance	Mowing	Cleaning	Bottom Retilling	Repair	Inspection
Detention/ Retention Basins		X	X	X		X			X	X
Detention/ Retention Tanks				X	X		X		X	X
Ponds	X	X	X	X					X	X
Parking Lot Detention							X		X	X
Roof-Top Retention							X		X	X
Open Space Detention		X				X				X
Road Embankment Detention		X	X	X			X		X	X
Seepage Basins		X	X	X		X		X		X
Infiltration Beds		X					X			X
Porous Pavement							X		X	X
Open Channels		X	X			X				X
Pipe Systems		X					X		X	X

Table 8-5

OPERATION AND MAINTENANCE CONSIDERATIONS FOR ON-SITE CONTROL METHODS

Table 8-4
(Continued)

Method	Advantages	Disadvantages
Underground Retention/ Detention Tanks	o Minimal interference with traffic or people. o Can be used in existing as well as newly developed areas. o Potential for using stormwater for non-potable uses.	o Subsurface excavation could be extremely expensive depending upon the type and amount of rock encountered.

planting, lattice walks, and dutch drains. Runoff to the pond would be conveyed by a waterway over a dutch drain with an overplanting of grass.

Should the soils underlying the site be only moderately drained, then the infiltration controls could be linked by underdrains or gravel trenches. Any excess runoff would drain slowly to the downslope detention facility and eventually to the receiving stream.

The overall stormwater management plan would provide the required reduction of peak runoff without causing on-site flooding. By the use of relatively inexpensive infiltration mechanisms and combined runoff control methods, the expense of stormwater conveyance systems and detention storage is greatly reduced. When planning all new developments, sufficient time should be provided for careful investigation and selection of the most cost-effective means of stormwater management.

Distributed Storage Concept

Traditionally, the approach to stormwater management has been to control the runoff on an individual site basis and to consider this control as being fully responsive to the overall stormwater management needs of the watershed. The choice of stormwater controls generally was made on the basis of convenience at the site.

The general philosophy has become to manage stormwater as close to the point where it falls as possible. On-site management techniques are proving to be cost-effective and environmentally sensitive. However, alone they may not guarantee that there will be no adverse impacts on the watershed.

Comprehensive planning for the control of stormwater runoff is becoming an increasingly significant part of overall development objectives for existing, as well as developing, communities. Successful management of stormwater runoff, and the overall urban water resources system, depends on the ability of urban planners and managers to:

- predict the effects of increased development on stormwater runoff;
- define the response of the drainage system to particular storm events;
- select the most cost-effective, optimum stormwater control system for a particular watershed.

Defining the Distributive Storage Concept

There is a growing commitment to find cost-effective control techniques that preserve and protect the natural drainage system and involve a comprehensive approach to stormwater management for the entire watershed. One of these concepts is distributed storage. 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 significantly improves the capability of land developers and communities to control stormwater on a watershed basis. The ideal design solution might be a system that absorbs or retains all the water falling on a site to the extent that the quantity and rate of water leaving the site is not significantly different after development than it was before. This ideal solution is often difficult to achieve, particularly given the natural constraints of many sites in the watershed. Therefore, the optimum approach may be to strike a balance between on-site and off-site management using on-site detention and distributed storage techniques.

The types of on-site detention and distributed storage devices being referred to here are:

- temporary ponding on ground surfaces;
- temporary ponding on paved areas;
- temporary ponding on roofs of buildings;
- storage in permanent ponds having provision for variable depth;
- treatment of ground surfaces to absorb and/or detain water;
- routing of runoff to infiltration pits to recharge groundwater supplies and reduce total flow to drainage systems;
- collection of stormwater for supplementary water supplies.

The goal should be the development and use of the most cost-effective and environmentally sensitive stormwater runoff controls. There is a need to balance a range of factors:

capital costs, operation and maintenance costs, risk of significant water-related damage, environmental protection and enhancement, public convenience, and other community development objectives.

One of the benefits of the distributed storage approach is that it offers stormwater planners and managers new flexibility in selecting alternative sites for storage facilities. Also, it increases the opportunities for utilizing stormwater control facilities to meet other community needs. For example, certain recreation areas might easily be used to provide temporary stormwater storage, or natural or artificial ponds and lakes might serve both recreation and stormwater management objectives. In many watersheds, the installation of one or more regional detention facilities may prove to be the most cost-effective and hydraulically sound stormwater management system.

Selecting Distributed Storage Locations

The distributed storage concept selects detention facility locations by analyzing the flow routing in the watershed, rather than by choosing possible locations solely where land is available. The key to the distributed storage method is the selection of sites that are hydrologically most appropriate for off-site (regional) storage. The final determination as to which storage area is actually constructed should be made by assessing the advantages and disadvantages of the identified storage locations.

Locations for distributed storage are determined by analyzing the flow routing in the watershed and selecting spots where streams join (confluences) and where peak runoff rates from two subbasins pass at approximately the same time. Locations where distributed storage would be most effective are those where the time from two subbasins for peak is equal (or nearly equal).

The watershed management group is able to assure that any proposed facility fits into the comprehensive watershed plan. It would be able to take over its operation and maintenance, since conceivably the facility could serve a large number of drainage subbasins in several municipalities. Without a watershed management system, the distributive storage concept undoubtedly will be more difficult to implement.

IX. PRIORITIES FOR IMPLEMENTATION OF THE PLAN

This stormwater management plan has been developed for the five municipalities (Findlay, Moon, North Fayette, and Robinson townships and Coraopolis Borough) affected by the stormwater in this watershed. The purpose of this plan is to require those who engage in the development of land, whether private or public entities, to implement reasonable measures to prevent harm to persons or properties downstream. This is to be accomplished on a watershed level.

These measures must include action:

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

This plan contains recommendations which will meet the basic standards of Act 167. It also addresses a regional storage facility which would preserve the "double peak" characteristic of the Montour Run Watershed.

Since the Stormwater Management Plan places the responsibility for implementation in the hands of the local municipalities, each of the five municipalities is affected by Montour Run Watershed Stormwater Management Plan.

Each municipality should incorporate the Montour Run Watershed Stormwater Plan into their appropriate municipal ordinance. Zoning, subdivision, and land development (erosion/sedimentation and grading), and building ordinances should be adopted or amended to provide a comprehensive ordinance package capable of covering all types of land alteration activities.

A flow chart for the approval of the Montour Run Watershed Stormwater Management Plan is shown in Figure 9-1.

Provisions for Updating the Plan

The Allegheny County Planning Department has been furnished data which should be periodically updated at least every 5 years. This would require the data file on future land use to be updated and the PSRM program rerun. The resultant information would then be evaluated and revised release rates be established for the subsheds. This data would then be furnished to the appropriate agency for their use. The stormwater management plan should assign an individual to monitor all stormwater management plans to see that these revisions are made at the appropriate time and the information provided to the responsible agency at the correct time interval.

