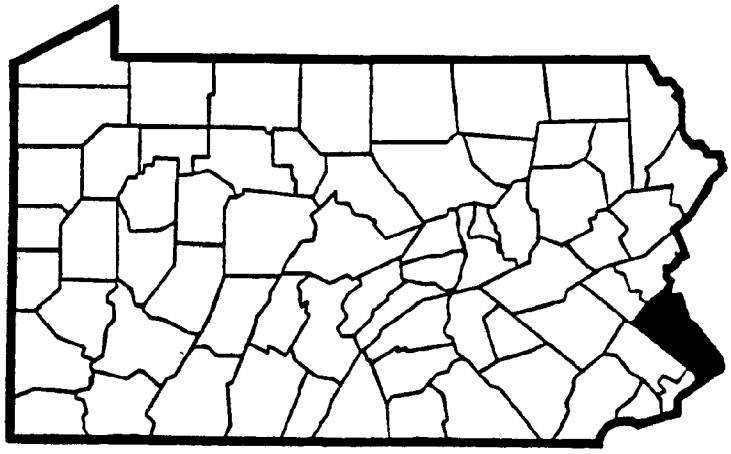
Neshaminy Creek Nonpoint Pollution and Wetlands Study

Volume 1—Study Report



September 1994

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Acknowledgments

Bucks County Conservation District
CZM Steering Committee of DVRPC
PaDER Coastal Zone Management Program
National Oceanic and Atmospheric Administration
Study Area Municipalities

Pennsylvania Coastal Zone Management Program

Neshaminy Creek Nonpoint Pollution and Wetlands Study

September 1994

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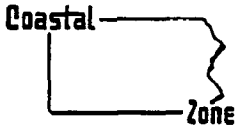
A REPORT OF THE PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES TO THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION PURSUANT TO NOAA AWARD NO. NA37070351



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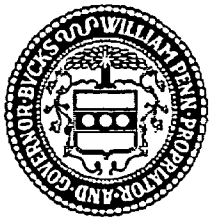

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ACRONYMS USED IN THE TEXT

BCPC	Bucks County Planning Commission
BMP	Best Management Practice
CCMP	Comprehensive Conservation and Management Plan of the Delaware Estuary Program
CWA	Clean Water Act
CZARA	Coastal Zone Act Reauthorization Amendment (1990)
CZM	Coastal Zone Management
DELEP	Delaware Estuary Program
DER	Pennsylvania Department of Environmental Resources
DVRPC	Delaware Valley Regional Planning Commission
EPA	United States Environmental Protection Agency
GAPC	Geographical Area of Particular Concern
GIS	Geographic Information System
NOAA	National Oceanic and Atmospheric Administration
NPS	Nonpoint Source
NWI	National Wetland Inventory
PaCZM	Pennsylvania Coastal Zone Management (a division of DER)
PNDI	Pennsylvania Natural Diversity Inventory
SCS	Soil Conservation Service (a division of the USDA)
USDA	United States Department of Agriculture
USGS	United States Geological Survey

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The Bucks County Planning Commission (BCPC) studied the effects of nonpoint pollution in the lower reaches of the Neshaminy Creek watershed on the Delaware Estuary. The study area is located along the lower-most portion of the Neshaminy Creek in Bucks County Pennsylvania and includes all or portions of Bensalem, Bristol, Lower Southampton, and Middletown townships and Hulmeville, Langhorne, Langhorne Manor, and Penndel boroughs. Although the study area is part of the most urbanized and densely developed portion of the county, numerous natural resources still remain. Most of the natural resource areas are associated with the Neshaminy Creek and the Delaware Estuary.

One aspect of the study focused on wetlands protection and pollutant mitigation. To create awareness of the value of wetlands to humans and wildlife and engender protection of the remaining wetlands in the lower reaches of the Neshaminy Creek watershed, an overlay corridor was recommended in the study. The corridor is centered on the Neshaminy Creek and extends one-half mile on each side of its banks. Everything falling within this corridor is considered high priority for protection and regulation. There are several recommended policies and activities for wetland protection and management set forth in the study. Examples include: minimizing the loss of wetlands by avoiding development projects that will alter or degrade wetlands; strengthening municipal zoning and land development ordinances; and increasing wetland acquisition for preservation and management.

