

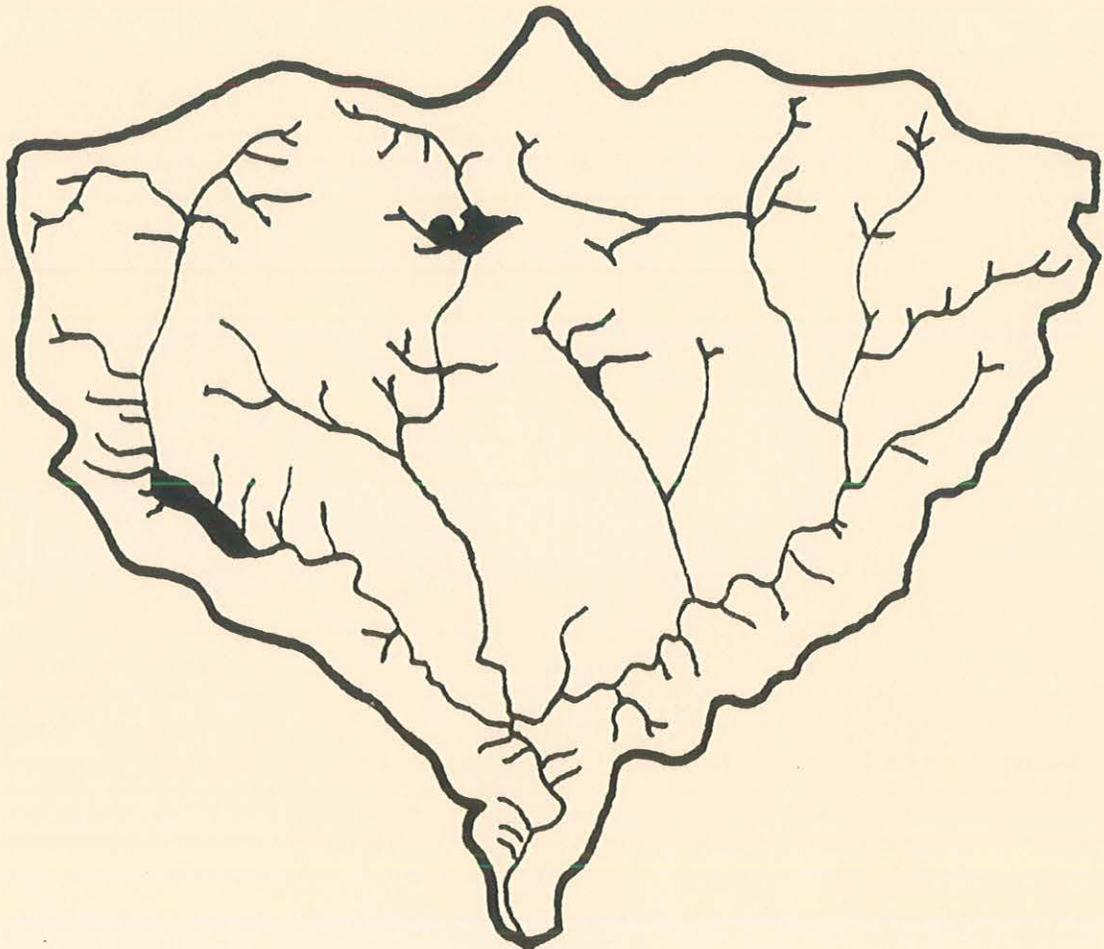
COCALICO CREEK WATERSHED

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STORM WATER MANAGEMENT PLAN

PHASE 1 SCOPE OF STUDY

ACT 167



JUNE 1991

Prepared for:

LANCASTER COUNTY
COMMISSIONERS

Prepared by:

LANCASTER COUNTY
ENGINEER

FILE NO. SWMP 061:36

**ACT 167 STORM WATER
MANAGEMENT PLAN
PHASE I - SCOPE OF STUDY**

**LANCASTER COUNTY
COCALICO CREEK WATERSHED
SWMP 061:36**

Prepared By:
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SUBMITTED TO:
THE PENNSYLVANIA DEPARTMENT
OF ENVIRONMENTAL RESOURCES

Date: June 30, 1991

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SUMMARY
COCALICO CREEK WATERSHED
PHASE I SCOPE OF STUDY

Who & Why

This Phase I Scope of Study for the Cocalico Creek Watershed in Lancaster County, Pennsylvania has been prepared by the Lancaster County Engineer for the Lancaster County Commissioners and the Pennsylvania Department of Environmental Resources to comply with the Pennsylvania Storm Water Management Act (Act 167). Act 167 requires the development of storm water management plans on a watershed-wide basis to address the critical interrelationship of land development, accelerated storm water runoff, and floodplain management.

Areat Municipalities

The Cocalico Creek Watershed drains 139 square miles in Lancaster, Lebanon and Berks Counties. Nineteen municipalities are within this watershed. The major land uses in this watershed are agriculture and woodland. However, commercial, residential and industrial use is also prevalent and is rapidly increasing. Because of the great potential for land development, this watershed can benefit greatly from a Watershed Plan.

Level of Effort or Cost Estimate (2 ways)

This Scope of Study includes a Plan Preparation Strategy for Phase II which breaks the plan development into eleven tasks that specifically identify the work and responsibilities necessary to complete the plan. The Scope of Study also includes a section entitled Level of Effort and Cost Estimate that evaluates the time and cost required to complete the Phase II work for the plan. The cost estimate has been prepared in two ways. The first is for all work required for Phase II to be completed by the Lancaster County Engineer. The second is for the required work to be completed by a consultant with Lancaster County providing administrative and other support services.

Est. Cost-

The total estimated cost for all work for the Cocalico Creek Watershed Plan to be completed by the Lancaster County Engineer is \$145,629.

The total estimated cost for all work for the Cocalico Creek Watershed Plan to be completed by a consultant with Lancaster County providing administrative and other support services is \$152,781.

I. INTRODUCTION

Storm Water Runoff - Its Problems and Its Solutions

The water that runs off the land into surface waters during and immediately following a rainfall event is referred to as storm water. In a watershed undergoing urban expansion, the volume of storm water resulting from a particular rainfall event increases because of the reduction in previous land area (i.e., natural land being covered by pavement, concrete, or buildings). That is, the alteration of natural land cover and land contours to residential, commercial, industrial and even crop land uses results in decreased infiltration of rainfall and an increased rate and volume of runoff.

As development has increased, so has the problem of dealing with the increased quantity of storm water runoff. Failure to properly manage this runoff has resulted in greater flooding, stream channel erosion and siltation, as well as reduced groundwater recharge. This process occurs every time the land development process causes changes in land surface conditions.

History has shown that individual land development projects are often viewed as separate incidents, and not necessarily a part of a "bigger picture". This has also been the case when the individual land development projects are scattered throughout a watershed (and in many different municipalities). However, it is now being observed and verified that this cumulative nature of individual land surface changes dramatically effects flooding conditions. This cumulative effect of development in some areas has resulted in flooding of both small and large streams with property damages running into the millions of dollars and even causing loss of life. Therefore, given the distributed and cumulative nature of the land alteration process, a comprehensive (i.e., watershed-level) approach must be taken if a reasonable and practical management and implementation approach and/or strategy is to be successful.

Pennsylvania Storm Water Management Act (Act 167)

Recognizing the need to deal with this serious and growing problem, the Pennsylvania General Assembly enacted Act 167. The statement of legislative findings at the beginning of the Pennsylvania Storm Water Management Act (Act 167), sums up the critical interrelationship between land development, accelerated runoff, and floodplain management. Specifically, this statement of legislative findings points out that:

1. Inadequate management of accelerated runoff of storm water resulting from development throughout a watershed increases flood flows and velocity, 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 floodplain management and floodplain control efforts in downstream communities, reduces groundwater recharge, and threatens public health and safety.

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

Up to the enactment of Act 167, storm water management had been oriented primarily towards addressing the increase in peak runoff rates discharging from individual land development sites to protect property immediately downstream. Minimal attention was given to the effects on locations further downstream (frequently because they were located in another municipality), or to designing storm water controls within the context of the entire watershed. Management of storm water also was typically regulated on a municipal level, with little or no designed consistency between adjoining municipalities in the same watershed concerning the types, or degree, of storm water runoff control to be practiced.

Act 167 changed this approach by instituting a comprehensive program of storm water planning and management--on a watershed level. The Act requires Pennsylvania counties to prepare and adopt storm water management plans for each watershed located in the county, as designated by the Pennsylvania Department of Environmental Resources (DEPARTMENT). Most importantly, these plans are to be prepared in consultation with municipalities located in the watershed, working through a Watershed Plan Advisory Committee (WPAC). The plans are to provide for uniform technical standards and criteria throughout a watershed for the management of storm water runoff from new land development sites.

The types and degree of controls that are prescribed in the watershed plan need to be based on the expected development pattern and hydrologic characteristics of each individual watershed. The management plan, specifically the standards and criteria, are to be developed from the technical evaluations performed in the planning process, in order to respond to the "cause and effect" nature of existing and potential storm runoff impacts in the watershed. The final product of the Act 167 watershed planning process is to be a comprehensive and practical implementation plan, developed with a firm sensitivity to the overall needs (e.g., financial, legal, political, technical, etc.) of the municipalities of the watershed, so that a common goal of area wide flood impacts management can be achieved.

II. COCALICO CREEK WATERSHED CHARACTERISTICS

A. Drainage Area

The Cocalico Creek Watershed, as illustrated in Figure 1, is located in the northern part of Lancaster County and extends into the southeast part of Lebanon County and the southwest part of Berks County. The watershed is contained within nineteen (19) municipalities. Thirteen of these municipalities are in Lancaster County, four are in Lebanon County and two are in Berks County. The Cocalico Creek drains a watershed area of approximately 139 total square miles (109 square miles are in Lancaster County, 25 square miles are in Lebanon County and 5 square miles are in Berks County). A list of the municipalities and Counties in the watershed and a breakdown of the areas for each is shown in Table 1.

Area of municipalities

The Cocalico Creek begins in the Furnace Hills of West Cocalico Township and flows southward as it is joined by other streams flowing from the Furnace Hills. At Denver Borough it is joined by the Little Cocalico Creek that flows from the hills on the Lancaster/Berks County boundary. The Cocalico Creek then turns in a southwesterly direction, is joined by Indian Run, and flows through Ephrata and Akron Boroughs. Below Akron, near the village of Millway, the Cocalico Creek is joined by two large tributaries, Hammer Creek and Middle Creek. Middle Creek originates in Heidelberg Township in Lebanon County and flows in a southerly direction through Clay Township to Millway. The Hammer Creek originates on the north slope of the Furnace Hills in Heidelberg and South Lebanon Townships in Lebanon County, continues through a gap in the hills at Pumping Station Road, and flows in a southeasterly direction through Elizabeth, Clay and Warwick Townships to Millway. Both Hammer and Middle Creeks are dammed near their headwaters to provide a reservoir for recreation and wildlife habitat. The headwaters of Hammer Creek provide water for the Lebanon Water Authority. From Millway, the Cocalico Creek flows southward until it discharges into the Conestoga River below Brownstown.

Narrative of Watershed

The named tributaries of the Cocalico Creek are:

- Hammer Creek
- Kettle Run
- Walnut Run
- Middle Creek
- Segloch Run
- Elders Run
- Meadow Run
- Indian Run
- Cover Run
- Stony Run
- Little Cocalico Creek
- Harnish Run

COCALICO CREEK WATERSHED (SWMP 061:36)