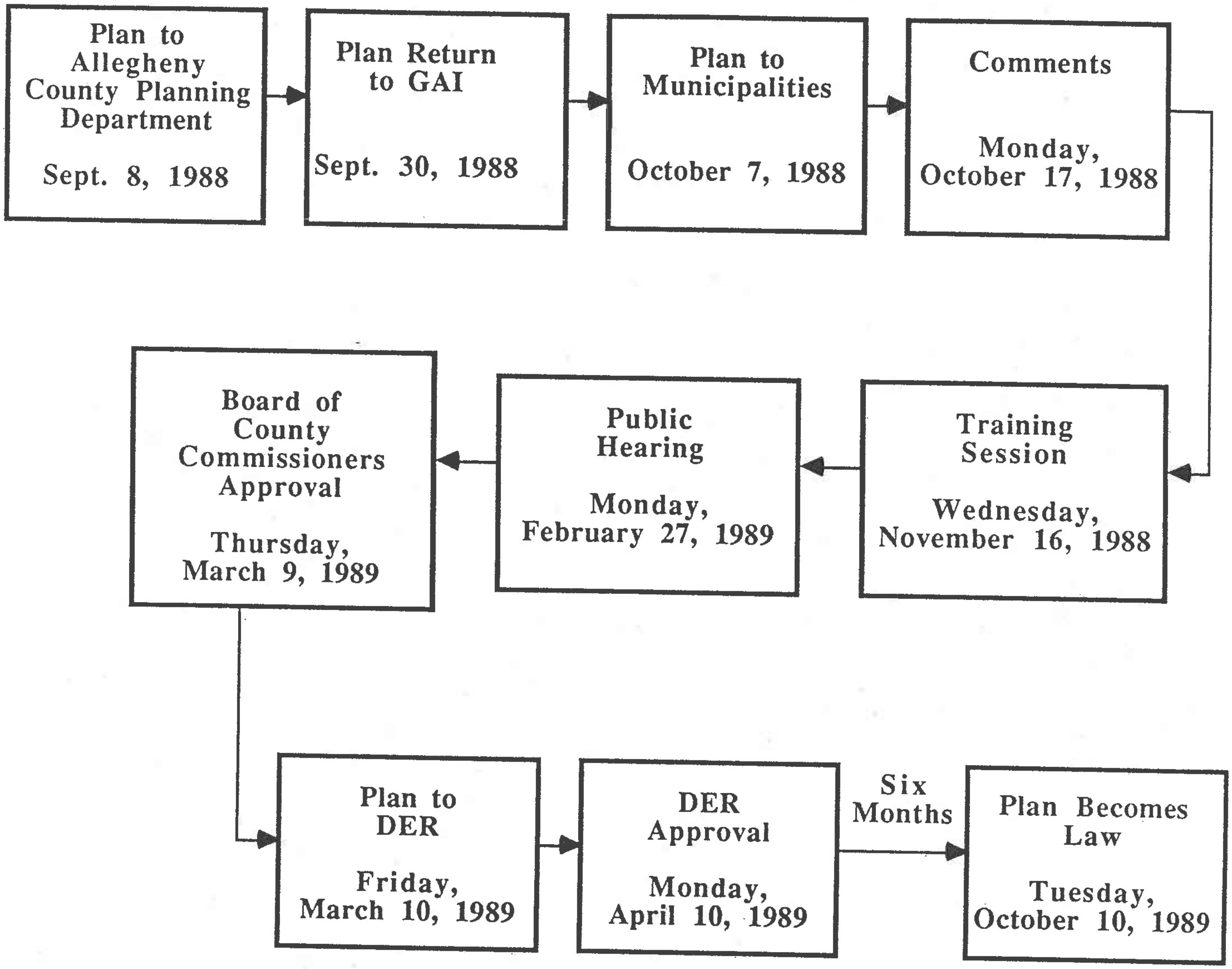

Figure 9-1

PRIORITIES FOR IMPLEMENTATION

MONTOUR RUN WATERSHED
STORMWATER MANAGEMENT PLAN

FLOW CHART

X. MODEL ORDINANCE

Section 100 Introduction

With the increased activity in physical development in Allegheny County, the issue of stormwater management has become a critical one. In light of the frequent flooding in the region, the search for solutions to mitigate the impact of heavy rainfall has become increasingly important. Solutions range from the imposition of design standards to regulation by performance standards. The following stormwater management provisions propose the use of performance standards in an overlay zoning ordinance, which, after adoption by the municipalities, will allow each respective jurisdiction to control development in the best interest of the total community. Simultaneously, the developer has the greatest freedom possible in designing the development of property.

Local municipalities will take the lead in implementing stormwater management, according to the provisions of the Storm Water Management Act (Act 167), through the adoption, administration, and enforcement of various regulatory controls. While certain management functions will be collectively performed, each municipality will have the responsibility for initiating the ordinance which provides the legal basis for stormwater management in the Montour Run Watershed.

The following report presents guidelines for constructing a workable regulatory approach using the legal authorities that are presently available to Pennsylvania municipalities. The recommendations of the provisions in the ordinance are consistent with the pilot watershed stormwater management study prepared by the Allegheny County Planning Department in 1982. They are designed to implement the standards and criteria of the Montour Run Stormwater Management Plan.

The regulatory approach presented by the following model ordinance provisions involves the creation of a stormwater ordinance package, utilizing the existing land use regulatory powers provided by the Pennsylvania Municipalities Planning Code and the general municipal codes or home rule charters. In this way, the model ordinance provides a comprehensive stormwater management system that applies to all types of land alterations, whether they are new developments, expansion, redevelopment of existing lots and structures, mining, or agricultural activities.

Section 101 Purpose

A. The governing body of the municipality of ____________ finds the inadequate management of accelerated runoff of stormwater 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 stormwater, undermines floodplain management and flood control efforts in downstream communities, reduces groundwater recharge, and threatens public health and safety.

B. A comprehensive program of stormwater management, including reasonable regulation of development and activities causing accelerated erosion, is fundamental to the public health, safety, welfare, and protection of the people of the municipality and all the people of the Commonwealth, their resources, and the environment.

C. The purpose of this ordinance is to promote the public health, safety, and welfare by minimizing the damages described in Section 108(A) of this ordinance by provision designed to:

1. control accelerated runoff and erosion and sedimentation problems at their source by regulating activities which cause such problems;
2. utilize and preserve the desirable existing natural drainage systems;
3. encourage the recharge of groundwater;
4. maintain the existing flows and quality of streams and water courses in the municipality and the Commonwealth;
5. preserve and restore the flood carrying capacity of streams;
6. provide for proper maintenance of all permanent stormwater management structures that are constructed in the municipality.

D. Applicability: The following activities are included within the scope of this ordinance:

1. land development;
2. subdivision;
3. earthmoving involving ____________ or more acres;
4. agricultural operations;
5. construction of new or additional impervious or semi-pervious surfaces (driveways, parking lots, etc.);
6. construction of new buildings of additions to existing buildings;
7. forest management operations;
8. nursery operations;
9. diversion or piping of any natural or man made stream channel;
10. installation of storm water systems or appurtenances thereto;
11. mining operations.

E. Repealer: Any ordinance of the municipality inconsistent with a of the provisions of this ordinance is hereby repeale to the extent of the inconsistency only.

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

G. Compatibility With Other Permit And Ordinance Requirements: Permits and approvals issued pursuant to the ordinance do not relieve the applicant of the responsibility to secure required permits or approvals for activities regulated by other applicable code, rule, act, or ordinance. If more stringent requirements concerning regulation of stormwater or erosion and sedimentation control are contained in the other code, rule, act, or ordinance, the more stringent regulation shall apply.

Section 102 Applicability

The provisions of this article shall apply to all subdivision and land development activity within the watershed subareas of the Montour Run Watershed within the municipality of ______________, including mobile home parks, unless specifically exempted or otherwise modified herein.

Section 103 Allegheny County Stormwater Management District

Section 103.1 Define Area. The Montour Run Watershed boundary is delineated on the Montour Run Watershed Boundary Map. (See Figure 5-1).

Section 103.2 Townships Affected. The Montour Watershed is located in, and will affect, the following municipalities: Coraopolis Borough, Findlay Township, Moon Township, North Fayette Township, and Robinson Township.

Section 103.3 Watershed Subsheds. A watershed subshed area is part of the overall watershed and is characterized by similar hydrological characteristics and drainage to a common point. The watershed subsheds are delineated on the Subshed Boundary Map (See Figure 5-3).

Table 10-1 identifies the subsheds by number and locality. One subshed can be in one or more municipalities (See Figure 5-3).

Table 10-1

WATERSHED SUBAREAS

Municipalities in Montour Run Watershed		Subsheds
North Fayette Township	3	1, 2, 5, 12, 17, 18
Findlay Township	3 3	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17
Moon Township	3 3	14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27
Robinson Township	3	18, 20, 21, 22, 23, 24, 26, 27
Coraopolis Borough	3	27

Section 104 Definitions

This list of definitions includes key ones used in this generic stormwater management ordinance. For the purposes of this ordinance, these terms shall be defined as follows:

Act: The Storm Water Management Act (Act of October 4, 1978, P.L. 864 No. 167; 32 P.S. 5680.1-680.17, as amended by Act of May 24, 1984, No. 63).

Accelerated Erosion: The removal of the surface of the land through the combined action of man's activities and natural processes at a rate greater than would occur because of the natural processes alone.

Airport Area Development Authority (AADA): The Airport Area Development Authority of Allegheny County.

Allegheny County Planning Department (ACPD): The Planning Department of Allegheny County, Pennsylvania.

Allegheny County Conservation District (ACCD): Allegheny County organization responsible for erosion and sedimentation control.

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

Basin: A defined area depression in the surface of the land within a watershed or subwatershed where water collects.

Bridge: A structure and its appurtenant works erected over the regulated waters of this Commonwealth.

Channel: A natural stream that conveys water; a ditch or open channel excavated for the flow of water.

Cistern: An underground reservoir or tank for storing rainwater.

Confluence: A point where watercourses join.

Conservation District (ACCD): The Allegheny County Conservation District.

County: The County of Allegheny, Pennsylvania.

Culvert: A pipe, conduit, or similar structure, including appurtenant works, which carries surface water or a stream under or through an embankment or fill.

Dam: Any artificial barrier, together with its appurtenant works, constructed for the purpose of impounding or storing water, or a structure for highway, railroad, or other purposes which may impound water.

Department: The Department of Environmental Resources of the Commonwealth of Pennsylvania.

Design Storm: The magnitude and distribution of precipitation for a rainfall event measured in probability of frequency of occurrence (e.g., 50-year storm) and duration (e.g., 24-hour) and used in analyzing and designing stormwater management control systems.

Detention: The slowing, dampening, or attenuating of runoff entering the natural drainage pattern or storm drainage system by temporarily holding it in surface or subsurface areas such as detention basins, reservoirs, rooftops, streets, parking lots, or within the drainage system itself, and releasing the water at a desired rate of discharge.

<u>Detention Basin</u>: A basin designed to retard stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate. A detention basin can be designed to drain completely after a storm event, or it can be designed to contain a permanent pool of water.

<u>Developer</u>: Any landowner, agent of such landowner, or tenant with the permission of such landowner who makes, or causes to be made, a subdivision or land development.

<u>Development</u>: Any activity, construction, alteration, change in land use, or similar action that affects stormwater runoff characteristics.

<u>Development Site</u>: A lot, parcel, or tract of land on which development is taking place or is proposed.

<u>Discharge</u>: A rate of flow, specifically fluid flow. A volume of fluid flowing from a conduit or channel, or being released from detention storage, per unit of time. Commonly expressed as cubic feet per second (cfs), million gallons per day (mgd), gallons per minute (gpm), or cubic meters per second (cms).

<u>Discharge Control Point</u>: A point of hydraulic concern, such as a bridge, culvert, or channel section, for which the rate of runoff is computed or measured in the watershed plan.

<u>Drainage</u>: Interception and removal of excess surface water or ground water from land by artificial or natural means.

<u>Drainage Area</u>: The contributing area, expressed in acres, square miles, or other units of area; also called a catchment area, watershed, or river basin; the area served by a drainage system or by a watercourse receiving storm and surface water.

<u>Drainage Basin</u>: The area from which water is carried off by a drainage system; a watershed or catchment area.

<u>Drainage Easement</u>: A right granted by a landowner to a grantee allowing the use of private land for stormwater management purposes.

<u>Encroachment</u>: 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.

<u>Engineer (Municipal Engineer)</u>: A professional engineer duly appointed as the engineer for the municipality/borough/township of ________________________, Allegheny County, Pennsylvania.

<u>Erosion</u>: The natural process by which the surface of the land is worn away by the action of water, wind, or chemical action.

Evaporation: The transfer of water from the liquid to the vaporous state.

Evapotranspiration: The combined loss or movement of moisture from the surface of the earth through evaporation and transpiration processes.

Excavation (Cut): Any act by which soil or rock is cut into, dug, quarried, uncovered, removed, displaced, or relocated and shall include the conditions resulting therefrom.

Flood: A general, but temporary, condition of partial or complete inundation of normally dry land areas from the overflow of streams, rivers, or other waters of this Commonwealth.

Floodplain: A normally dry land area adjacent to stream channels that is susceptible to being inundated by overbank stream flows. For regulatory purposes the Flood Plain Management Act (Act of October 4, 1978, P.L. 851, No. 166) and regulations pursuant to the act define floodplain as the area inundated by a 100-year flood and delineated on a map by FEMA (Federal Emergency Management Agency).

Floodway: The channel of the watercourse and those portions of the adjoining floodplain which are reasonably required to carry and discharge the 100-year-frequency flood. Unless otherwise specified, the boundary of the floodway is as indicated on maps and flood insurance studies provided by FEMA. In an area where no FEMA maps or studies have defined the boundary of the 100-year-frequency floodway, it is assumed - absent evidence to the contrary - that the floodway extends from the stream to 50 feet from the top of the bank of the stream.

Flood Control Project: Any device or structure designed and constructed to protect a designated area from flood flows of a specified (design storm) magnitude and probability (frequency) of occurrence.

Flood Hazard Area: A normally dry land area that has been and is susceptible to being inundated by surface or subsurface flow in addition to stream overbank flows. For regulatory purposes the Flood Plain Management Act (Act of October 4, 1978, P.L. 851, No.166) and regulations pursuant to the act define flood hazard areas identified by FEMA (as shown on the floodplain map) as being subject to flooding by a 100-year flood.

Ground Water: That part of the subsurface water which is within the zone of saturation.

Ground-water Recharge: Replenishment of existing underground water supplies.

Ground-water Recharge Area: Any surface area from which water penetrates and subsequently passes into the ground-water supply.

Hydrology: The science dealing with the waters of the earth and their distribution and circulation through the atmosphere. Engineering hydrology deals with the application of hydrologic concepts to the design of projects for use and control of water.

Hydrograph: A graph showing, for a given point in any drainage system, the discharge, stage, or other property of water in respect to time.

Impervious Material: Material which resists the entrance or passing through of water or other liquids.

Impervious Surface: A surface which prevents the infiltration of water into the ground.

Infiltration: The penetration and movement of water through the earth's surface.

Infiltration Structures: A structure designed to direct runoff into the ground, e.g., french drains, seepage pits, or seepage trench.

Interception: Precipitation which is retained by the leaves and stems of vegetation.

Land Development: As defined by the Pennsylvania Municipalities Planning Code [Section 107(11)]: "(i) 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 buildings, or (b) a division or allocation of land or space between or among two or more existing or prospective occupants by means of, or for the purpose of, streets, common areas, leaseholds, and condominiums, building groups, or other features; (ii) a division of land".

Land Disturbance: Any activity involving grading, digging, or filling or stripping of vegetation; or any other activity which causes land to be exposed to the danger of erosion.

Municipality: (Name of Municipality), Allegheny County, Pennsylvania.

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

Obstruction: Any structure or assembly of materials, including fill above or below the surface of land or water; any activity which might impede, retard, or change flood flows.

Outlet Structure: A structure designed to control the volume of stormwater runoff that passes through it during a specific length of time.

PaDER: Pennsylvania Department of Environmental Resources.

Peak Discharge (or Peak Rate of Runoff or Peak Flow Rate): The maximum rate of flow of water at a given point resulting from a naturally occurring storm or which may result from a design storm.