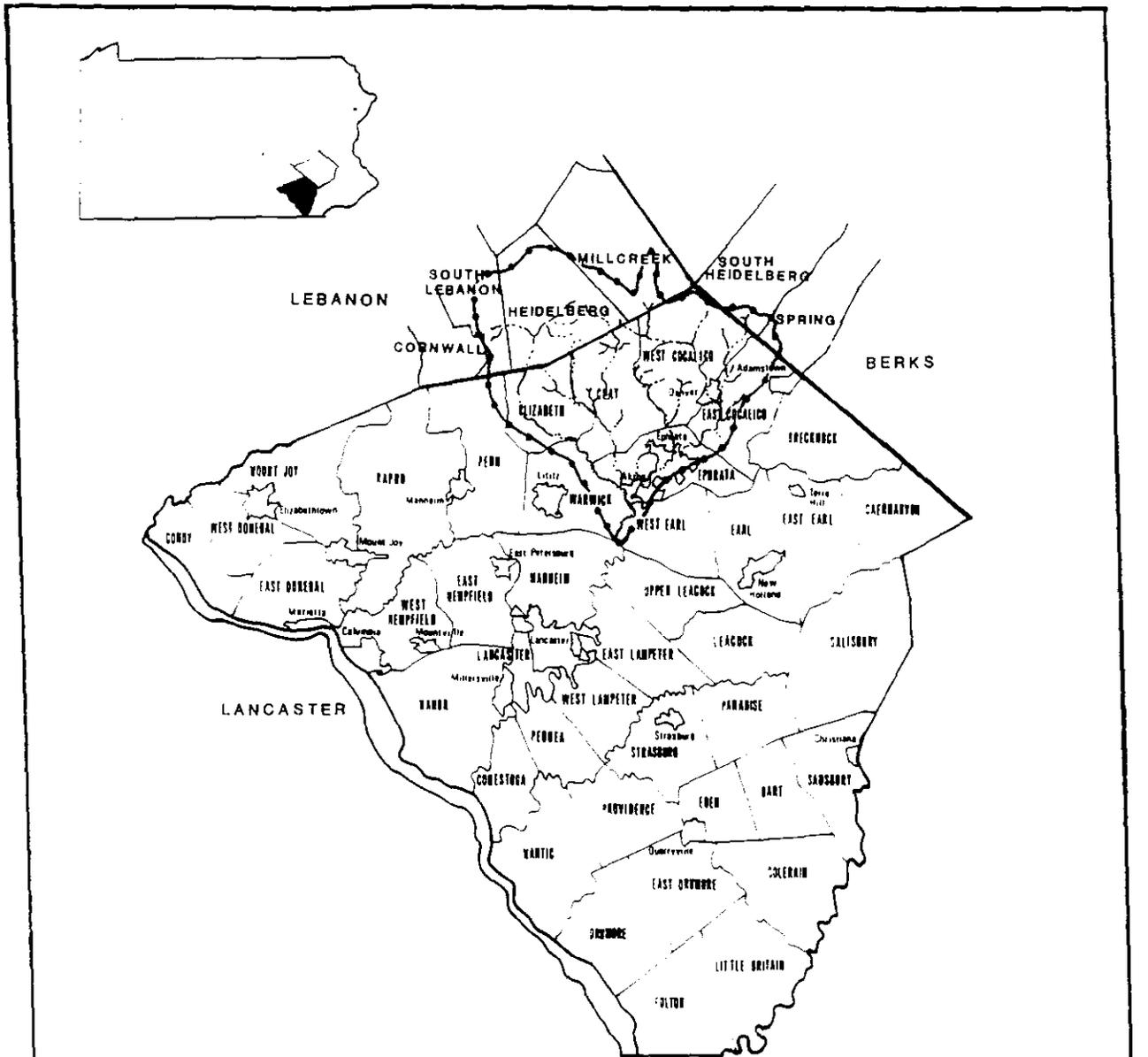
MUNICIPALITIES RANKED BY AREA

<u>Municipality</u>	<u>County</u>	<u>Acres</u>	<u>Square Miles</u>	<u>Percent Of Total Area</u>
W.Cocalico Twp.	Lancaster	17,711	27.67	20.0%
Clay Twp.	Lancaster	14,636	22.87	16.5%
Heidelberg Twp.	Lebanon	10,576	16.52	11.9%
Elizabeth Twp.	Lancaster	10,074	15.74	11.4%
E.Cocalico Twp.	Lancaster	9,504	14.85	10.7%
Ephrata Twp.	Lancaster	6,860	10.71	6.7%
Warwick Twp.	Lancaster	4,711	7.36	5.3%
S.Lebanon Twp.	Lebanon	4,062	6.35	4.6%
Ephrata Boro.	Lancaster	2,264	3.54	2.6%
Penn Twp.	Lancaster	1,612	2.52	1.8%
S.Heidelbrg Twp.	Berks	1,555	2.43	1.8%
Spring Twp.	Berks	1,389	2.17	1.6%
Millcreek Twp.	Lebanon	1,199	1.87	1.4%
West Earl Twp.	Lancaster	1,091	1.70	1.2%
Denver Boro.	Lancaster	719	1.12	0.8%
Akron Boro.	Lancaster	529	0.83	0.6%
Adamstown Boro.	Lancaster	107	0.17	0.1%
Cornwall Boro.	Lebanon	57	0.09	0.1%
Manheim Twp.	Lancaster	17	0.03	-
TOTAL		88,673	138.55	100%

COUNTIES RANKED BY AREA

<u>County</u>	<u>Number of Municipalities</u>	<u>Acres</u>	<u>Square Miles</u>	<u>Percent Of Total Area</u>
Lancaster	13	69,835	109.12	78.8%
Lebanon	4	15,894	24.83	17.9%
Berks	2	2,944	4.60	3.3%
Total	19	88,673	138.55	100%