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.

Pervious Material: Material which permits the passage or entrance of water or other liquid.

Point of Interest: A point of hydrologic, hydraulic, legal, social, or economic importance for which a release rate percentage is computed. These may include points of stream confluences, an existing obstruction or problem area, or other similar points.

Runoff: That part of precipitation which enters the surface drainage channels.

Rate of Runoff: Instantaneous measurement of water flow expressed in a unit of volume per unit of time, also referred to as DISCHARGE. Usually stated in cubic feet per second (cfs) or gallons per minute (gpm).

Release Rate Percentage (or Release Rate): The percentage that, when multiplied by the pre-development peak rate of runoff from a development site, defines the allowable post-development peak discharge from any development site in that subarea.

Retention Basin: A basin designed to retard stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate. A retention basin is designed to contain a permanent pool of water.

Runoff Characteristics: The surface components of any watershed that 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: Soil Conservation Service, U.S. Department of Agriculture.

Sediment: Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site or origin, by air, water, gravity, or ice and has come to rest on the earth's surface.

Sediment Basin: A barrier or dam built at a suitable location to retain rock, sand, gravel, silt, sediment, or other material carried in a stream or channel.

Soil-Cover Complex Method: A method of runoff computation developed by the U.S. Soil Conservation Service and found in its publication Urban Hydrology for Small Watersheds, Technical Release No. 55, SCS, June 1986 (or most current edition).

Storage Facility: (See Detention Basin).

Storm Sewer: A sewer that carries intercepted surface runoff, street water, and other wash-waters or drainage but excludes domestic sewage and industrial wastes.

Storm Sewer Discharge: Flow from a storm sewer that is discharged into a receiving stream.

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

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 (SWMP): The plan for managing storm-water runoff adopted by Allegheny County as required by the act of October 4, 1978, P.L. 864, (Act 167) and known as the "Storm Water Management Act".

Stormwater Management District (SWMD): The Allegheny County agency responsible for implementation and administration of the stormwater plan(s) for all of the PaDER-designated watersheds in Allegheny County, Pennsylvania.

Stormwater Runoff: Waters resulting from snowmelt or precipitation within a drainage basin, flowing over the surface of the ground, collected in channels and conduits and carried by receiving streams.

Stream: A natural watercourse.

Subshed: A defined area within a designated watershed which drains to a specific point.

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

Transpiration: The process by which plants release water vapor into the air.

Tributary: A drainage area, or equally, a stream which enters another.

Volume of Stormwater Runoff: Quantity of water normally measured in inches, cubic feet, or acre feet, measured or determined analytically from runoff coefficients, rainfall/runoff ratios, or areas underneath the plotted lines of hydrographs.

Watercourse (Waterway): 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 PaDER and approved by the Environmental Quality Board for which counties are required to develop watershed stormwater management plans.

Watershed Stormwater Management Plan (or Watershed Plan): The plan for managing stormwater runoff throughout a designated watershed adopted by Allegheny County as required by the Pennsylvania Storm Water Management Act.

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

Section 105 Stormwater Management Performance Standards

A. For purposes of stormwater management the portion of the municipality that is part of the Montour Run Watershed is divided into subsheds which have similar hydrological characteristics and drain to a common point.

B. The location and boundaries of the watershed and subsheds are adopted as overlay districts to the municipal zoning map and are shown on the zoning map and the watershed maps which are available with the municipal engineer, the Allegheny

County Planning Department (ACPD), or the Airport Area Development Authority.

Section 105.1 General Standards

A. The following provisions shall be considered the overriding performance standards against which all proposed stormwater control measures shall be evaluated, and they shall apply to all subsheds of the Montour Run Watershed in the municipality.

   1. 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:

      a. to assure that the maximum rate of stormwater runoff is no greater after development than prior to development activities;

      b. 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 must consider stormwater runoff flowing across the site from upgradient areas as well as the runoff originating from the site itself.

Section 105.2 Watershed Standards: Montour Run Watershed

A. The stormwater performance standards contained in this section are intended to implement the standards and criteria contained in the Montour Run Stormwater Management Plan, adopted and approved as required by the Pennsylvania Storm Water Management Act (Act 167). If there is any discrepancy between the provisions of this ordinance and the standards and criteria of the plan, or if the watershed plan is subsequently amended, then the standards/criteria of the current watershed plan shall govern.

1. Design Storms. Five selected frequency design storms (i.e., 2-, 5-, 10-, 25-, and 100-year storm events of 24 hour duration) and two land use scenarios (existing and post-development conditions) shall be used for analyzing stormwater runoff. Table 10-2 summarizes the rainfall associated with each storm magnitude.

2. Release Rate Percentage.

   a. Application. All subdivisions and land development activities that result in an increase in the post-development peak rate or volume of stormwater runoff from any outfall on the development site shall be subject to the release rate percentage for the watershed plan.

Table 10-2

RAINFALL FOR SELECTED STORM MAGNITUDES
SCS TYPE II 24-HOUR STORM

Return Period	Probability of Exceedence	Rainfall (inch)
2-year	50%	2.6
5-year	20%	3.3
10-year	10%	3.8
25-year	4%	4.4
100-year	1%	5.0

Note: 1. Probability of exceedence of a storm indicates the probability of that size storm or a larger storm occurring in any given year.
2. Rainfall amounts taken from Urban Hydrology for Small Watersheds, SCS Technical Report No.55 (TR-55), Appendix B, June 1986.

b. Definition. The release rate percentage is defined as the percentage of the pre-development peak rate of runoff that can be discharged from an outfall on the site after development. It applies uniformly to all land developments or alterations within a subarea.

c. Procedure for Use. The steps that must be followed in order to utilize the release rate percentage for a particular development site are:

1) Identify the specific subarea in which the development site is located and obtain the subshed release rate percentage from Table 7-1.

2) Compute the pre- and post-development runoff hydrographs for each stormwater outfall for the site using an acceptable hydrological procedure model, for 2-, 5-, 10-, 25-, and 100-year design storms, applying no on-site detention for stormwater management but including any techniques to minimize impervious surfaces and/or increase the time of concentration for stormwater runoff flowing over the development site. If the post-development peak runoff rate and the runoff volume are less than or equal to the predevelopment peak runoff rate and volume, then additional stormwater control shall not be required at that outfall. If the post-development peak runoff rate and volume are greater than the pre-development peak runoff rate and volume, then stormwater detention will be required and the capacity of the detention facility needs to be calculated. (Step 3.)

3) Multiply the subshed's release rate percentage by the pre-development rate of runoff from the development site to determine the maximum allowable release rate from the site for the five different storm events of the Montour Run Watershed Stormwater Management Plan (See Appendix A for an example).

3. <u>No Harm Evaluation</u>.

   a. An applicant may seek to exceed the otherwise applicable subshed release rate percentage by performing the "No Harm Evaluation" which requires an independent engineering analysis to demonstrate that other reasonable options exist to protect downstream areas from harmful storm runoff impacts.

   b. The "No Harm Evaluation" shall be prepared by a registered engineer who is experienced in hydrology and hydraulics in accordance with the procedure contained in Section 105, A1 and A2, and Sections 106 and 107 of this ordinance (See Appendix E for procedure).

   c. The analysis for the "No Harm Evaluation" shall be submitted to the ACPD for review and approval.

Section 106 Design Criteria for Stormwater Management Controls

Section 106.1 General Design 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 must be subject to approval of the municipal engineer and /or the ACPD. The municipal engineer and/or the ACPD may request specific information 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 on the proposed stormwater management techniques of any special soil conditions or geological hazards which may exist on the development site. In the event such conditions are identified on the development site, the ACPD and/or 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.

Section 106.2 Criteria for Stormwater Detention Facilities

A. If detention facilities are utilized for the development site, the facilities shall be designed so that the post-development peak runoff rates from the developed site are controlled to those rates defined by the subshed release rate percentage (See Appendix A for procedure) or "No Harm Evaluation" for the 2-, 5-, 10-, 25-, 100-year design storms (See Appendix E for procedure).

B. All detention facilities shall be equipped with outlet structures to provide discharge control for the five different storm frequencies. Provisions shall also be made for safely passing the post-development 100-year storm runoff flows without damaging (i.e., impairing the function of) the facilities.

C. Shared storage facilities, which provide retention of runoff for more than one development site, may be considered within a single subshed. Such facilities shall meet the design 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 storage facilities.

D. Where detention facilities will be utilized, multiple-use facilities, such as lakes, ballfields, or similar recreational uses, may be permissible as long as the welfare and safety of human life is protected.

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

   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 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 or facilities shall be protected and designed to minimize safety hazards.

4. Appropriately landscaped fencing shall be required.

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

6. Landscaping which harmonizes with the surrounding area is encouraged.

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

Section 107 Stormwater Plan Requirements

Section 107.1 General

A. No final subdivision or land development plan shall be approved, no permit authorizing construction issued, nor any earthmoving 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.

Section 107.2 Exemptions

A. At the time of application, the municipality and/ or the ACPD shall determine if the subdivision or land development qualifies as a "small development" and, therefore, is eligible for a simplified stormwater plan subdivision submission. For the purposes of this article, a small development is:

1. any subdivision or land development which results (or will result when fully constructed) in the creation of 5,000 or less square feet of impervious surface area;
2. land disturbance associated with existing one and two-family dwellings;
3. use of land for gardening for home consumption;
4. agriculture, when operated in accordance with a conservation plan or erosion and sedimentation control plan prepared by the Allegheny County Conservation District;
5. forest management operations which are following the Department of Environmental Resources management practices contained in its publication Soil Erosion and Sedimentation Control Guidelines for Forestry and are operating under an erosion and sedimentation control plan.

B. Subdivision of a parcel of land in order to meet the definition of a "small development" is not acceptable. A stormwater management plan is always required in the case of a subdivision under a single ownership.

Section 107.3 Plan Contents

A. General: The stormwater plan shall be prepared using the general requirements for plan format contained in this section (Section 107.3) of this ordinance and shall conform to the "Minimum Requirements for Stormwater Management Plan Submission" listed in Appendix B.

Start

B. Watershed Location: Provide a key map showing the development site's location within the designated watershed and watershed subsheds. On all site drawings, show the boundaries of the watershed(s) and subsheds as they are located on the development site and identify watershed names and/or subshed number(s).

C. Floodplain Boundaries: Identify the 100-year floodplain(s) on the development site based on the FEMA maps or a determination by the applicant's engineer.

D. Natural Features: Show all bodies of water (natural and artificial), watercourses (permanent and intermittent), swales, wetlands, and other natural drainage courses on the development site, or those off-site which will be affected by runoff from the development.

E. Soils: Provide an overlay showing soils, types, and boundaries within the development site.

F. Contours: Show existing and final contours at intervals of two feet; in areas with slopes greater than 15%, five-foot contour intervals may be used.

G. 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.

H. Professional Certification: The stormwater management plan (including all calculations) must be prepared and sealed by a Pennsylvania Registered Professional Engineer with training and expertise in hydrology and hydraulics. Documentation and qualifications may be required by the municipality and/or the ACPD.

I. 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 method and data prescribed by Section 105 of this ordinance.

J. Stormwater Controls: All proposed 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. Allegheny County Conservation District approved erosion/sedimentation controls shall be shown. The preliminary plan should provide information on the general type, location, sizing, etc., of all proposed facilities and their relationship to the existing watershed drainage system.

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.

K. Easements, Rights-of-Way, Deed Restrictions: All existing and proposed easements and rights-of-way for drainage and/or access to stormwater control facilities shall be shown and the proposed owner identified. Show any areas subject to special deed restrictions relative to or affecting stormwater management on the development site.

L. Other Permits/Approvals: A list of any approvals/permits relative to stormwater management that will be required from other governmental agencies (e.g., an obstructions permit from PaDER) and anticipated dates of submission/receipt should be included with the preliminary plan submission. Copies of applications may be requested by the municipality when they may be helpful for the stormwater review.

M. Maintenance Program: The preliminary application shall contain a proposed maintenance plan for all stormwater control facilities in accordance with the following:

1. Identify the proposed ownership entity (e.g., municipality, property owner, homeowners' association, or other management entity).

2. Include a maintenance program for all facilities, outlining the type of maintenance activities, probable frequencies, personnel and equipment requirements, and estimated annual maintenance costs.

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

Section 107.4 Final Plan Contents

A. All information pertaining to stormwater management from the preliminary plan along with any changes;

B. final plan maps and drawings showing the exact nature and location of all temporary and permanent stormwater management controls along with design and construction specifications;

C. a schedule for the installation of all temporary and permanent stormwater control measures and devices;

D. an accurate survey showing all current and proposed easements and rights-of-way, and copies of all proposed deed restrictions;

E. a maintenance program establishing ownership and maintenance responsibilities for all stormwater control facilities (identify specific person or entity) and detailing financial requirements and sources of funding, as well as any legal agreements required to implement the maintenance program and copies of the maintenance agreement as specified by Section 109 of this ordinance;

F. financial guarantees, consistent with Section 109 of this ordinance, to ensure that all stormwater controls will be installed properly and function satisfactorily.

Section 108 Plan Review Procedure

A. The department shall, in consultation with the Department of Community Affairs, review all watershed stormwater plans and revisions or amendments thereto. It shall approve the plan if it determines:

1. that the plan is consistent with the municipal floodplain management plans, state programs which regulate dams, encroachments, and water obstructions, and state and federal flood control programs;

2. that the plan is compatible with other watershed stormwater plans within the municipality for the basin in which the watershed is located and is consistent with the policies and purposes of this act.

Should the department neither approve or disapprove a watershed plan or amendment or revision thereto within 90 days of its submission to the department, the plan or amendment or revision shall be deemed to be approved.

Any person aggrieved by a final decision of the department approving or disapproving a watershed plan or amendment thereto, may appeal the decision to the Environmental Hearing Board in accordance with the provisions of section 1921-A of the Act of April 9, 1929 (P.L. 177, No.175), known as the "Administrative Code of 1929," and the Act of June 4,1945 (P.L. 1388, No.442), know as the "Administrative Agency Law", and to the Act of October 4, 1978 (P.L. 834, No. 167), known as the Storm Water Management Act.

Section 108.1 Administrative Responsibilities

A. The municipality's Pennsylvania Registered Engineer shall review all stormwater plan applications. Upon completion of the municipalities review, the plan will be reviewed by the Allegheny County Planning Department (ACPD). Notice of the status of the plan will then be forwarded to the municipality within thirty days of submission, or the plan will be assumed to have been approved. The municipality will issue the permit authorizing the plan to be implemented.

Section 108.2 Application for Permit

A. Prior to submitting the preliminary stormwater management plan, applicants are urged to consult with the municipality's engineer and/or the ACPD on the requirements for safely managing stormwater runoff from the development site in a manner consistent with the municipal ordinance and the stormwater management plan. These agencies may be helpful in providing the information necessary for preparing the stormwater management plan.

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

C. The pre-application phase is not mandatory, but encouraged, and any review comments provided by the municipal engineer or other agencies are advisory only and do not constitute any legally binding action on the part of the municipality or any county agency.

Section 108.3 Stormwater Plan Application Review

A. Preliminary and final stormwater management plans, in accordance with the requirements of Section 107, will be submitted with the preliminary and final subdivision or land development application.

B. Preliminary and final plans will be reviewed by the municipal engineer and the ACPD. At its discretion, the municipality may also designate the entire review function to the ACPD.