TABLE 1 -COCALICO CREEK WATERSHED



LEGEND

----- COCALICO CREEK & TRIBUTARIES

~~~~~ WATERSHED BOUNDARY

———— COUNTY BOUNDARY

**DRAINAGE AREA**

**139 SQUARE MILES**

**COCALICO CREEK WATERSHED**

**Figure 1**

**COCALICO CREEK WATERSHED**  
**1990 LAND DEVELOPMENT/POPULATION CHANGES**

| <u>Municipality</u>        | <u>1990 DEVELOPMENT</u> |              | <u>POPULATION</u> |             |               |
|----------------------------|-------------------------|--------------|-------------------|-------------|---------------|
|                            | <u>No. of Lots</u>      | <u>Acres</u> | <u>1980</u>       | <u>1990</u> | <u>2000**</u> |
| Adamstown Borough          | 5                       | 2            | 1107              | 1108        | 1094          |
| Akron Borough              | 28                      | 14           | 3471              | 3869        | 4233          |
| Clay Township              | 9                       | 119          | 3718              | 5050        | 6410          |
| Cornwall Bor., Lebanon Co. | *                       |              |                   |             |               |
| Denver Borough             | 3                       | 1            | 2018              | 2861        | 3728          |
| East Cocalico Township     | 165                     | 473          | 6354              | 7809        | 9253          |
| Elizabeth Township         | 12                      | 175          | 2379              | 3691        | 5054          |
| Ephrata Borough            | 2                       | 1            | 11095             | 12133       | 13100         |
| Ephrata Township           | 114                     | 54           | 4789              | 7116        | 9523          |
| Heidelberg Twp., Leb. Co.  | *                       |              |                   |             |               |
| Manheim Township           | 562                     | 279          | 26042             | 28880       | 31450         |
| Millcreek Twp., Leb. Co.   | *                       |              |                   |             |               |
| Penn Township              | 97                      | 165          | 5865              | 6760        | 7613          |
| S. Heidelberg Twp., Berks  | *                       |              |                   |             |               |
| S. Lebanon Twp., Leb. Co.  | *                       |              |                   |             |               |
| Spring Twp., Berks         | *                       |              |                   |             |               |
| Warwick Township           | 192                     | 199          | 8213              | 11622       | 15126         |
| West Cocalico Township     | 33                      | 343          | 4948              | 5521        | 6045          |
| West Earl Township         | 46                      | 158          | 5552              | 6434        | 7279          |

*Significant growth  
is projected for just  
about all municipalities.  
Time is right for  
Act 167*

\* Information not available for this municipality

\*\* Projected population from Lancaster County Planning Commission Draft Estimate

**TABLE 2 - LAND DEVELOPMENT/POPULATION**

B. Land Use

A preliminary survey of the existing land use for this watershed was made from information on the USGS quad maps. This survey shows that existing land use is approximately 58% agricultural, 33% woodland, 8% residential development/village and 1% urban/industrial.

Much of the woodland is part of the State Game Land System and will not be developed. The privately held woodland is currently under development pressure to provide dwellings in a forested locale.

The corridor that parallels Route 222 that includes Brownstown, Akron, Ephrata, Denver and Adamstown is currently under heavy development pressure due to its proximity to Route 222 and the Pennsylvania Turnpike. The development is residential, commercial and industrial. This corridor is expected to continue to grow rapidly.

*Land Use  
Breakdown*

Agriculture is expected to remain a predominant land use in this watershed. However, it is expected that most of the agricultural land along the Route 222 corridor will change to other uses in the next decade.

*Population*

Table 2 on the preceding page shows the number of lots and acreage that were approved and recorded in Lancaster County in 1990 for the municipalities in the Cocalico Creek Watershed. Also shown is the population change from 1980 to 1990 based on the U.S. Census and the projected population in the year 2000 from the Lancaster County Planning Commission Draft Estimate.

### C. Topography

The watershed topography ranges from the moderate hills ringing the northern part of the watershed to the undulating valleys comprising the southern part. There is also a broad, flat valley in Lebanon County that is part of the headwaters of the watershed. The highest point in the watershed is on South Mountain in Millcreek Township, Lebanon County at 1360-feet. The lowest point is at the confluence with the Conestoga River below Brownstown at 275-feet. Cocalico Creek flows for a distance of approximately 26.3 miles with an average slope of about 0.8%. The lower reaches are characterized by bed slopes of about 0.1%, with meandering of the streambed and numerous horseshoe bends.

### D. Soils and Geology

The Cocalico Creek Watershed consists of the following General Soil Units:

#### Manor-Chester-Glenelg

Nearly level to very steep, well drained soils on broad ridgetops and side slopes. These soils were formed in residuum from mica schist, quartzite and gneiss. The unit is about 32% Manor soils, 30% Chester soils, 23% Glenelg soils, and 15% soils of minor extent.

#### Duffield-Hagerstown

Nearly level to steep, well-drained soils in undulating, broad valleys. These soils were formed in residuum from limestone. The unit is about 42% Duffield soils, 40% Hagerstown soils, and 18% soils of minor extent.

#### Ungers-Bucks-Lansdale

Nearly level to very steep, well-drained soils on ridges, side slopes and foot slopes. These soils were formed in residuum from

Triassic siltstone, conglomerate, shale and sandstone. The unit is about 34% Ungers soils, 19% Bucks soils, 13% Lansdale soils and 34% soils of minor extent.

#### Bedington

Nearly level to moderately steep, well-drained soils on dissected ridgetops and side slopes. These soils were formed in residuum from acid shale. The unit is about 75% Bedington soils and 25% soils of minor extent.

#### Carbonate Rock

Large parts of the Cocalico Creek Watershed are underlain by substantial amounts of carbonate rock, namely limestone and dolomite. Sinkhole activity is common in these areas. Rapid infiltration of storm water runoff into the groundwater system at sinkholes and sinking streams can cause a significant reduction in streamflow and flood peaks at downstream locations. The most prevalent area of this activity in this watershed is in Lebanon County at the headwaters of Hammer and Middle Creeks. Sinkhole activity is also found in other areas of the watershed.

*Sinkhole  
Activity*

### III. ACT 167 PLANNING FOR THE COCALICO CREEK WATERSHED

Given the above watershed characteristics, the watershed planning process for this study area must be fitted to the watershed characteristics, as well as the resources (technical, political, and economic) of this area. This section of the Phase I - Scope of Study presents the concept and approach that has been developed to fully meet these requirements, as well as the specific requirements of Act 167, for this watershed storm water management project.

#### Benefits of the Plan

The purpose and benefit of the study and implementation plan is to provide all of the municipalities in the watershed (in compliance with the requirements of Pennsylvania Act 167) with an accurate and consistent implementation strategy and procedures for comprehensive storm water management. Currently, all of the watershed municipalities in Lancaster County enforce storm water management regulations either through their own ordinances or through the County's ordinance. However, actual enforcement criteria vary. Given the nature of storm water runoff and its impacts, as described earlier in this document, a critical objective of sound storm water management planning is to provide for consistency of implementation requirements throughout the watershed. Therefore, the primary objective of the technical study and planning process is to develop a technical and institutional support document to encourage and/or support the consistency of regulations for implementation based on watershed-wide consideration.

*Consistency of  
Implementation of  
Storm Water Controls*

Technical Information Resulting From  
Plan will be available to  
municipalities to use for  
projects.

The currently accepted watershed planning approach (technical and institutional) recommended by the Department of Environmental Resources also provides the municipalities of a watershed (in addition to the county) with a considerable amount of usable technical information, such as a detailed watershed runoff simulation model, that can be used for numerous other associated purposes for participating municipalities. Therefore, as a result of developing the primary product of the watershed planning effort (i.e., the implementation plan for local regulation of storm water runoff impacts), the participating municipalities, as well as the county, will realize benefits and/or products that are usable for other planning and engineering purposes.

For example, land use updates and environmental data management are functions that are necessary for effective planning in a watershed. The technical approach being proposed for this Cocalico Creek Watershed Act 167 planning project will provide unique environmental database management benefits for not only the county, but also for municipal use. Another example of the associated benefits of an Act 167 watershed plan relates to basic public works and/or engineering functions, primarily at the municipal level.

In addition, technical support information, provided as a part of the watershed modeling effort, can be used by public works officials for bridge replacement and flood plain management analysis, and design and regulatory permitting efforts. Further, the stream encroachment permit process, which involves the need to supply detailed stream flow data as a part of the application process, can be more efficiently and cost-effectively developed using the calibrated watershed model. Therefore, the benefits of the watershed planning process are wide-ranging, even beyond the important function of developing comprehensive storm water management strategies and ordinance provisions.

#### Approach for the Development of the Cocalico Creek Watershed Plan

In order to implement watershed-wide comprehensive planning for and management of storm water runoff, it was necessary to take a very close look at all portions of the watershed for this Phase I study. Since the Act itself is very dependent on municipal coordination to provide for the total planning and management of storm water throughout the watershed, it was necessary to get each municipality in the watershed involved in the planning process.

WPAC +  
Questionnaire  
Strategy

In order to initiate municipal level involvement in the overall development of the PLAN, a Watershed Plan Advisory Committee and a questionnaire strategy is incorporated into the Phase I work approach for the watershed. The Watershed Plan Advisory Committee (WPAC) is formed by the COUNTY and consists of the required municipal County Conservation District and interested group representatives. A WPAC meeting was held on April 30, 1991 during Phase I preparations. The WPAC Membership list is shown in Table 3.

COCALICO CREEK WATERSHED ADVISORY COMMITTEE

| <u>WPAC Member</u>     | <u>Affiliation</u>                                   |
|------------------------|------------------------------------------------------|
| Mike Wetherhold        | Adamstown Borough                                    |
| *                      | Akron Borough                                        |
| John C. Gondek         | Clay Township                                        |
| Eric Slavin            | Cornwall Borough, Lebanon Co.                        |
| George Whetsel         | Denver Borough                                       |
| Robert Roggenburg      | East Cocalico Township                               |
| Robert Gabriel         | Elizabeth Township                                   |
| D. Robert Thompson     | Ephrata Borough                                      |
| Dan Fox                | Ephrata Township                                     |
| Harold McQuate         | Heidelberg Twp., Lebanon Co.                         |
| Carl Neff              | Manheim Township                                     |
| Michael E. Ludwig      | Mill Creek Twp., Lebanon Co.                         |
| Robert Tucci           | Penn Township                                        |
| *                      | S. Heidelberg Twp., Berks Co.                        |
| Curtis Culp            | S. Lebanon Twp., Lebanon Co.                         |
| Charles M. Jones, P.E. | Spring Township, Berks Co.                           |
| V. Riggs Kohler        | Warwick Township                                     |
| Marvin E. Bennetch     | West Cocalico Township                               |
| Don Robinson           | West Earl Township                                   |
| **                     | Save Our Creek Foundation                            |
| Don Robinson           | Lancaster County Conservation<br>District            |
| Edwina Coder           | Lancaster County Planning<br>Commission              |
| Edwina Coder           | Chesapeake Bay Commission                            |
| Jean Sonntag           | League of Women Voters                               |
| Jim Humpreville        | Conestoga Valley Association                         |
| **                     | Lancaster Chamber of Commerce<br>and Industry        |
| **                     | Building Industry Association<br>of Lancaster County |

\* This municipality has not designated a WPAC member.

\*\* This organization has not designated a WPAC member.

TABLE 3 - COCALICO CREEK WPAC

## Municipalities Questionnaire

The Municipalities Questionnaire was designed to solicit input from each municipality, relative to very specific problems in the watershed, as well as for the needs they may see for storm water management in their particular area. The questionnaire was distributed along with a summary of the purpose of Act 167 which includes an emphasis on Act 167 goals as they relate to this watershed. [An example of the questionnaire package is included as Appendix A of this document.]

*Asked each municipality to identify 3 problem areas*

Because the most important part of the Act 167 planning process is the actual implementation of the plan, another consideration in utilizing this questionnaire strategy for the Cocalico Creek Watershed is the interest by the responding municipalities for the need and the desire to actively implement storm water management measures within their community. A summary of the storm water related problems and the identification of properties affected by flooding incidences in each municipality is an important expected product out of the Phase I study.

The overall evaluation of the questionnaires illustrates a very significant point. The results indicate that even though there are localized storm water problems their number and frequency of occurrence appears to be relatively low. Therefore, this watershed will realize significant benefits during the planning period because of the Act 167 Plan, since storm water management will be initiated before there are a significant amount of existing problems. Because there is so much room for growth and development in the Cocalico Creek Watershed (and because this growth is being projected with some degree of confidence), the Act 167 Watershed Storm Water Management Plan for this area may be the best example of a storm water impact "prevention" plan - as is the true intent of Act 167.

As additional areas of the watershed will experience growth, the technical support basis for the standards and criteria developed in this initial planning project can be easily modified without invalidating the overall plan. The detailed description of the technical modeling activities, presented in the work step descriptions in the next section of this document, will provide more insight into the specific modeling approach to be used to accomplish this objective.

Municipalities Questionnaire Summary

The Municipalities Questionnaire shown in Appendix A was distributed by mail to the municipalities in the Cocalico Creek Watershed on April 10, 1991. The results of the questionnaire are shown in Table 4.

**MUNICIPAL QUESTIONNAIRE SUMMARY**  
**COCALICO CREEK WATERSHED**

| <u>Municipality</u>  | <u>Problems Concerns Identified (A)</u> | <u>Causes of Storm Water Problems (B)</u> | <u>Frequency of Occurrence (C)</u> | <u>Type of Damages Incurred</u>         |
|----------------------|-----------------------------------------|-------------------------------------------|------------------------------------|-----------------------------------------|
| Adamstown Borough    | 1                                       | 1,3,5                                     | 3,4                                | Private                                 |