C. A copy of the preliminary plan, along with all runoff calculations, will be forwarded to the ACPD. A report of the findings of the agency will be returned to the municipality within thirty (30) days. If the county planning review identifies the possibility of harmful impacts downstream of the development site, the applicant will be advised, so that the necessary modifications can be made to the stormwater management plans that received a negative watershed impact review from the ACPD.

D. When both preliminary and final plan applications are submitted, the municipality shall notify municipalities upstream and downstream of the development site that may be affected by the stormwater runoff and proposed management system 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 will be submitted with the engineer's report to the governing body and the ACPD.

E. The municipal engineer and the ACPD shall approve or disapprove the preliminary and final 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 to the governing body, the ACPD, for its consideration as part of the overall subdivision or land development review.

F. The approval or disapproval of the site's stormwater management plan by the municipal engineer and the ACPD shall be considered final. The municipal governing body shall not reverse the engineer's and the ACPD determination by approving or disapproving the site's stormwater management plan or any specific control measure in contradiction to the engineer's and the ACPD's action. The municipality's governing body can request modifications or alternative approaches to the stormwater management controls, provided these are agreed to by the municipal engineer and the ACPD and the applicant's engineer.

G. No preliminary or final approval shall be granted for the overall subdivision or land development application until a stormwater management plan for the site has been approved.

H. When the subdivision or land development application requires an obstruction permit from the PaDER and/or an erosion/sedimentation permit from ACCD, final subdivision or land development plan approval shall be conditional upon receipt of such permits. However, no building permit shall be issued, nor construction started, until the permits are received and copies filed with the municipality and the county agency.

Section 108.4 Status of the Plan After Final Approval

A. Upon final stormwater management plan approval, the applicant may commence to install or implement the approved stormwater management controls, subject to the provisions of Section 108.3 above. If site development or building construction does not begin within two (2) years of the date of final approval of the subdivision or land development plan, then, before doing so, the applicant shall resubmit the stormwater management plans to verify that no condition has changed within the watershed that would affect the feasibility or effectiveness of the previously approved stormwater management controls. If for any reason development activities are suspended for two (2) years or more, then the same requirements for resubmission of the stormwater management plan shall apply.

Section 108.5 Stormwater Plan Modifications

A. Requests for modifications in the finally approved stormwater management controls shall be submitted to the municipal engineer and the ACPD as follows:

1. If the request is initiated before construction begins, the stormwater plan must be resubmitted and reviewed according to the procedures in Section 108.3 of this ordinance.

2. If the request is initiated after construction is underway, the municipal engineer and the ACPD shall have the authority to approve or disapprove the modification, based on field inspection, provided (a) the requested changes in stormwater controls do not result in any modifications to other approved municipal land use/development requirements, and (b) the performance standards in

Section 105 are met. The governing body may issue a stay of stormwater plan modification within five (5) days and require the permittee to resubmit the plan modification for full stormwater review in accordance with procedures in Section 108.3.

Section 108.6 Enforcement and Penalties

A. Inspection

1. The municipal engineer shall inspect the construction of the temporary and permanent stormwater management for the development site. The permittee shall notify the municipal engineer forty eight (48) hours in advance of the completion of the following key development phases:

   a. preliminary site preparation, including stripping of vegetation, stockpiling of topsoil, and construction of temporary stormwater management and erosion control facilities;

   b. rough grading, prior to the placement top soil, permanent drainage, or other site development improvements and ground covers;

   c. construction of the permanent stormwater facilities at times specified by the municipal engineer;

d. installation of permanent stormwater management facilities, including established ground covers and plantings;

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

2. 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.

3. If, during construction, the contractor or permittee identifies any site conditions, such as a subsurface soil condition or alterations in surface or subsurface drainage, which could affect the feasibility of the approved stormwater facilities, he/she must notify the municipal engineer, building inspector, or the municipality's designated agent within twenty-four (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.

4. In cases where stormwater facilities are to be installed in areas of landslide-prone soils or

other special site conditions, the municipal engineer and/or the ACPD may require special precautions, such as soil tests and core boring, full-time resident inspectors, and/or similar measures. All costs of any such measures shall be borne by the permittee.

B. Right-of-Entry

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

2. In the event that an owner, subdivider, developer, or his/her agent fails to comply with the requirements of this ordinance or fails to conform to the requirements of any permit, he/she shall be given written notification of violation(s). Such notification shall set forth the nature of the violation(s) and establish a time limit for correction of the violation(s). Upon failure to comply within the time specified, the owner, subdivider, developer, or his/her agent shall be subject to the penalty provisions of this ordinance (Section 108.6-C) where applicable.

C. Penalties

1. Anyone violating the provisions of the ordinance shall be guilty of a misdemeanor and upon conviction shall be subject to a fine of not more than $ 500.00 for each violation, recoverable with costs, or imprisonment of not more that 30 days, or both. Each day that the violation continues shall be a separate offense. In addition, the municipality may institute injunctive, mandamus, or any other appropriate action or proceeding at law or in equity for the enforcement or this ordinance. Any court of competent jurisdiction shall have the right to issue restraining orders, temporary or permanent injunctions, mandamus, or other appropriate forms of remedy or relief.

D. Appeal to Court

1. Any person aggrieved by any decision of the municipality and/or the ACPD may appeal to the County Court of Allegheny County within thirty (30) days of that decision.

Section 109 Financial Guarantees and Maintenance

A. Maintenance Responsibilities

1. The stormwater plan for the development site shall establish responsibilities for the continuing operation and maintenance of all proposed stormwater control

facilities. The proposed maintenance plan should be consistent with the general policies established by the municipal engineer and adopted by the municipal government.

2. The municipal engineer shall make the final determination on the continuing maintenance responsibilities as part of the development application review and the municipality reserves the right to accept the ownership and operating responsibility of any or all of the stormwater management controls.

B. <u>Maintenance Agreement for Privately Owned Stormwater Facilities</u>

1. Prior to final approval of the site's stormwater management plan, the property owner shall sign and record a maintenance agreement covering all stormwater control facilities which are to be privately owned. The agreement shall stipulate that:

   a. The owner shall maintain all facilities in accordance with the approved maintenance schedule and shall keep all facilities maintained in a safe and attractive manner.

   b. The owner shall convey to the municipality easements and/or rights-of-way to assure access for periodic inspections by the municipality and maintenance if required.

   c. The owner shall keep on file with the township the name, address, and telephone number of the person or company responsible for maintenance activities. In the event of change, new information will be submitted to the municipality within ten (10) days of the change.

d. The owner shall establish any special maintenance funds or other financing sources in accordance with the approved maintenance plan.

e. The owner shall pay the amount due to the municipality's Stormwater Facility Maintenance Fund (see Section 109.C).

f. If the owner fails to maintain the stormwater control facilities following due notice by the municipality to correct the problems, the municipality shall perform the necessary maintenance or corrective work. The 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. The maintenance agreement shall be subject to the review and approval of the municipal counsel and the governing body of the municipality.

C. Municipal Stormwater Facility Maintenance Fund

1. Persons installing stormwater storage facilities will be required to pay a specified amount to the Municipal Stormwater Maintenance Fund to help defray costs of periodic inspections and annual maintenance expenses.

The amount of the deposit shall be determined as follows:

a. If the storage facility(s) 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 municipality. After that period of time, inspections will be performed at the expense of the municipality.

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

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

d. The amount of the deposit to the maintenance fund, covering annual inspection and maintenance costs 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 final approval of the municipal governing body. With this approach, the required deposit would be equal to an amount that, with interest, would generate sufficient income annually to pay the maintenance and inspection costs over the ten-year period. For example, if the estimated maintenance and inspection cost for a facility is $500 each year, the required deposit could be the full $5000.00 (500 x 10 years). If this amount is converted to present worth of the annual series, the deposit would be reduced to $3,690, assuming a 6 percent annual interest rate and that the funds for this development site would be reduced to zero at the end of the ten-year period.

2. If a storage facility which also serves as a recreation facility such as a lake or ballfield is proposed, the municipality may reduce or waive the amount of the maintenance fund deposit based on the value of the land for public recreational purposes.

3. If at some future time any storage facility (whether publicly or privately owned) is eliminated due to installation of storm sewers or another storage facility (e.g., a distributed storage facility), the unused portion of the maintenance fund 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 depositor.

D. Guarantee of Improvements and Dedication of Public Improvements

1. Guarantees 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. This guarantee will cover all streets, sanitary sewers, stormwater management facilities, water systems, fire hydrants, sidewalks, and other required improvements. The guarantees shall:
   a. run to favor the municipality;
   b. be in the amount of 15 percent;
   c. be acceptable to the municipal solicitor.

2. Default of Completion Guarantee: If improvements are not installed and completed within two (2) years of the date of recording for the plat or do not comply with the standards and specifications of the ordinance, the municipality may proceed to complete the improvements and facilities and may use whatever proceeds from the bonds, case deposits, checks, or securities as are required to meet the expense of completing such improvements.

3. Dedication of Public Improvements: When streets, sanitary sewers, storm drainage facilities, waterlines, or other required improvements in the subdivision or

land development have been completed in accordance with this ordinance and approved plan for development of the site, 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. Prior to acceptance of any improvement, 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. In addition, the developer shall submit as-built plans of all facilities proposed for dedication.

4. Construction Warranty: Prior to acceptance of any improvements for facilities, the applicant shall provide to the municipality for a period of 18 months from the date of acceptance of the improvements and facilities a financial security bond in the form of a bond, cash, certified check, or other negotiable securities acceptable to the municipality in an amount equal to 15 percent of the actual cost of the improvements and facilities in order to guarantee against any defect in material or installation of the improvements and facilities.

Section 110 Fees

A reasonable schedule of fees for administrative services necessary to implement and to enforce the stormwater management plan's controls will be established by the municipality and adopted by resolution of the municipal governing body.

APPENDIX A

SAMPLE CALCULATIONS
RELEASE RATE METHOD

A developer wishes to develop a 50-acre site in the Montour Run Watershed. Upon consulting the local ordinances, he finds out that his development would be subject to the stormwater management controls as given in Act 167. To illustrate the following data has been assumed:

1. Site area: 50 acres
2. Montour Run Watershed Subshed 7
3. Appropriate Design Storm for Stormwater Management and Control: 100-Year

A design of the proposed development is made, and calculations are performed to predict the change in flows due to the development.

Assume that the following values were obtained from these analyses.

Methodology: SCS Curve Number Runoff Method (REF: "Urban Hydrology for Small Watersheds", 2nd ed., June 1986)

Area Considered: The site plus all areas tributary (with drainage) to the site. 50 acres + 10 acres upstream = 60 acres total

Design Storm: 100-year, 24-hour, 5.0 inches of rain

Existing (Pre-development) Conditions at the Site:

50 acres, actual site, meadow

10 acres, upstream, residential, 1/2 acre lots

Hydrologic Soil Group "C"

Representative Curve Number: 72

Runoff Volume Predicted: 2.20 inches over the entire area (2.20 in) (1 ft/12in) (60 acres) = 11 acre-ft (479, 160 cf)

Peak Flow from the Site: 105 cfs

Future (Post-development) Conditions at the Site:

50-acres, actual site, development

10-acres, upstream, residential, 1/2-acre lots

Hydrologic Soil Group "C"

Representative Curve Number: 87

Runoff Volume Predicted: 3.57 inches over the entire area 17.8 acre-feet (777, 546 cf)

Peak Flow from the Site: 228 cfs

Based on the Montour Run Watershed Study and the applicable local ordinances, the developer determines that he is in Subshed 7 of the watershed, which has an established release rate of 75 percent.

The developer may therefore discharge up to, but may not exceed, a flow equal to 75 percent of the existing (pre-development) condition peak flow, or

$$0.75 \times 105 \text{ cfs} = 79 \text{ cfs}$$

The developer would therefore incorporate stormwater control measures upon his site such that the peak discharge (flow) is no greater than 79 cfs.

These measures may include detention (pond), landscaping to increase infiltration, flow restrictions that serve to increase the time for flow to collect and concentrate, and similar measures.

For example, if the developer could modify his designs such that the time-of-concentration would not change (decrease) from pre- to post-development conditions, the peak flow rate he would have to control would be reduced from 228 cfs to 171 cfs. The peak flow he could discharge would remain at 79 cfs, regardless of the measures implemented.

By storing the entire excess (in a pond), the required capacity can be estimated as the difference between the runoff volumes under pre- and post-development conditions.

Pre-development	11 acre-ft
Post-development	17.8 acre-ft

The difference is approximately 6.8 acre-ft (296,208 cf)

Worksheet 2: Runoff curve number and runoff

Project 50-Acre Development By ____ Date ____

Location Montour Run Watershed, Subshed 7 Checked ____ Date ____

Circle one: (Present) Developed ____

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/] Table 2-2	CN [1/] Fig. 2-3	CN [1/] Fig. 2-4	Area ☒ acres ☐ mi^2 ☐ %	Product of CN x area
"C"	Residential, 1/2 acre lots	80			10	800
"C"	Meadow	71			50	3550
					Totals = 60	4350

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{4350}{60} = 72.5$; Use CN = 72

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	yr	100 yr.		
Rainfall, P (24-hour)	in	5.0		
Runoff, Q (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	in	2.20		

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project 50-Acre Development By ____ Date ______

Location Montour Run Watershed, Subshed 7 Checked ____ Date ______

Circle one: (Present) Developed

Circle one: T_c T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)

	Unit	Segment ID			
1. Surface description (table 3-1)		meadow			
2. Manning's roughness coeff., n (table 3-1) ..		0.24			
3. Flow length, L (total L $\leq$ 300 ft)	ft	200			
4. Two-yr 24-hr rainfall, P_2	in	2.6			
5. Land slope, s	ft/ft	0.03			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	0.39	+	=	0.39

Shallow concentrated flow

	Unit	Segment ID			
7. Surface description (paved or unpaved)		unpaved			
8. Flow length, L	ft	600			
9. Watercourse slope, s	ft/ft	0.02			
10. Average velocity, V (figure 3-1)	ft/s	2.3			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.07	+	=	0.07

Channel flow

	Unit	Segment ID			
12. Cross sectional flow area, a	ft^2	24			
13. Wetted perimeter, p_w	ft	14			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft	1.7			
15. Channel slope, s	ft/ft	0.01			
16. Manning's roughness coeff., n		0.040			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s	5.3			
18. Flow length, L	ft	1000			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.05	+	=	0.05

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) .... hr 0.5

Worksheet 4: Graphical Peak Discharge method

Project 50-Acre Development By ____ Date ____

Location Montour Run Watershed, Subshed 7 Checked ____ Date ____

Circle one: (Present) Developed

1. Data:

Drainage area .... A_m = 0.09375 mi^2 (acres/640)

Runoff curve number .... CN = 72 (From worksheet 2)

Time of concentration .. T_c = 0.5 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ...... = 0 percent of A_m (0 acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency	yr	100		
3. Rainfall, P (24-hour)	in	5.0		
4. Initial abstraction, I_a .... (Use CN with table 4-1.)	in	0.778		
5. Compute I_a/P		0.1556		
6. Unit peak discharge, q_u .... (Use T_c and I_a/P with exhibit 4- II)	csm/in	510		
7. Runoff, Q .... (From worksheet 2).	in	2.20		
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		1.0		
9. Peak discharge, q_p .... (Where $q_p = q_u A_m Q F_p$)	cfs	105		