| Clay Township        | 1,3,4                                   | not specified                             |                                    |                                         |
| Denver Borough       | 1,2                                     | 2,4,5                                     | 3,4                                | Private, Public, Loss of Vital Services |
| Elizabeth Township   | 1,2,3,4                                 | not specified                             | 4                                  |                                         |
| Ephrata Borough      | 1,2,3                                   | 1,2                                       | 4                                  | Private                                 |
| Ephrata Township     | 1,2,3,4                                 | not specified                             |                                    |                                         |
| Heidelberg Township  | 1,2,3,4                                 | 4,5,6                                     | 4                                  |                                         |
| Millcreek Twp., Leb. | 3,4,5                                   | not specified                             |                                    |                                         |
| Penn Township        | 3                                       | no major problems                         |                                    |                                         |
| Spring Township      | 2,3                                     | 4,5                                       | 4                                  | Private                                 |
| S. Lebanon Township  | 1,2,3,5                                 | not specified                             |                                    |                                         |

(A) Problems/Concerns Identified

1. Stream flooding
2. Street flooding
3. Soil washoff
4. Storm water pollution
5. Other

(B) Causes of Storm Water Problems

1. Too large an increase in uncontrolled runoff
2. Uncontrolled runoff from upstream municipalities
3. Inadequate drainage system
4. Obstructions in the system that need to be removed
5. Lack of maintenance of drainage ways
6. Other

(C) Frequency of Occurrences

1. Every rain
2. More than 10 times per year
3. More than 1 time per year
4. Only on major flood events

**TABLE 4 - MUNICIPAL QUESTIONNAIRE SUMMARY**

#### IV. PLAN PREPARATION STRATEGY

The PLAN will contain, at a minimum, the following items:

- (1) a survey of existing runoff characteristics in small as well as large storms, including the impact of soils, slopes, vegetation and existing development;
- (2) a survey of existing significant obstructions and their capacities;
- (3) an assessment of projected and alternative land development patterns in the watershed, and the potential impact of runoff quantity and velocity;
- (4) an analysis of present and projected development in flood hazard areas, and its sensitivity to damages from future flooding or increased runoff;
- (5) a survey of existing drainage problems and proposed solutions;
- (6) a review of existing and proposed storm water collection systems and their impacts;
- (7) an assessment of alternative runoff control techniques and their efficiency in the particular watershed;
- (8) an identification of existing and proposed State, Federal and local flood control projects located in the watershed and their design capacities;
- (9) a designation of those areas to be served by storm water collection and control facilities within a ten-year period, an estimate of the design capacity and costs of such facilities, a schedule and proposed methods of financing the development, construction and operation of such facilities, and an identification of the existing or proposed institutional arrangements to implement and operate the facilities;
- (10) an identification of floodplains within the watershed;
- (11) criteria and standards for the control of storm water runoff from existing and new development which are necessary to minimize dangers to property and life and carry out the purposes of this Act;
- (12) priorities for implementation of action within each plan;
- (13) provisions for periodically reviewing, revising, and updating the plan;

- (14) provisions as are reasonably necessary to manage storm water such that development or activities in each municipality within the watershed do not adversely affect health, safety and property in other municipalities within the watershed and in basins to which the watershed is tributary; and
- (15) consideration for consistency with other existing municipal, county, regional and State environmental and land use plans.

The concept and approach presented in the previous discussions have been organized into the set of following detailed tasks. These tasks include the above indicated 15 elements of the plan.

Two separate cost estimates have been prepared. One is based on the use of a consultant with County support services. The other is based on using County services only. Under Project Team Responsibilities, the work is divided between the Lancaster County Engineer and a Consultant. If it is decided to do the Plans with County services only, the County Engineer will be responsible for the full completion of the tasks.

#### Task 1 - Project Initiation

This task covers the administrative work required to initiate the Agreement between the Department of Environmental Resources (DEPARTMENT) and the County, and to initiate selection of a Consultant and, upon selection, to initiate contracts between the County and the Consultant and to lay out a frame work for the critical coordination aspect with the municipalities. Activities include defining the framework for accomplishing various elements of the PLAN as described in the tasks 2 through 11, scheduling of time and defining the budget, progress reporting procedures and formats, and finalizing the work schedule. It will also include the preparation for and holding to the Phase II start-up meeting between DEPARTMENT, the Lancaster County Engineer and the selected Consultant.

#### Project Team Responsibilities

- \* The County Engineer shall be responsible for overall administration of this task, including the finalizing of the Phase II Agreement with the DEPARTMENT and negotiating a contract with a consultant, the establishment of the project coordination roles and procedures, project scheduling and budget finalization, and the development of progress reporting procedures and formats.
- \* Consultant - will perform a support role to COUNTY and will attend all necessary project initiation and planning meetings. Consultant shall also finalize a detailed budget and schedule for technical and institutional planning.

*Funding  
Contracts  
Work schedule  
Correspondence file*

### Anticipated Task Product

The anticipated product of this task will be a written summary of the notes and/or minutes of project initiation meetings. In addition, the finalized project work program, along with the associated budget and schedule, will be documented for review by the DEPARTMENT and for use as a project management guide. A project correspondence file will also be developed and organized and will be maintained throughout the total project duration.

### Task 2 - Project Coordination/Public Participation Through Watershed Plan Advisory Committee

*Hold WPAC  
Meetings*

Coordination efforts and/or activities will continue throughout the duration of the project and will be organized to include the necessary meeting with the County, consultant and DEPARTMENT (assume one progress and/or coordination meeting between the county and consultant per month for the duration of the project) and a progress meeting with the DEPARTMENT every three months. A WPAC was established in accordance with Section 6 of the Act. The details of the WPAC including membership is included under Section III. Coordination efforts will also involve the reactivation of the Watershed Plan Advisory Committee (WPAC), notification to the members of the WPAC concerning meeting, preparation of Agenda and attendance records at the WPAC meetings.

The purpose of the WPAC meetings will be to initiate the important and necessary municipal education process and data gathering efforts, including the preparation and distribution of the questionnaire for technical and institutional data. Additionally, the advisory role of the WPAC during the development of the plan is vital to the ultimate adoption and implementation processes. Included in the overall public participation program for the project will be the various education and training meetings for the WPAC to maintain critical municipal involvement and understanding of the project. The following chart describes proposed WPAC and municipal training meetings and public hearing schedules including the purpose of each meeting.

WPAC  
Meeting  
Number

Purpose of Meeting

Meeting  
Schedule

|                                         |                                                                                                                                                                                                                                                                                                                                                 |                                                              |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| 1                                       | Phase II Start-up meeting - Introduce the municipalities to the Phase II Planning process and establish the degree of critical municipal involvement needed throughout the study. Present the data collection questionnaire and request assistance in gathering the required information.                                                       | Beginning of the Project                                     |
| 2                                       | To review the project status, the data questionnaire results, and to solicit any additional comments/concerns from municipalities with respect to watershed data items.                                                                                                                                                                         | Subsequent to Task 3 (Data Collection)                       |
| 3                                       | Institutional Data Review and Analysis Meeting - To review final ordinance matrix and introduce methods to incorporate plan provisions into existing ordinances. Also provide and discuss the basic DEPARTMENT model ordinance to begin to illustrate the kinds of changes the municipalities may have to make as a result of the Act 167 plan. | Subsequent to Task 4 (Institutional Data Preparation)        |
| 4                                       | Present technical modeling results and identify/describe the storm water runoff problems in the watershed, as well as the "cause and effect" analysis.                                                                                                                                                                                          | Subsequent to Task 8 (Model Runs)                            |
| 5                                       | Present technical standards and criteria for the overall watershed, and preliminary ordinance provisions for the municipalities (general and overall).                                                                                                                                                                                          | Subsequent to Task 8 (Development of standards and criteria) |
| Training Session                        | Present a day-long discussion of standards and criteria implementation, discuss municipal actions necessary to comply with the plan, present municipal engineer procedures recommended by the plan.                                                                                                                                             | Subsequent to Task 10 (Final Preparation)                    |
| Individual Municipal Follow Up Meetings | Individual municipal meetings (with manager and engineer) to discuss specific application of the standards and criteria, as well as recommended municipal ordinance provisions. Intensive question and answer session anticipated.                                                                                                              | Prior to Plan Adoption                                       |
| Public Hearing                          | Conduct the hearing by Act 167 to present the final PLAN to the public.                                                                                                                                                                                                                                                                         |                                                              |

### Project Team Responsibilities

- \* County will be responsible for the development of the coordination strategy for the overall project team (including documentation/reporting responsibilities for the WPAC and DEPARTMENT). Also will be responsible for identifying and finalizing the WPAC members, as well as for the necessary arrangements to hold the WPAC meetings, and reproducing necessary material.
- \* Consultant - responsible for supporting the County in developing project coordination procedures and for providing guidance and input in the formation of the WPAC. Responsible for the preparation of WPAC meeting agendas and technical presentations (including graphics).

### Anticipated Task Product

The product of this task will include correspondence and meeting notes/minutes from the WPAC meetings. In addition, the presentation material prepared for the WPAC meetings will also constitute a defined product of this task for the project.

### Task 3 - Data Collection/Review/Analysis

This task will involve the necessary efforts to gather, review and analyze the required data to complete the technical and institutional planning steps for the Act 167 Watershed Storm Water Management Plan. The consultant and the County will work jointly to collect data from county offices, municipalities, and local, state, and federal agencies that will aid in preparation of the PLAN. The data will consist of information concerning existing and future conditions in the watershed. All data collection activities will be limited to the gathering of available information from either the agencies that will be contacted or, more importantly, on the basis of the data collection questionnaire that will be provided to the municipalities (as well as selected agencies/organizations).

*Go to municipalities & get data, engineers, zoning, ordinances, maps*

Data to be collected will be based on available information and/or questionnaire results and will include the following:

- \* Comprehensive land use plans
- \* Existing municipal ordinances
- \* Zoning maps and ordinances
- \* Storm water-related problems and proposed solutions
- \* Existing and proposed flood control projects
- \* Existing and proposed storm water control facilities

- \* Existing and proposed storm water collection and control facilities, including a designation of those areas to be served by storm water collection and control facilities within a 10-year period, an estimate of the design capacity and costs of such facilities, a schedule and proposed methods of financing the development, construction, and operation of such facilities, and an identification of the existing or proposed institutional arrangements to implement and operate the facilities, where this information is readily available.
- \* Soils
- \* Geology
- \* Flow obstructions
- \* Topographic mapping
- \* Aerial photographs
- \* Engineering and planning studies
- \* Streamflow data
- \* Floodplain information

Additionally, necessary field investigations will be accomplished to gather and/or confirm the data. This task effort will also coordinate closely with the start-up WPAC meeting, which will involve the distribution of data questionnaires to the municipalities. In addition, a discussion of procedures to be followed in the completion of the questionnaires will be provided at the initial WPAC meeting.

This task also involves the review and preliminary analysis of the technical data that has been obtained for consistency and usability in the development of the final product - i.e., the development of technical standards and criteria for storm water management. It also includes the review of the institutional data collected through the municipal data questionnaire process for consistency and usability in the final implementation plan. The analysis will, however, involve the identification of initially missing data and verify the ability to gather the missing items. Floodplain information will be gathered for areas where detailed Flood Insurance Studies (F.I.S.) are available, with alternate sources being explored for stream sections that do not have detailed F.I.S.'s. Municipalities which have detailed F.I.S.'s will be identified and tabulated. Where detailed flood control engineering plans for proposed remedial measures are available from municipal, county or private agencies, a summary analysis and evaluation of those plans will be included in the storm water management plan. Where detailed plans are not available, preliminary recommendations relating to such measures will be provided.

### Project Team Responsibility

- \* COUNTY - responsible for the distribution and initial training associated with the municipal data questionnaire, including the actual data gathering, organizing, and cataloging of data questionnaire responses at the COUNTY offices.
- \* Consultant - responsible for assisting COUNTY with the preparation of municipal data questionnaires. Shall provide support for the actual data gathering and organizing efforts, as well as the preliminary review for consistency and content. Responsible for the review of gathered and organized data and the acceptability of the data, as well as for the preparation of a missing data list. Final responsibilities also include the final determination of data usability for the completion of the necessary technical and institutional planning efforts, as well as for providing input and/or alternatives for the collection of missing data.

### Anticipated Task Product

The product of this task will essentially include the information listed above, gathered and organized in such a way as to be usable for both short- and long-term watershed planning (including updates). A final data summary will be prepared that will identify and/or catalogue the collected data.

### Task 4 - Institutional Data Preparation

This task involves the detailed evaluation of the municipal ordinances (gathered during the Task 3 data collection efforts) in order to prepare a municipal ordinance comparison matrix. This matrix is intended to display, for both the actual preparation of the implementation plan and also for the municipal education process, the current storm water management provisions in the various municipal ordinances for all watershed municipalities. The objective for the preparation of the matrix is to easily and effectively see the similarities and differences, as well as the consistency/ inconsistency, between the various municipal ordinances in the watershed. The matrix will be used in the institutional analysis task (Task 9) to develop ordinance provision recommendations for the various municipalities that are based on the storm water management standards and criteria (identified in the technical plan) for the watershed. This matrix then serves the long-term implementation efforts by providing a convenient reference for the COUNTY to evaluate the individual changes to the various municipal ordinances that will be required as a part of the Act 167 watershed plan adoption process.

*Ordinance Matrix*

### Project Team Responsibilities

- \* COUNTY - responsible for the preparation of the municipal ordinance provisions matrix for the entire watershed.

- \* Consultant - responsible to provide insight and guidance to COUNTY staff in the formatting of the municipal ordinance comparison matrix. Also responsible to review the completed municipal ordinance provisions matrix for consistency with the needs of the Task 9 institutional analysis and implementation plan development efforts.

### Anticipated Task Product

The product of this task will be a completed matrix of storm water management ordinance provisions for the watershed municipalities which identifies the current status of ordinance provisions as they relate to storm water management.

### Task 5 - Data Preparation For Technical Analysis

This task involves the engineering work necessary to transform the raw information collected in Task 3 into a form/format that can be directly used for the later technical tasks in the overall planning program. A primary effort to be conducted as a part of this task is the preparation of the "land characteristics" information for modeling purposes. That is, this task effort includes the necessary map preparation efforts to develop land use, soils, and slope maps for modeling.

This map preparation effort involves the following:

- \* Land Use/Land Cover Information - the aerial (if available) and zoning maps will be used to prepare an existing conditions map for modeling. The most current aerial map of the watershed will provide the basis for existing land development conditions for storm water modeling and planning purposes. Land development projects completed subsequent to the aerial map preparation will be included (by hand drawing) onto the watershed aerial map. The zoning maps for the affected municipalities will be overlaid onto the aerial map so that the different land development types that currently exist in the watershed will be indicated separately for modeling purposes.
- \* Future Land Use Conditions - the existing land development conditions (modified aerial photography base) will be updated to also separately illustrate those areas that are projected for development within a 10-year planning period. These future land development areas will be separately and individually indicated on the aerial base map for purposes of future conditions modeling and planning.
- \* Soils Information - the County Soils Survey maps will be modified and/or prepared to illustrate SCS hydrologic soils groups instead of individual soil types. Overlay mapping will be necessary to prepare the hydrologic soils group map for use in the hydrologic modeling.

*Put Data  
Into Usable Form*

- \* Slope Information - existing slope maps or USGS topographic maps will be utilized and evaluated to assign slope category information to the subareas for which detailed modeling will be completed.

#### Delineation of Subwatersheds

The watershed and subwatersheds will be delineated by the consultant on a base map at a scale of 1 inch equals 2,000 feet. Subwatersheds will be established based on the office data and results of the field reconnaissance task. This breakdown of the watershed by major tributary drainage courses and points-of-interest will be the basis for the hydrologic and hydraulic analysis.

The subwatersheds will be further delineated to subareas based on the following:

- \* the location of existing problems, as identified by local officials in the municipal survey during the field reconnaissance, or from data previously compiled in any previous studies such as water quality monitoring programs,
- \* the location of major obstructions (primarily bridges), highway culverts, or storm water control facilities,
- \* confluence points of tributaries, as deemed appropriate based on engineering judgement and a good modeling practice, and
- \* lakes, dams or reservoirs,
- \* other points of interest, such as stream gaging or water quality monitoring stations, locations of water quality concerns, or outfall sections downstream of existing developments or where development could be anticipated to occur.

This task will also include the mapping of relevant watershed planning information onto a final watershed map. This mapped information will be selected from the data identified and collected in the Task 3 effort, including:

- \* floodplain areas - which will involve the indication on the maps of those areas for which detailed flood insurance studies are available, as well as an indication of those areas and/or sections of streams for which such detailed information is not currently available.
- \* significant obstructions and their capacities - where "significant" obstructions will be those that are identified in the municipal data questionnaires and which are confirmed by the consultant as being areas where insufficient capacity exists for the necessary storm flows.

- \* storm sewer systems - for significant system components: areas where storm sewerage exists will be indicated generally on the final watershed base map.
- \* existing state, federal and local flood protection and storm water management facilities.
- \* proposed storm water facilities within the 10-year planning period - where known and confirmed by the municipalities through the municipal data questionnaire process.
- \* storm water related "problems" - where indicated in the municipal data questionnaire and where confirmed by technical modeling/analysis.

Project Team Responsibilities

- \* COUNTY - responsible for the actual map preparation work described above and the development of watershed base maps for use in both the technical planning process as well as for final plan presentation.
- \* Consultant - responsible for review and analysis of the catalogued municipal data questionnaire information to help identify the data, as described above, that will be included on the various maps. Also responsible for providing technical support and guidance in the watershed map preparation process. Responsible for final review of technical mapping information prepared by COUNTY for use in modeling efforts.

Anticipated Task Product

The product of this task will be the completed watershed maps for the information presented above. The maps completed for this task will, however, be preliminary mapping that can and/or will be modified and finalized as a part of the final plan preparation efforts.

Task 6 - Model Selection and Model Set Up

This task involves the selection and preparation of a hydrologic model appropriate for the analysis of the existing and projected land characteristic of the watershed. Technical input data required to run the models (in addition to land characteristics) will also be prepared such as rainfall information, drainage system layouts and capacities, travel times of subareas and information on man-made impoundments.

Hydrologic models currently in use include, but are not limited to, the Penn State Runoff Model (PSRM), HEC-1 (Corps of Engineers), TR-20 (SCS) and SWMM. An example of currently used water quality models are the AGNPS from the U.S. Department of Agriculture or EPA's SWMM model.

*Run test runs on various models & select proper one for watershed.*

The selected model(s) will be applicable to the size, land use and geological characteristics of the watershed and will be able to accurately and reliably simulate the runoff characteristics for design storms of various frequencies and durations to produce routable hydrographs that can easily be combined.

#### Project Team Responsibilities

- \* COUNTY - responsible for support of consultants efforts in the model selection and development of the necessary model input data.
- \* Consultant - primary responsibility for the model selection and development and/or preparation of the model input data.

#### Anticipated Task Product

The product of this task will be a selected model along with the required hydrologic and hydraulic parameters for the watershed.

#### Task 7 - Model Runs

##### Model Calibration, Runs for Selected Frequency Storms and Interpretation of Results

This task utilizes the material prepared in Task 5 and organized in Task 6, in order to actually run the model and develop watershed-level storm runoff characteristics for six selected frequency design storms (i.e., the mean annual 5-, 10-, 25-, 50-, and 100-year storm events with various durations) and two land use scenarios (existing and future conditions). This task also includes the necessary efforts to calibrate and verify the model for the watershed.

Calibration efforts will include the adjustment of model parameters to accurately simulate natural runoff conditions of the watershed. Consideration will be given to all calibration techniques including, but not limited to the following: use of any available gaging information; comparison with rainfall and runoff information from similar watersheds and short-term gaging. Calibration will, if possible, be performed at multiple points within the watershed to assure the most accurate modeling.

The model, once calibrated, will be verified through test model runs and comparison with any available prior watershed hydrologic results (for example, those completed by the U.S. Army Corps of Engineers).

A single, uniformly distributed storm is not realistic for a large watershed. Storms of high frequency are not uniform, and may move across the watershed and may vary in intensity at different locations affecting timing of hydrographs. This will be evaluated, if applicable, based on the size of the watershed and available rainfall information on past occurrences.

*Run Models for each sub & watershed recalibrate with other watersheds*

Where concurrent rainfall and streamflow records are available (including high water marks for known storm events), these will be used to "test" the accuracy of the model by making model runs. Where rainfall/streamflow data is not available, a regression-type approach (such as using PennDot's PSU IV method) will be used to generally corroborate the model for the watershed. The calibration effort will result in the final selection of watershed modeling input data parameters in order that the required design storm modeling efforts can be initiated with confidence.

After the watershed is calibrated, it must be checked for calibration with the other watersheds in the Conestoga River Basin. This will require one or more recalibrations until all of the watersheds are in agreement. Line Item 7.3 has been added to the cost estimates in Tables 5 and 6 to account for the recalibration required due to interfacing with the other watersheds.

Subsequent to calibration of the model, the consultant will run the model for the mean annual, as well as the 5-, 10-, 25-, 50-, and 100-year storm events with various durations (which depend on time of concentrations). The anticipated evaluation of the results will consider the peak flow rates, as well as flood conditions, in the stream for the various storms. This evaluation will be judged based on detailed HEC-II analysis of the creek and tributaries if available. If HEC-II results are not available, no effort will be made to perform a HEC-II analysis and the required evaluation will be solely judgmental. Existing capacities of the obstructions on the stream and other downstream locations will also be used to identify storm runoff problem areas for use in developing the technical standards and criteria for storm water management in Task 8.

This analysis will also involve determination of the required design storm. The selection of a watershed design storm, for use in the standards and criteria, will be based on an evaluation of the watershed hydrologic response for six design storms to be evaluated. Downstream impacts for the various design storms will be evaluated to determine what level of control (e.g., 100-year versus 10-year) will provide cost-effective management of projected downstream areas. For example, it would not be reasonable to select the 100-year storm for the standards and criteria if current (or anticipated) floodplain management and/or zoning requirements in the municipalities would address 100-year runoff impacts in floodplain areas. The selected design storm will also consider the results of the institutional analysis of current procedures in the municipalities.

The two land use scenarios to be evaluated for this Act 167 watershed plan include: (1) existing land use, as identified from the most current mapping for the watershed with modifications based upon municipal input concerning recent land development projects; and (2) future land use that will be projected to occur within an approximate planning time frame of ten years.

## Project Team Responsibilities

- \* COUNTY - responsible for support of consultant in the technical activities.
- \* Consultant - responsible for the actual modeling and analysis/interpretation efforts to be conducted as a part of this task.

## Anticipated Task Product

The product of this task will be the charts, tables and graphs developed to present the modeling results, and the technical interpretation of the modeling results.

## Task 8 - Develop Technical Standards And Criteria

This task will involve the detailed evaluation of modeling results to perform a problem identification analysis (i.e., a "cause and effect" analysis). This analysis will concentrate on identifying the downstream runoff impacts of projected future land development projects. This evaluation will obviously consider both the increase in current downstream storm water runoff problems, as well as new downstream runoff problems.

This work step also consists of performing a technical evaluation of the hydrologic analysis for existing and ultimate land use conditions and recommending standards and criteria to regulate development activity which impacts storm water runoff. This task also involves a release rate (or other similar) analysis and a preliminary distributed storage analysis, and developing criteria and standards for proper control for storm water for new developments. Recommended standards and criteria will accommodate each land developments activity, which may range from small lot sizes such as single family dwellings to large commercial or institutional complexes such as shopping malls, schools, hospitals, industrial parks, landfills, etc. The standards and criteria will provide for the application of management practices for the implementation of storm water control measures.

The standards and criteria will address the following:

- a. identification of all areas within the watershed where different criteria apply;
- b. recommended release rate percentages (if applicable) or other levels of control to accelerated runoff from the subareas identified in item a;
- c. recommended design flood frequencies and computational methodologies for storm water management measures;
- d. a list of recommended alternate storm water collection and control measures;

*Develop sections for ordinance to address specific problems and to guide development*

- e. specifications for construction and maintenance of storm water systems (if applicable);
- f. safety requirements for storm water systems during and after construction.