Worksheet 2: Runoff curve number and runoff

Project 50-Acre Development   By ____   Date ______

Location Montour Run Watershed, Subshed 7   Checked ____   Date ______

Circle one: Present (Developed) ______________

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area ☒ acres ☐ mi^2 ☐ %	Product of CN x area
"C"	Residential, 1/2 acre lots	80			10	800
"C"	Development					
		91			20	1820
		86			30	2580
				Totals =	60	5200

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{5350}{60}$ = 86.7; Use CN = 87

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	yr	100 yr.		
Rainfall, P (24-hour)	in	5.0		
Runoff, Q .... (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	in	3.57		

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project 50-Acre Development By ____ Date ____

Location Montour Run Watershed, Subshed 7 Checked ____ Date ____

Circle one: Present (Developed)

Circle one: T_c T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Units	Segment ID			
1. Surface description (table 3-1)		short gr			
2. Manning's roughness coeff., n (table 3-1)		0.15			
3. Flow length, L (total L $\leq$ 300 ft)	ft	100			
4. Two-yr 24-hr rainfall, P_2	in	2.6			
5. Land slope, s	ft/ft	0.01			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	0.24	+		= 0.24

Shallow concentrated flow	Units	Segment ID			
7. Surface description (paved or unpaved)		unpaved			
8. Flow length, L	ft	400			
9. Watercourse slope, s	ft/ft	0.02			
10. Average velocity, V (figure 3-1)	ft/s	2.3			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.05	+		= 0.05

Channel flow	Units	Segment ID			
12. Cross sectional flow area, a	ft^2	40			
13. Wetted perimeter, p_w	ft	24			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft	1.7			
15. Channel slope, s	ft/ft	0.02			
16. Manning's roughness coeff., n		0.035			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s	8.6			
18. Flow length, L	ft	500			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.02	+		= 0.02

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) .... hr 0.3

Worksheet 4: Graphical Peak Discharge method

Project 50-Acre Development   By ____   Date ______

Location Montour Run Watershed, Subshed 7   Checked ____   Date ______

Circle one: Present (Developed) ______________________

1. Data:

Drainage area .... A_m = 0.09375 mi^2 (acres/640)

Runoff curve number .... CN = 87 (From worksheet 2)

Time of concentration .. T_c = 0.1 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ...... = 0 percent of A_m (____ acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency	yr	100		
3. Rainfall, P (24-hour)	in	5.0		
4. Initial abstraction, I_a .... (Use CN with table 4-1.)	in	0.299		
5. Compute I_a/P		0.06		
6. Unit peak discharge, q_u .... (Use T_c and I_a/P with exhibit 4-II)	csm/in	680		
7. Runoff, Q .... (From worksheet 2).	in	3.57		
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		1.0		
9. Peak discharge, q_p .... (Where $q_p = q_u A_m Q F_p$)	cfs	228		

APPENDIX D

DOCUMENTATION LETTERS

United States Department of Agriculture

Soil Conservation Service

One Parkway Center, Room 115
875 Greentree Road
Pittsburgh, PA 15220

February 23, 1988

Mr. John M. Mores
Staff Planner
GAI Consultants, Inc.
570 Beatty Road
Monroeville, PA 15146

Dear Mr. Mores:

In response to your letter of February 19, 1988, the Soil Conservation Service (SCS) does not have any flood control structures in the Montour Run Watershed. There are also no plans by SCS to build any structures in the future in this watershed.

Sincerely,

Robin

ROBIN L. MOYER
District Conservationist

RLM/jk

The Soil Conservation Service is an agency of the Department of Agriculture

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PENNSYLVANIA DER

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
Post Office Box 1467
Harrisburg, Pennsylvania 17120
February 25, 1988

Bureau of Water Projects

717-783-1766

FEB 29 1988

John M. Mores, A.I.C.P.
Staff Planner
GAI Consultants, Inc.
570 Beatty Road
Pittsburgh, Monroeville, PA 15146

Re: DER File No. C2:0

Dear Mr. Mores:

This is in response to your February 19, 1988 letter to Robert Adams, formerly of this office, regarding the Montour Run Stormwater Management Plan. You requested information on this Department's flood protection projects or studies in the watershed.

To date, we have not constructed any projects nor have we been asked to conduct feasibility studies in the area. I hope this information is useful to you in developing the plan.

Sincerely,

David P. Lambert

David P. Lambert, Acting Chief
Division of Project Development

DEPARTMENT OF THE ARMY
PITTSBURGH DISTRICT, CORPS OF ENGINEERS
WILLIAM S. MOORHEAD FEDERAL BUILDING
1000 LIBERTY AVENUE, PITTSBURGH, PA 15222-4186

March 3, 1988

MAR 7 1988

Mr. John M. Mores
Staff Planner
GAI Consultants, Inc.
570 Beatty Road
Monroeville, Pennsylvania 15146

Dear Mr. Mores:

In response to your inquiry of February 19, 1988, regarding a storm water management plan on Montour Run, the U.S. Army Corps of Engineers has no projects in the Montour Run watershed.

At this time, we have no future plans to construct any projects in that watershed.

Sincerely,

E. R. Kovanic

Edward R. Kovanic, P.E.
Chief, Engineering Division

APPENDIX E
NO-HARM OPTION - PROCEDURE

The release rate percentages assigned to each subshed of the Montour Run Watershed have been established to prevent additional flood damages downstream of future development sites. In certain circumstances, these percentages may be "unreasonably restrictive" when applied to a specific site. The procedure presented here constitutes the technical means through which an owner could demonstrate that his document would have no adverse effects on downstream areas.

The Penn State Runoff Method (PSRM, Version 1988 or later) is the hydrologic model required in the procedure. Use of this model would produce results from a "No-Harm" analysis that could be compared to the results of the watershed study.

1. Develop the runoff hydrograph(s) for the design storms of the site and areas tributary to it using the PSRM and the Montour Watershed Storm Water Plan land use of the development for both pre-development and post-development conditions (Sketch 1).
2. Develop the discharge hydrograph from the proposed site using the PSRM. If no management or controls are proposed, this would be equivalent to the runoff hydrograph under post-development conditions. If some management or controls are proposed, then the runoff hydrograph under post-development conditions would be modified to reflect their effect on the rate, volume, and timing of discharges (Sketch 2).

3. Subtract the runoff hydrograph ordinates under pre-development conditions (Step 1) from the discharge hydrograph ordinates (Step 2), maintaining the time scales of both hydrographs for one-to-one correspondence (Sketch 3).

4. Obtain the PSRM for existing conditions for the Montour Run Watershed, as developed in the Watershed Study, from the Allegheny County Planning Department or from its equivalent.

5. Locate the subshed(s) in which the proposed development is located and into which the discharge hydrograph enters. If more than one subshed receives this incremental flow, divide the flow accordingly.

6. Add the incremental increase computed in Step 3 to the runoff hydrograph for the subshed(s) identified in Step 5.

7. Route the adjusted runoff hydrograph through the Montour Run Watershed PSRM and note any increase in peak flows which would occur in downstream subsheds. If no increase is noted, then the "No-Harm" has been demonstrated. If no increase is observed in peak flows, the owner shall evaluate the increased potential for erosion and/or sedimentation in downstream channels due to his development which may occur due to any change in the flood hydrograph predicted by the model. If no increased potential can be demonstrated

by appropriate technical means, then the "No-Harm" exemption may be requested.

8. If an increase in peak flow is observed in any of the downstream subsheds, then the owner shall evaluate the relative impact of the increased peak flow in all such downstream areas using appropriate water surface elevation prediction methods. An evaluation of the increased potential for erosion and/or sedimentation must also be performed.

Sketch 1

PRE-DEVELOPMENT AND POST-DEVELOPMENT HYDROGRAPH