The recommendations will be presented in layman's language, keeping in mind that they are directed toward the local municipalities and are to address solutions to storm water management needs and will be read and interpreted by technical as well as non-technical people. The technical standards and criteria developed as a part of this task will be based on a watershed-wide evaluation in their interpretation and/or application.

To determine the adequacy of the recommended standards and criteria, the calibrated model will be run under future land use conditions for the specified design storm incorporating these standards. Techniques to accomplish this may include the introduction of "dummy" reservoirs at selected subarea outlets to simulate specified release rates. The results will be analyzed for the effectiveness of the standards in maintaining the desired level of storm water control and adequately protecting life and property at critical points within the watershed.

#### Project Team Responsibilities

- \* COUNTY - responsible for support in preparation of the technical standards and criteria. Also responsible for the detailed review of the standards and criteria project memorandum, and the submission to the consultant of questions and concerns for resolutions prior to the completion of the final Act 167 plan (Task 11).
- \* Consultant - responsible for the actual technical evaluation/analysis to be completed for the development and verification of technical standards and criteria as a part of this task.

#### Anticipated Task Product

The product of this task will be the definition of the technical standards and criteria for use in the preparation of the PLAN.

#### Task 9 - Institutional Analysis

*Review Ordinances*  
This task involves the detailed review of ordinances for each individual municipality in the watershed using the ordinance provisions matrix completed as a part of Task 4. The evaluation of the municipal ordinance matrix will be conducted using the results of Task 8 (i.e., the development of the technical standards and criteria). Essentially, this task effort will involve the identification of the necessary ordinance

provisions for each watershed municipality that will be required to be instituted in order to effectively comply with the technical standards and criteria developed in Task 8.

In addition, this review and analysis will include the identification of appropriate legal and/or financial alternatives that can be used, under the proposed PLAN, for storm water management. Also included as a part of this task will be the evaluation of intermunicipal arrangements for watershed-level storm water management, including those that would be necessary to implement a regional storm water management concept (e.g., the distributed storage concept).

The evaluation for this task will include the preparation of ordinance provisions for single or multi-purpose ordinances, as selected by the County with appropriate municipal involvement, in order to effectively implement the technical standards and criteria for storm water management in this watershed.

#### Project Team Responsibilities

- \* COUNTY - responsible for the completion of the ordinance review activities as a part of this task. Also responsible for the development, the legal and financial alternatives for storm water management. Additional responsibilities exist for the evaluation and identification of intermunicipal arrangements for watershed level (i.e., regional) storm water management in the watershed. Final responsibility for the identification of ordinance provisions for each municipality to be included in the final implementation plan for the watershed.
- \* Consultant - responsible for providing support and guidance in this task, including the necessary coordination between selected ordinance provisions and the technical standards and criteria developed in Task 9.

#### Anticipated Task Product

The product of this task will be the identification of necessary recommended municipal ordinance provisions.

#### Task 10 - Plan Report Preparation

The consultant with COUNTY support will compile various components of the PLAN. Each component of each previous task will be directly included, or at least referred to, in the plan. In this way, the plan shall contain such provisions as are reasonably necessary to manage storm water such that runoff from development or activities in each municipality within the watershed shall not adversely affect health, safety and property in other municipalities within the watershed and in basins to which the

*Write  
Report*

watershed is tributary. In addition, the plan shall consider and be consistent with other existing municipal, county, regional and state environmental and land use plans. The PLAN shall include the following:

- \* A description of the hydrologic characteristics of the watershed, the present and future land uses and their impacts on runoff, storm water collection systems and their impacts on runoff, the available runoff control techniques and their efficiencies in the watershed, a list of significant obstructions and a justification of their classification and available floodplain information. The available floodplain information will either be included in the plan or their sources referenced;
- \* The technical evaluation determining the criteria and standards governing storm water management controls throughout the watershed. This evaluation shall be based upon the results of the watershed modeling. An important aspect of the technical components of the plan will be the delineation of areas which should (and areas that should not) use storm water detention to reduce peak flows. This determination will be made based upon an evaluation of subarea contributions to peak flows at the identified critical drainage points throughout the entire watershed. Each of the storm water management alternatives as discussed earlier will be incorporated in the plan, as appropriate, based upon the modeling results. Peak discharge tables will be compiled for the critical drainage points from the computer runs involved in the modeling effort;
- \* The tables for the rainfall depths for various frequency durations which are computed as part of the hydrologic modeling;
- \* Recommendations for solutions to the existing drainage problems (since the Act 167 is not intended to solve existing problems, but to prevent their aggravation and also prevent other future problems; these recommendations for solutions to existing problems that are found to be relevant to the PLAN will only be conceptual in nature indicating the type of approach needed and intermunicipal cooperation issues);
- \* Recommendations for new drainage facilities to prevent future problems due to new development, and a discussion regarding intermunicipal arrangements for funding the projects will also be discussed.
- \* A model storm water management ordinance, a list of priorities for implementation and a list of recommendations. Recommended actions will be listed according to the agency, municipality or individual responsible for each action. Priority for actions will be based upon chronological order, importance, hydrologic significance or other appropriate factors. Also included will be a formal process of reviewing the storm drainage elements of subdivision plans against the performance standards of the PLAN, and the procedures for updating the PLAN at least every five years.

The preliminary outline for the PLAN is as follows:

- Section I - Introduction
- Section II - Act 167 Watershed Level Storm Water Management Planning and Implementation
- Section III - Watershed Characteristics
  - \* Present Land Use
  - \* Projected Land Developments
  - \* Significant Obstructions
  - \* Floodplain and Drainage Problems
  - \* Storm Water and Flood Management Systems
- Section IV - Watershed Technical Analysis - Modeling
  - \* Land Developments Impacts on Storm Runoff
- Section V - Technical Standards and Criteria for Control of Storm Water Runoff Modeling Results Evaluation
- Section VI - Runoff Control Techniques and Their Efficiencies
- Section VII - Existing Municipal Ordinance Information
- Section VIII- Institutional Plan - Development of Model Storm Water Ordinance Provisions
- Section IX - Priorities for Implementation of Technical Standards and Criteria
- Section X - Plan Review Adoption and Updating Procedures

PLATES:

- \* a base map showing the watershed delineation and political subdivisions, roadway network and the location as referenced to the county
- \* watershed subareas used for hydrologic analysis (including release rate percentage table, if applicable)
- \* stream obstructions, flooding and drainage problem areas, and streams for which 100-year floodplain information is available
- \* areas where storm sewer networks exist (if available)
- \* additional information as determined by the County

### TABLES:

- \* runoff characteristics of the watershed
- \* rainfall values for various frequency durations
- \* peak flow values at points of interest for mean annual, 5-, 10-, 25-, 50-, and 100-year storm events for various durations and for present & future conditions
- \* results of the flood damage analysis (if available)
- \* subareas and corresponding release rate percent, if applicable

### APPENDICES:

- \* a list (or table) of all obstructions, including their locations, sizes, calculated capacities and any particular information which may seem helpful to the use of the plan
- \* recommended design storm
- \* any special information concerning detention/retention basins

All backup material including hydrologic and hydraulic analyses of the watershed will be retained at the COUNTY office for future use during the future plan update or any other reference.

### Project Team Responsibilities

- \* COUNTY - To provide a support role for the preparation of text material associated with those sections, or aspects of the work program (i.e., Tasks 1 through 9). Also responsible for the preparation of project maps for presentation in the final PLAN document. Finally, responsible for the overall review and approval of the preparation of the PLAN documents, with the identification of
- \* revisions/modifications to be addressed by the Consultant.
- \* Consultant - responsible for the coordination and preparation of the overall report for the Phase II project. Also responsible for the preparation of the technical results, tables and charts for presentation in the final PLAN document.

### Anticipated Task Product

The product of this task will be the final watershed PLAN. The final PLAN will be prepared in two parts: Volume I - Executive Summary and Volume II - a document containing the full text and descriptions of the various PLAN contents as described above.

## Task 11 - Priorities for Implementation, PLAN Update, PLAN Adoption

### Priorities for Implementation

The consultant will summarize the conclusions and recommendations of the PLAN. Recommended actions will be listed according to agency, municipality or individual responsible for each action. Priority of recommended actions will be based on chronological order, importance, hydrologic significance or other factors as may be appropriate.

### Plan Update

As a part of the implementation strategy for the PLAN, specific steps and/or procedures will be established for pursuing and completing the necessary updates of the PLAN as required by Act 167. Specific circumstances will be identified and described in the PLAN document that will "trigger" a decision to update. For example, land development circumstances (such as major changes in the type and/or amount of proposed land development, and certainly in excess of that which was assumed for the preparation of the original PLAN) will be identified as reasons for pursuing an update of the PLAN prior to the required 5-year time frame identified in Act 167.

### Plan Adoption

The COUNTY will transmit the completed PLAN to the official planning agency and governing body of each involved municipality, each member of the WPAC and the DEPARTMENT by official correspondence. The involved municipalities, WPAC and DEPARTMENT will then review the PLAN. Their review will include an evaluation of the PLAN's consistency with other plans and programs affecting the watershed. The reviews and comments will be submitted to the COUNTY by official correspondence. The review comments will be received, tabulated, and addressed appropriately and the PLAN will be revised accordingly.

Prior to PLAN adoption, meetings will be held with each municipality individually as identified in WPAC meetings and municipal training schedule under Task 2; to identify specific ordinance changes and method(s) of incorporation of the standards and criteria into the municipalities' existing framework. In addition, the meeting(s) can also serve to provide clarification of any remaining questions or concerns that the municipality may have concerning the implementation of the PLAN for any municipality.

The COUNTY will hold a public hearing concerning the PLAN. A notice for the public hearing will be published at least two weeks before the hearing date. The public hearing notice will contain a brief summary of the principal provisions of the PLAN and a reference to the places within each affected municipality where copies of the PLAN may be examined or purchased at cost. The comments received at the public hearing will be reviewed by the COUNTY and appropriate modifications in the PLAN will be made if applicable.

The PLAN will be voted on as a resolution by the County governing body for the purpose of adoption. The resolution must be carried by an affirmative vote of at least a majority of the members of the governing body, and should refer expressly to the maps, charts, textual matter and other materials intended to comprise the PLAN. This action will then be recorded on the adopted PLAN.

The County will then submit to the DEPARTMENT a letter of transmittal and three copies each of the adopted PLAN, the review by the official planning agency and governing body of each municipality, County Planning Commission, regional planning agencies (Section 6(c) of Act 167), public hearing notice and minutes (Section 8(a) of Act 167), and the resolution of adoption of the PLAN by the COUNTY (Section 8(b) of Act 167). The letter of transmittal will state that the COUNTY has complied with all procedures outlined in Act 167 and will request that the DEPARTMENT approve the adopted PLAN.

#### Project Team Responsibilities

- \* COUNTY - primary responsibility for the adoption activities described above, and will also assist the consultant concerning establishment of priorities for implementation of actions identified in the PLAN and update schedule.
- \* Consultant - responsible for providing support and guidance to COUNTY during the PLAN adoption process and will establish priorities for implementation of actions identified in the PLAN and set update schedule with the help of COUNTY.

#### Anticipated Task Product

The product of this task will include the official documentation regarding PLAN adoption and implementation process, including the necessary documentation from the COUNTY certifying the adoption of the PLAN, an adopted PLAN and priorities schedule as well as update schedule.

### **V. LEVEL OF EFFORT AND COST ESTIMATE**

The previous 11 work steps were further broken down into subtasks to analyze the required level of effort, both by the County and the consultant to complete each work step. The estimated staff-time for each project team member for each task are presented in this section.

The cost estimates presented in Tables 5 and 6 reflect the specific work step descriptions presented in Section IV, including the use of the particular procedures and methodologies that are presented. The cost estimates include line items for reimbursement of consultants and staff of the municipalities and other Counties for work performed in assisting completion of Tasks 1, 3, 6, 8 and 11.

COUNTY SERVICES FOR COCALICO CREEK WATERSHED PLAN  
Complete Project in House

| Task        | Description        | County Engineer |      | Project Engineer |       | Technician |       | GIS/Drafting |       | Clerical |      | County Solicitor |      | Planning Commission |      | TOTALS |        |
|-------------|--------------------|-----------------|------|------------------|-------|------------|-------|--------------|-------|----------|------|------------------|------|---------------------|------|--------|--------|
|             |                    | hours           | cost | hours            | cost  | hours      | cost  | hours        | cost  | hours    | cost | hours            | cost | hours               | cost | hours  | cost   |
| 1.          | Proj. Initiation   | 10              | 600  | 60               | 2400  | 10         | 300   | 0            | 0     | 30       | 600  | 10               | 800  | 20                  | 600  | 140    | 5300   |
| 1.2         | County Reimb.      | 0               | 0    | 5                | 200   | 0          | 0     | 0            | 0     | 5        | 100  | 0                | 0    | 5                   | 150  | 15     | 450    |
| 2.          | Project Coord.     | 10              | 600  | 80               | 3200  | 20         | 600   | 40           | 1200  | 40       | 800  | 2                | 160  | 20                  | 600  | 212    | 7160   |
| 3.          | Data Collection    | 4               | 240  | 180              | 7200  | 140        | 4200  | 80           | 2400  | 20       | 400  | 0                | 0    | 20                  | 600  | 444    | 15040  |
| 3.1         | Munic. Reimb.      | 0               | 0    | 10               | 400   | 5          | 150   | 0            | 0     | 5        | 100  | 0                | 0    | 0                   | 0    | 20     | 650    |
| 4.          | Data Prep(Inst)    | 2               | 120  | 40               | 1600  | 40         | 1200  | 0            | 0     | 20       | 400  | 0                | 0    | 10                  | 300  | 112    | 3620   |
| 5.          | Data Prep(Tech)    | 4               | 240  | 100              | 4000  | 110        | 3300  | 100          | 3000  | 20       | 400  | 0                | 0    | 10                  | 300  | 344    | 11240  |
| 6.          | Model Set-Up       | 8               | 480  | 120              | 4800  | 110        | 3300  | 60           | 1800  | 20       | 400  | 0                | 0    | 0                   | 0    | 318    | 10780  |
| 6.1         | Munic. Reimb.      | 0               | 0    | 10               | 400   | 0          | 0     | 0            | 0     | 0        | 0    | 0                | 0    | 0                   | 0    | 10     | 400    |
| 7.          | Model Runs         | 8               | 480  | 80               | 3200  | 160        | 4800  | 40           | 1200  | 0        | 0    | 0                | 0    | 0                   | 0    | 288    | 9680   |
| 7.3         | Calibrate/Conestog | 0               | 0    | 30               | 1200  | 30         | 900   | 15           | 450   | 0        | 0    | 0                | 0    | 0                   | 0    | 75     | 2550   |
| 8.          | Tech Standards     | 16              | 960  | 60               | 2400  | 40         | 1200  | 0            | 0     | 40       | 800  | 4                | 320  | 10                  | 300  | 170    | 5980   |
| 8.1         | Munic. Reimb.      | 0               | 0    | 10               | 400   | 5          | 150   | 0            | 0     | 5        | 100  | 0                | 0    | 0                   | 0    | 20     | 650    |
| 9.          | Review Wrdocs.     | 8               | 480  | 60               | 2400  | 60         | 1800  | 0            | 0     | 20       | 400  | 4                | 320  | 20                  | 600  | 172    | 6000   |
| 10.         | Prepare Report     | 8               | 480  | 120              | 4800  | 60         | 1800  | 120          | 3600  | 80       | 1600 | 0                | 0    | 20                  | 600  | 408    | 12880  |
| 11.         | Plan Implement     | 24              | 1440 | 100              | 4000  | 100        | 3000  | 0            | 0     | 40       | 800  | 16               | 1280 | 40                  | 1200 | 320    | 11720  |
| 11.2        | County Reimb.      | 0               | 0    | 10               | 400   | 0          | 0     | 0            | 0     | 5        | 100  | 0                | 0    | 10                  | 300  | 25     | 800    |
| TOTAL HOURS |                    | 192             |      | 1075             |       | 890        |       | 455          |       | 350      |      | 36               |      | 185                 |      | 3093   |        |
| TOTAL COST  |                    |                 | 6120 |                  | 43000 |            | 26700 |              | 13650 |          | 7000 |                  | 2880 |                     | 5550 |        | 104900 |

TABLE 5 COUNTY SERVICES

CONSULTANT SERVICES FOR THE COCALICO CREEK WATERSHED PLAN  
Complete Project Using Consultant and County

| Task        | Description        | Principal |      | Senior Engineer |       | Technician |       | GIS/<br>Drafting |       | Clerical |      | TOTALS |        |
|-------------|--------------------|-----------|------|-----------------|-------|------------|-------|------------------|-------|----------|------|--------|--------|
|             |                    | hours     | cost | hours           | cost  | hours      | cost  | hours            | cost  | hours    | cost | hours  | cost   |
| 1.          | Proj. Initiation   | 2         | 200  | 40              | 2800  | 10         | 400   | 0                | 0     | 20       | 400  | 72     | 3800   |
| 2.          | Project Coord.     | 1         | 100  | 70              | 4900  | 20         | 800   | 40               | 2000  | 40       | 800  | 171    | 8600   |
| 3.          | Data Collection    | 1         | 100  | 70              | 4900  | 140        | 5600  | 60               | 3000  | 20       | 400  | 291    | 14000  |
| 3.1         | Munic. Reimb.      | 0         | 0    | 7               | 490   | 5          | 200   | 0                | 0     | 5        | 100  | 17     | 790    |
| 4.          | Data Prep(Inst)    | 2         | 200  | 40              | 2800  | 10         | 400   | 0                | 0     | 40       | 800  | 92     | 4200   |
| 5.          | Data Prep(Tech)    | 2         | 200  | 60              | 4200  | 120        | 4800  | 120              | 6000  | 20       | 400  | 322    | 15600  |
| 6.          | Model Set-Up       | 1         | 100  | 30              | 2100  | 80         | 3200  | 40               | 2000  | 10       | 200  | 161    | 7600   |
| 6.1         | Munic. Reimb.      | 0         | 0    | 7               | 490   | 0          | 0     | 0                | 0     | 0        | 0    | 7      | 490    |
| 7.          | Model Runs         | 1         | 100  | 100             | 7000  | 200        | 8000  | 40               | 2000  | 0        | 0    | 341    | 17100  |
| 7.3         | Calibrate/Conestog | 0         | 0    | 30              | 2100  | 30         | 1200  | 15               | 750   | 0        | 0    | 75     | 4050   |
| 8.          | Tech Standards     | 4         | 400  | 80              | 5600  | 40         | 1600  | 10               | 500   | 30       | 600  | 164    | 8700   |
| 8.1         | Munic. Reimb.      | 0         | 0    | 7               | 490   | 5          | 200   | 0                | 0     | 5        | 100  | 17     | 790    |
| 9.          | Review Ordncs.     | 1         | 100  | 30              | 2100  | 20         | 800   | 0                | 0     | 20       | 400  | 71     | 3400   |
| 10.         | Prepare Report     | 4         | 400  | 140             | 9800  | 40         | 1600  | 140              | 7000  | 100      | 2000 | 424    | 20800  |
| 11.         | Plan Implement     | 4         | 400  | 40              | 2800  | 20         | 800   | 0                | 0     | 40       | 800  | 104    | 4800   |
| TOTAL HOURS |                    | 23        |      | 751             |       | 740        |       | 465              |       | 350      |      | 2529   |        |
| TOTAL COST  |                    |           | 2300 |                 | 52570 |            | 29600 |                  | 23250 |          | 7000 |        | 114720 |

TABLE 6a - CONSULTANT SERVICES

COUNTY SERVICES FOR COCALICO CREEK WATERSHED PLAN  
Complete Project Using Consultant and County

|             |                  | County Engineer |      | Project Engineer |      | Clerical |      | County Solicitor |      | Planning Commission |      | TOTALS |       |
|-------------|------------------|-----------------|------|------------------|------|----------|------|------------------|------|---------------------|------|--------|-------|
| Rate:       |                  | 60 /hr          |      | 40 /hr           |      | 20 /hr   |      | 80 /hr           |      | 30 /hr              |      |        |       |
| Task        | Description      | hours           | cost | hours            | cost | hours    | cost | hours            | cost | hours               | cost | hours  | cost  |
| 1.          | Proj. Initiation | 8               | 480  | 16               | 640  | 10       | 200  | 6                | 480  | 10                  | 300  | 50     | 2100  |
| 1.2         | County Reimb.    | 0               | 0    | 5                | 200  | 5        | 100  | 0                | 0    | 5                   | 150  | 15     | 450   |
| 2.          | Project Coord.   | 8               | 480  | 16               | 640  | 10       | 200  | 2                | 160  | 10                  | 300  | 46     | 1780  |
| 3.          | Data Collection  | 4               | 240  | 16               | 640  | 10       | 200  | 0                | 0    | 20                  | 600  | 50     | 1680  |
| 4.          | Data Prep(inst)  | 1               | 60   | 16               | 640  | 10       | 200  | 0                | 0    | 10                  | 300  | 37     | 1200  |
| 5.          | Data Prep(lech)  | 1               | 60   | 8                | 320  | 10       | 200  | 0                | 0    | 10                  | 300  | 29     | 880   |
| 6.          | Model Set-Up     | 2               | 120  | 4                | 160  | 10       | 200  | 0                | 0    | 0                   | 0    | 16     | 480   |
| 7.          | Model Runs       | 2               | 120  | 4                | 160  | 0        | 0    | 0                | 0    | 0                   | 0    | 6      | 280   |
| 8.          | lech Standards   | 10              | 600  | 8                | 320  | 15       | 300  | 4                | 320  | 10                  | 300  | 47     | 1840  |
| 9.          | Review Ordncs.   | 4               | 240  | 16               | 640  | 10       | 200  | 4                | 320  | 20                  | 600  | 54     | 2000  |
| 10.         | Prepare Report   | 8               | 480  | 16               | 640  | 20       | 400  | 0                | 0    | 20                  | 600  | 64     | 2120  |
| 11.         | Plan implement   | 8               | 480  | 32               | 1280 | 15       | 300  | 16               | 1280 | 40                  | 1200 | 111    | 4540  |
| 11.2        | County Reimb.    | 0               | 0    | 10               | 400  | 5        | 100  | 0                | 0    | 10                  | 300  | 25     | 800   |
| TOTAL HOURS |                  | 56              |      | 167              |      | 130      |      | 32               |      | 165                 |      | 550    |       |
| TOTAL COST  |                  |                 | 3360 |                  | 6680 |          | 2600 |                  | 2560 |                     | 4950 |        | 20150 |

TABLE 66 - COUNTY SERVICES IN SUPPORT OF CONSULTANT

Cost Estimate Summary

A summary of the estimated cost to complete the Cocalico Creek Storm Water Management Plan is as follows. A breakdown of the Direct Costs is shown in Appendix B.

ALL WORK BY COUNTY

| <u>Participant</u> | <u>Number Hours</u> | <u>Labor Cost</u> | <u>Direct Cost</u> | <u>Total Cost</u> |
|--------------------|---------------------|-------------------|--------------------|-------------------|
| County             | 3093                | \$104900          | \$ 40729           | \$145629          |
| Consultant         | <u>N/A</u>          | <u>N/A</u>        | <u>N/A</u>         | <u>N/A</u>        |
| <b>TOTAL</b>       | <b>\$ 3093</b>      | <b>\$104900</b>   | <b>\$ 40729</b>    | <b>\$145629</b>   |

or:

WORK BY COUNTY AND CONSULTANT

| <u>Participant</u> | <u>Number Hours</u> | <u>Labor Cost</u> | <u>Direct Cost</u> | <u>Total Cost</u> |
|--------------------|---------------------|-------------------|--------------------|-------------------|
| County             | 550                 | \$ 20150          | \$ 8997            | \$ 29147          |
| Consultant         | <u>2329</u>         | <u>114720</u>     | <u>8914</u>        | <u>123634</u>     |
| <b>TOTAL</b>       | <b>\$ 2879</b>      | <b>\$134870</b>   | <b>\$ 17911</b>    | <b>\$152781</b>   |

The County and consultant will provide services for all the work tasks at a level of staff time involvement consistent with Tables 5 or 6. Tables 5 and 6 list the breakdown of the estimated level of effort for the work program described herein, based on and including the items identified in the task descriptions.

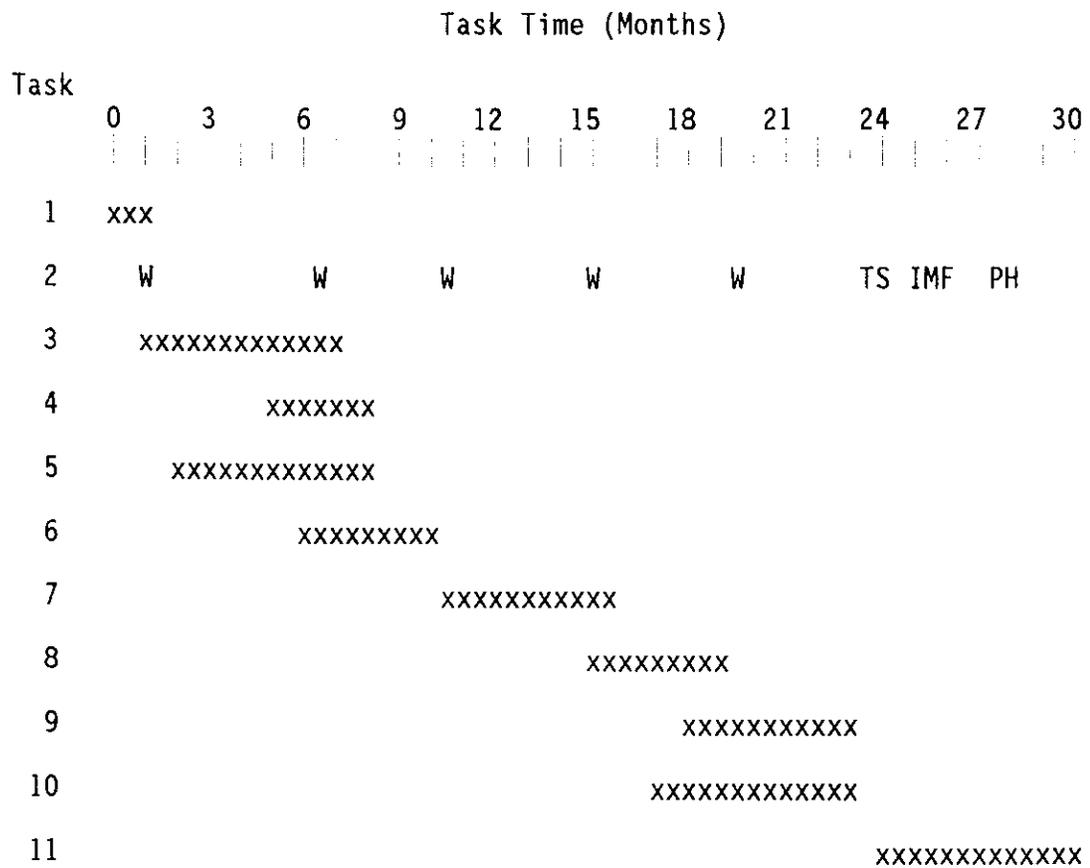
Included in the estimated Direct Cost of the Cocalico Creek Watershed Plan, where Lancaster County is to perform all required work, is the cost of Geographic Information System (GIS) hardware and software necessary to complete the work (see Appendix B, page 45). The GIS cost assigned to the Cocalico Creek watershed is prorated based on distributing the total GIS cost among the Cocalico Creek, Little Conestoga Creek, Mill Creek and Conestoga River Watershed Plans.

**VI. PROPOSED PLAN DEVELOPMENT SCHEDULE**

A schedule has been developed for completing the work program described herein. It is felt that the developed time frame for this project is sufficient for all the necessary contacts and follow-up correspondence, for each of the municipalities and for the applicable tasks.

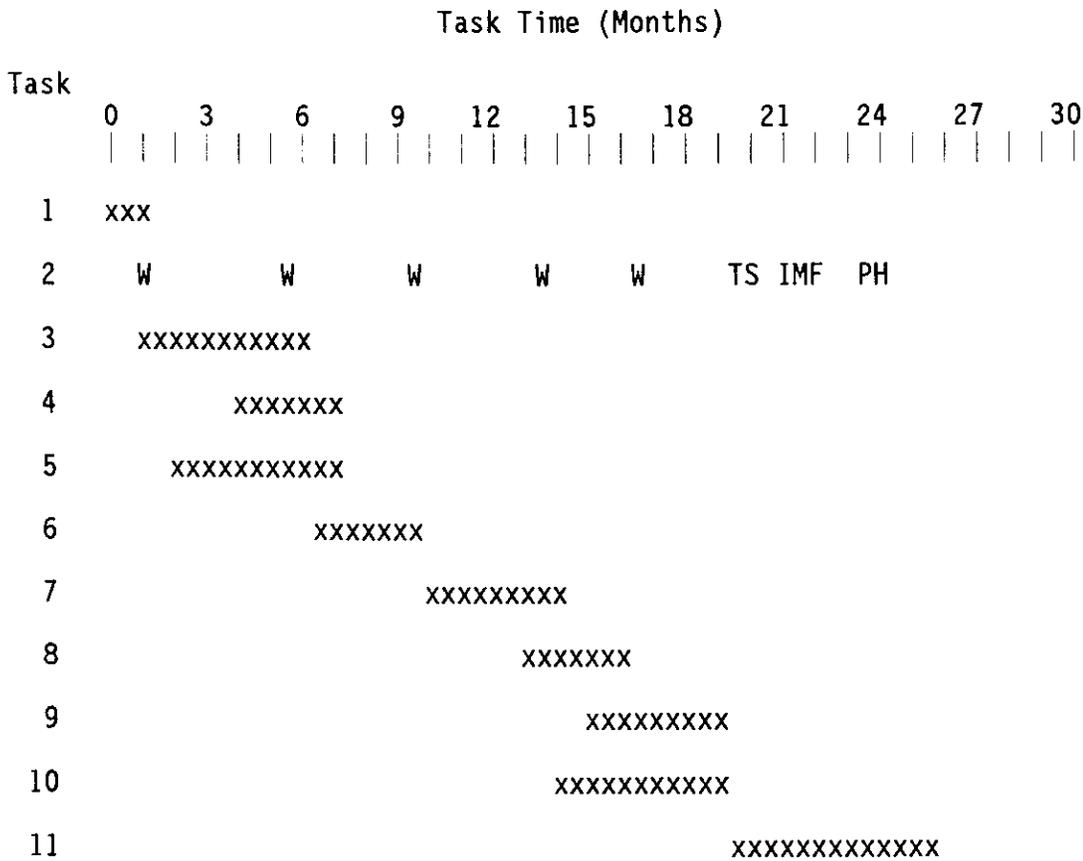
The proposed work schedule follows in Figures 2a and 2b.

**FIGURE 2a-PHASE II WORK SCHEDULE**  
**ALL WORK BY COUNTY**



W -Watershed Plan Advisory Committee Meeting  
 TS -Training Sessions  
 IMF -Individual Municipal Follow-up Meetings  
 PH -Public Hearing

**FIGURE 2b-PHASE II WORK SCHEDULE  
WORK BY COUNTY AND CONSULTANT**



W -Watershed Plan Advisory Committee Meeting  
 TS -Training Sessions  
 IMF -Individual Municipal Follow-up Meetings  
 PH -Public Hearing

## VII. LANCASTER COUNTY ENGINEERING CAPABILITIES

This Act 167 Phase I Scope of Study Storm Water Management Plan was prepared by the Lancaster County Engineer for the Lancaster County Commissioners. The County Engineer's Office is actively involved in storm water management planning for Lancaster County through enforcement of the storm water management sections of the Lancaster County Subdivision and Land Development Ordinance. The storm water management sections of the ordinance were written by David McCudden, P. E., the current County Engineer. The Engineer's Office is also directly involved in the maintenance of the County Bridge System and is familiar with the stream system in Lancaster County. We also have direct involvement with the municipal officials affected by this plan.

The Engineer's Office has been active in the Act 167 program for several years in an effort to implement the requirements of the Act. We have conducted and participated in seminars on Act 167 with the purpose of educating the public, generating support and developing sources of funding for the watershed plans in Lancaster County.

The Engineer's Office has HEC 1, HEC 2, PSRM, HY8, TR20 and other computer programs available for design and analysis of storm water management systems. Lancaster County has a Geographic Information System (GIS) that will be available for use in the Act 167 watershed planning process. Further improvements to the GIS are anticipated to facilitate the implementation of the Phase II Watershed Plans if the work is done exclusively by the County.

This Phase I Scope of Study was developed by the following persons in the Lancaster County Engineer's Office:

David T. McCudden, P.E., Lancaster County Engineer

Associate Degree in Drafting & Design Technology, Pennsylvania State University, 1969.

Bachelor of Science Degree in Water Resources Engineering, Pennsylvania State University, 1971.

Continuing Education Courses in the following: Urban Hydrology and Hydraulics, Flood Plain Hydrology (HEC-1), Flood Plain Hydraulics (HEC-2), and various seminar on storm water management techniques, applications and computer modeling.

Professional Civil Engineer in the State of Pennsylvania since 1976.

Seven years of experience as the Assistant County Engineer for the County of Lancaster, responsible for the review and implementation of County's storm water management ordinance requirements.

Thirteen years of professional experience in the administration and management of a wide range of engineering projects for more than 20 municipalities and/ or Counties.

John M. Vengrin, E.I.T., Assistant County Engineer

Bachelor of Science Civil Engineering, Pennsylvania State University, 1979

Experienced in the design of storm water management facilities, currently performing the storm water management plan reviews for the Lancaster County Planning Commission. Experienced with current storm water management technology including HEC 1 Hydrograph Program, HEC 2 Hydraulics Program, TR 20 Routing Program, HY8 Culvert Program and the Penn State Runoff Model. Attended Computational Methods in Storm Water Management Seminar and HEC 2 Hydraulics Seminar at Penn State.

6 years of professional experience preparing plans, technical specifications and contract documents for construction and rehabilitation of sewers and water facilities.

Robert Navitski, P. E., Assistant County Engineer

Bachelor of Science Degree in Civil Engineering, University of Pennsylvania, 1972.

Professional Engineer since 1981.

Duties as Assistant County Engineer include supervision of major construction project, performing County bridge inspections and supervising bridge repair program and performing storm water management plan reviews for the Lancaster County Planning Commission.

16 years of professional experience preparing plans, technical specifications and contract documents and providing construction inspection/administration for construction and rehabilitation of sewers, site structures, bridges and commercial and industrial structures.

John Fasano, Engineering Technician

Currently enrolled in Bachelor of Science Degree program in Civil Engineering, Lehigh University, 3 years of studies completed.

His educational background has provided John with the engineering skills and experience necessary to serve as a technician. Experience performing data collection and technical data preparation. Experience with engineering computer programs and a variety of other general computer programs.

John Fix, County Planner, Lancaster County Planning Commission

Bachelor of Science Degree in Geoenvironmental Studies, Shippensburg University, 1988.

4 years experience coordinating the development and application of the County's Geographic Information System (GIS) utilizing PC Arc/Info software. Responsible for overseeing data entry, data analysis and map composition. Experience with geographic information systems, database management, graphical and statistical analysis on a variety of computer programs.

R. Todd Martin, Planning Technician, Lancaster County Planning Commission

Bachelor of Science Degree in Geography, Pennsylvania State University, 1987.

Provide technical and research support for professional staff. Prepare maps and other graphics in support of Planning Commission projects. Perform data entry, digitizing data, map composition and generation for the County's GIS utilizing PC Arc/Info software.

Jonell Walker, Director, Records Management

Bachelor of Arts Degree in English, Franklin and Marshall College, 1984.

Five years experience with information management and data analysis. Familiar with a variety of computer software for database management, statistical analysis and office management. Experience developing records management applications including reviewing computerized solutions to records management problems.

APPENDIX A

\_\_\_\_\_ Creek Watershed  
Act 167 - Phase I  
Municipalities Questionnaire

Please fill out the following questionnaire. If you have any questions or comments please contact the Lancaster County Engineer's Office at 717-299-8323. Return the completed form to:

Lancaster County Engineer's Office  
Lancaster County Courthouse  
50 North Duke Street  
PO Box 3480  
Lancaster, PA 17603-1881

\_\_\_\_\_  
(Name of Municipality)

\*Person completing this form:

Name \_\_\_\_\_  
Address \_\_\_\_\_  
\_\_\_\_\_  
Phone \_\_\_\_\_  
\_\_\_\_\_

GENERAL INFORMATION

These are the types of storm water related problems that may occur in your community. Please indicate the degree of severity of each of the problems.

Stream Flooding

\_\_\_\_\_ critical \_\_\_\_\_ occasional \_\_\_\_\_ no problem

Street Flooding

\_\_\_\_\_ critical \_\_\_\_\_ occasional \_\_\_\_\_ no problem

Soil Erosion and Sedimentation

\_\_\_\_\_ critical \_\_\_\_\_ occasional \_\_\_\_\_ no problem

Storm Water Pollution

\_\_\_\_\_ critical \_\_\_\_\_ occasional \_\_\_\_\_ no problem

Other (please specify)

\_\_\_\_\_ critical \_\_\_\_\_ occasional \_\_\_\_\_ no problem

\* Do you have ordinances or regulations to address the following?

Storm Water Management            Yes\_\_\_ No\_\_\_  
Drainage                                Yes\_\_\_ No\_\_\_  
Erosion and Sediment Control    Yes\_\_\_ No\_\_\_

\* Where are the above regulations/ordinances contained?

\_\_\_ Separate Ordinances  
\_\_\_ Subdivision/Land Development Ordinance  
\_\_\_ Building Code

\* Would you provide involvement and support the development of a storm water plan, including the Watershed Advisory Committee and attend meetings in a convenient location?

\_\_\_ Yes  
\_\_\_ No

SPECIFIC STORM WATER PROBLEM AREAS  
\_\_\_\_\_ CREEK WATERSHED

\* Please list three specific storm water problem areas by number. Locate these areas on the attached map by marking the number at the problem area. If the area affected is extensive, use a highlighter to show the extent of the problem area:

1. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
3. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

AREA  
(Identified Above)

| 1 | 2 | 3 |
|---|---|---|
|---|---|---|

Causes

Please check off the causes of the storm water problems specified above?

- \* Too large an increase in uncontrolled runoff.
- \* Uncontrolled runoff into your municipality from upstream municipalities
- \* Drainage system is too small, and corrections need to be made.
- \* Obstructions in system that need to be removed.
- \* Lack of maintenance of drainage ways.
- \* Other. Explain.

Occurrences

How often do the specific storm water problems identified above occur?

- \* Every rain.
- \* More than 10 times per year.
- \* More than 1 time per year.
- \* Only during major flood events.

Damages

What type of damages do you experience with the specific problems identified above?

- \* Loss of life.
- \* Loss of vital services.
- \* Private property damage.
- \* Public property damage
- \* Other property damage (specify).
- \* Number of properties affected.



**APPENDIX B**  
**BREAKDOWN OF EXPENSES SUPPLEMENTAL TO TABLE 5**  
**ALL WORK BY COUNTY**  
**COCALICO CREEK WATERSHED**

1. PLAN COPIES

Number of Plan Reports

|    |                                          |          |
|----|------------------------------------------|----------|
| 19 | Municipalities @ 2 Each                  | 38       |
| 3  | Counties - Commissioners @ 3 Each        | 9        |
| 3  | Planning Commissions @ 3 Each            | 9        |
| 1  | DEPARTMENT @ 5 each                      | 5        |
| 3  | Soil Conservation Districts @ 2 Each     | 6        |
|    | Storm Water Consultant/Engineer's Office | 3        |
| 8  | Public Groups in WPAC @ 2 each           | 16       |
|    | Media                                    | 4        |
|    | Federal/State Officials/Agencies         | 6        |
|    | Others/Public Distribution               | <u>6</u> |
|    | Total Plan Reports                       | 102      |

Printing

|     |                                |            |
|-----|--------------------------------|------------|
| 102 | Draft Plans @ \$10.00/copy     | \$1020     |
| 102 | Final Plans @ \$40.00/copy     | 4080       |
| 102 | Draft Summaries @ \$5.00/copy  | 510        |
| 102 | Final Summaries @ \$10.00/copy | 1020       |
|     | Ordinances (Included in Plans) | <u>---</u> |
|     | Total Printing                 | \$6630     |

Postage

|     |                                        |               |
|-----|----------------------------------------|---------------|
| 102 | Draft Plans and Summaries @ \$3.00 ea. | \$ 306        |
| 102 | Final Plans and Summaries @ \$4.00 ea. | \$ 408        |
|     | Ordinances (Included in Plans)         | <u>---</u>    |
|     | Total Postage                          | <u>\$ 714</u> |

TOTAL PRINTING AND POSTAGE \$ 7344

2. GENERAL ADMINISTRATION

|   |                                                                    |         |
|---|--------------------------------------------------------------------|---------|
| * | Program/Financial Management: 130 hrs. @ \$40/hr.<br>(1 hrs./week) | \$ 5200 |
| * | Progress Reports: 60 hrs. @ \$40/hr.<br>(2 hrs./month)             | 2400    |

|                                                 |            |
|-------------------------------------------------|------------|
| * Invoices: 30 hrs. @ \$40/hr.<br>(1 hr./month) | 1200       |
| * Office Supplies                               | 400        |
| * Travel: 1000 miles @ \$0.265/mile             | 265        |
| * Legal Advertising: 4 Ads @ \$250/ad           | 1000       |
| * WPAC Meetings (Included in Table 5)           | ---        |
| * Audit: 8 hours @ \$40/hr.                     | <u>320</u> |
| TOTAL GENERAL ADMINISTRATION                    | \$10785    |

3. COMPUTER HARDWARE & SOFTWARE

|                                                                                                                                                                                                                                                                                       |             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| * Geographic Information System (GIS) Equipment and Software: 27% of \$80,000 (County cost to be amortized during development Cocalico Creek, Little Conestoga Creek, Mill Creek and Conestoga River Watershed Plans. 27% represents share attributable to Cocalico Creek watershed.) | \$ 21600    |
| * Additional Software                                                                                                                                                                                                                                                                 | <u>1000</u> |
| TOTAL COMPUTER HARDWARE & SOFTWARE                                                                                                                                                                                                                                                    | \$ 22600    |

TOTAL SUPPLEMENTAL EXPENSES (ALL WORK BY COUNTY) COCALICO CREEK WATERSHED

|                              |                 |
|------------------------------|-----------------|
| PRINTING AND POSTAGE         | \$ 7344         |
| GENERAL ADMINISTRATION       | \$ 10785        |
| COMPUTER HARDWARE & SOFTWARE | <u>\$ 22600</u> |
| TOTAL SUPPLEMENTAL EXPENSES  | \$ 40729        |

APPENDIX B (Continued)  
BREAKDOWN OF EXPENSES SUPPLEMENTAL TO TABLE 6  
WORK BY COUNTY AND CONSULTANT  
COCALICO CREEK WATERSHED

1. PLAN COPIES

Number of Plan Reports

|    |                                          |          |
|----|------------------------------------------|----------|
| 19 | Municipalities @ 2 Each                  | 38       |
| 3  | Counties - Commissioners @ 3 Each        | 9        |
| 3  | Planning Commissions @ 3 Each            | 9        |
| 1  | DEPARTMENT @ 5 each                      | 5        |
| 3  | Soil Conservation Districts @ 2 Each     | 6        |
|    | Storm Water Consultant/Engineer's Office | 3        |
| 8  | Public Groups in WPAC @ 2 each           | 16       |
|    | Media                                    | 4        |
|    | Federal/State Officials/Agencies         | 6        |
|    | Others/Public Distribution               | <u>6</u> |
|    | Total Plan Reports                       | 102      |

Printing

|     |                                |            |
|-----|--------------------------------|------------|
| 102 | Draft Plans @ \$10.00/copy     | \$1020     |
| 102 | Final Plans @ \$40.00/copy     | 4080       |
| 102 | Draft Summaries @ \$5.00/copy  | 510        |
| 102 | Final Summaries @ \$10.00/copy | 1020       |
|     | Ordinances (Included in Plans) | <u>---</u> |
|     | Total Printing                 | \$6630     |

Postage

|     |                                        |               |
|-----|----------------------------------------|---------------|
| 102 | Draft Plans and Summaries @ \$3.00 ea. | \$ 306        |
| 102 | Final Plans and Summaries @ \$4.00 ea. | \$ 408        |
|     | Ordinances (Included in Plans)         | <u>---</u>    |
|     | Total Postage                          | <u>\$ 714</u> |

TOTAL PRINTING AND POSTAGE \$ 7344

2. GENERAL ADMINISTRATION (COUNTY)

|   |                                                                    |         |
|---|--------------------------------------------------------------------|---------|
| * | Program/Financial Management: 112 hrs. @ \$40/hr.<br>(1 hrs./week) | \$ 4480 |
| * | Progress Reports: 52 hrs. @ \$40/hr.<br>(2 hrs./month)             | 2080    |

|                                                |            |
|------------------------------------------------|------------|
| * Invoices: 26hrs. @ \$40/hr.<br>(1 hr./month) | 1040       |
| * Office Supplies                              | 50         |
| * Travel: 100 miles @ \$0.265/mile             | 27         |
| * Legal Advertising: 4 Ads @ \$250/ad          | 1000       |
| * WPAC Meetings (Included in Table 6)          | ---        |
| * Audit: 8 hours @ \$40/hr.                    | <u>320</u> |
| TOTAL GENERAL ADMINISTRATION                   | \$ 8997    |

3. GENERAL ADMINISTRATION (CONSULTANT)

|                                                  |            |
|--------------------------------------------------|------------|
| * Travel: 1000 miles @ \$0.27/mile               | \$ 270     |
| * Mylars and Prints                              | 500        |
| * Postage and Telephone                          | 300        |
| * Photocopying: 10000 misc. copies @ \$0.05 each | <u>500</u> |
| TOTAL GENERAL ADMINISTRATION (CONSULTANT)        | \$ 1570    |

TOTAL SUPPLEMENTAL EXPENSES (WORK BY COUNTY AND CONSULTANT)  
COCALICO CREEK WATERSHED

|                                     |                |
|-------------------------------------|----------------|
| PRINTING AND POSTAGE                | \$ 7344        |
| GENERAL ADMINISTRATION (COUNTY)     | \$ 8997        |
| GENERAL ADMINISTRATION (CONSULTANT) | <u>\$ 1570</u> |
| TOTAL SUPPLEMENTAL EXPENSES         | \$ 17911       |

**APPENDIX B (Continued)**  
**TASK COST BREAKDOWN**  
**ALL WORK BY COUNTY**

|                                                                         |                      |
|-------------------------------------------------------------------------|----------------------|
| Task No. 1 - Project Initiation                                         | \$ 5750              |
| Task No. 2 - Project Coordination                                       | 7160                 |
| Task No. 3 - Data Collection/Review/Analysis                            | 15690                |
| Task No. 4 - Institutional Data Preparation                             | 3620                 |
| Task No. 5 - Data Preparation for Technical Analysis                    | 11240                |
| Task No. 6 - Model Selection and Set Up                                 | 11180                |
| Task No. 7 - Model Runs                                                 | 12230                |
| Task No. 8 - Develop Technical Standards & Criteria                     | 6630                 |
| Task No. 9 - Institutional Analysis                                     | 6000                 |
| Task No. 10 - PLAN Report Preparation                                   | 12880                |
| Task No. 11 - Implementation, PLAN Update and Adoption                  | 12520                |
| <br>TOTAL TASKS 1-11                                                    | <br>\$ 104900        |
| <br>Project Direct Cost (See Appendix B)                                | <br>40729            |
| <br><b>GRAND TOTAL COCALICO CREEK WATERSHED</b><br>(ALL WORK BY COUNTY) | <br><b>\$ 145629</b> |
| <br>Maximum Department Share (75%)                                      | <br>\$ 109222        |
| Maximum County Share (25%)                                              | \$ 36407             |

Cost Breakdown for DEPARTMENT Fiscal Years:

|         | <u>Total</u> | <u>Dept. Share</u> | <u>COUNTY Share</u> |
|---------|--------------|--------------------|---------------------|
| FY91/92 | \$ 29126     | \$ 21844           | \$ 7282             |
| FY92/93 | \$ 58252     | \$ 43689           | \$ 14563            |
| FY93/94 | \$ 58251     | \$ 43689           | \$ 14562            |

APPENDIX B (Continued)  
TASK COST BREAKDOWN  
WORK BY COUNTY AND CONSULTANT

|                                                        |                      |
|--------------------------------------------------------|----------------------|
| Task No. 1 - Project Initiation                        | \$ 6350              |
| Task No. 2 - Project Coordination                      | 10380                |
| Task No. 3 - Data Collection/Review/Analysis           | 16470                |
| Task No. 4 - Institutional Data Preparation            | 5400                 |
| Task No. 5 - Data Preparation for Technical Analysis   | 16480                |
| Task No. 6 - Model Selection and Set Up                | 8570                 |
| Task No. 7 - Model Runs                                | 21430                |
| Task No. 8 - Develop Technical Standards & Criteria    | 11330                |
| Task No. 9 - Institutional Analysis                    | 5400                 |
| Task No. 10 - PLAN Report Preparation                  | 22920                |
| Task No. 11 - Implementation, PLAN Update and Adoption | 10140                |
| <br>TOTAL TASKS 1-11                                   | <br>\$ 134870        |
| <br>Project Direct Cost (See Appendix B)               | <br>17911            |
| <br><b>GRAND TOTAL COCALICO CREEK WATERSHED</b>        | <br><b>\$ 152781</b> |
| <b>(WORK BY COUNTY AND CONSULTANT)</b>                 |                      |
| <br>Maximum Department Share (75%)                     | <br>\$ 114586        |
| Maximum County Share (25%)                             | \$ 38195             |

Cost Breakdown for DEPARTMENT Fiscal Years:

|         | <u>Total</u> | <u>Dept. Share</u> | <u>COUNTY Share</u> |
|---------|--------------|--------------------|---------------------|
| FY91/92 | \$ 30556     | \$ 22917           | \$ 7639             |
| FY92/93 | \$ 61112     | \$ 45834           | \$ 15278            |
| FY93/94 | \$ 61113     | \$ 45835           | \$ 15278            |

**APPENDIX C**  
**BIBLIOGRAPHY**

1. "Sample Act 167 Storm Water Management Plan, Phase I Scope of Study", Pennsylvania Department of Environmental Resources.
2. " Storm Water Management Act", Act of October 4, 1978, P.L. 864 No. 167 Commonwealth of Pennsylvania, Office of Resources Management, Bureau of Dams and Waterways Management.
3. "Procedure PSU-IV for Estimating Design Flood Peaks On Ungaged Pennsylvania Watersheds", Dr. Gert Aron and Dr. David F. Kibler, Institute for Research on Land and Water Resources, The Pennsylvania State University, April 1981.
4. "Soil Survey of Lancaster County, Pennsylvania", United States Department of Agriculture, Soil Conservation Service, 1982.
5. "Scope of Study for the Brodhead Creek Watershed", R.K.R. Hess Associates, Inc., in conjunction with Monroe County, 1988.