Another aspect of the study focused on nonpoint source pollutant generation, characterization, and management. Because nonpoint source pollutants have no specific or consistent point of entry into waterways, controlling such pollution is difficult. In the Neshaminy Creek study area, the sources of nonpoint pollutants that most threaten the coastal area are marina/recreational boating sources and urban stormwater runoff from land uses such as residential, commercial, industrial, recreational, and government facilities. Specific pollutants commonly associated with urbanization include: sediment, nutrients, road salts, heavy metals, petroleum hydrocarbons, pathogenic bacteria, insecticides, and trash/litter debris. These pollutants are introduced into watercourses primarily in stormwater runoff from roadways, construction sites, existing development, and households.

The Delaware Estuary and the freshwater and tidal wetlands found along the Neshaminy Creek are pollution-sensitive and require protection to maintain their vitality and viability. Stormwater management options for water quality improvement, including Best Management Practices (BMPs), are recommended for municipal use in the study area. BMPs are designed to reduce

negative impacts from pollutants such as sediment or hydrocarbons by using innovative technology. By incorporating BMPs in the study area for stormwater control and water quality benefits, the objective of protecting sensitive areas can be achieved.

The study gathered much useful information on the natural resources of the study area. Wetlands and species habitats were inventoried and mapped. This type of information, along with information on the use of best management practices for stormwater control, is intended for use by municipalities in updating municipal comprehensive plans, zoning ordinances, and/or subdivision regulations and, if implemented, will foster wetland conservation.

The study identified a potential demonstration site at which to investigate the possibility of implementing an upgrade to a standard stormwater detention basin. The study recommends that a follow-up study be conducted to further investigate how such a facility could be retrofitted to be brought up to a level of a stormwater best management practice for water quality control.

Study research found that the recent trend toward mitigation, or lessening, adverse environmental impacts upon wetlands includes techniques such as avoiding activities in wetlands and fringe areas, minimizing damage to wetlands from human activities, and restoring, enhancing, or creating new wetlands to compensate for wetland losses. Investigation of the feasibility of creating replacement wetlands in exchange for disrupting existing wetlands will require additional research and would be appropriate as a follow-up study.

A public awareness brochure was produced which focuses on the significance of wetlands in the study area and explains their importance as natural pollutant mitigation mechanisms. The brochure will be distributed to local municipal officials, conservation groups, businesses, and the public to increase public awareness of the connection between wetland protection, stormwater management, and the improvement of water quality in the Delaware Estuary and its tributaries.

The study presents recommended policies and activities that promote wetland protection and management of nonpoint source pollutants. The policies and activities call for minor amendments to municipal zoning ordinances and/or subdivision/land development regulations. For example, land use planning is encouraged, including the use of cluster zoning for residential developments, overlay districts for natural resource protection areas, and the use of natural resource performance standards.

The application of the results of the study and the implementation of recommended policies and activities are intended to lead to the improvement of the water quality of the lower reaches of the Neshaminy Creek and the Delaware Estuary.

INTRODUCTION

INTRODUCTION

Each year the Pennsylvania Coastal Zone Management (PaCZM) Program within the Pennsylvania Department of Environmental Resources (DER) makes available funding in the form of grants to local governments. Grant funds are to be used for conducting projects involving the planning, design, construction, or acquisition of activities and/or facilities that will improve the quality of life in the areas designated by DER as within the Coastal Zone.

For fiscal year 1993, the Bucks County Planning Commission submitted a proposal to conduct a study of the effects of nonpoint pollution in the lower portion (referred to as the "lower reaches") of the Neshaminy Creek watershed on the Delaware Estuary. The study proposal was reviewed by the CZM Steering Committee of the Delaware Valley Regional Planning Commission and was recommended to DER as a viable project based on consistency with the "High Priority Selection Criteria" of the PaCZM. The PaCZM staff agreed with the recommendation and passed it on to the Office of Coastal Zone Management within the National Oceanic and Atmospheric Administration (NOAA) which ultimately approved the proposal.

The study, known as the Neshaminy Creek Nonpoint Pollution and Wetlands Study, involved the cooperation and input of several entities. Specifically, the Bucks County Planning Commission (BCPC) coordinated with municipalities within the study area, the Pennsylvania National Diversity Inventory, the Morris Arboretum, and the Bucks County Conservation District.

Purpose Of The Study

The purpose of the Neshaminy Creek Nonpoint Pollution and Wetlands Study was fourfold:

1) To identify a demonstration site to investigate the possibility of implementing an upgrade to a standard stormwater detention basin.

2) To inventory wetlands occurring along the main channel of the Neshaminy Creek which may be adversely affected by non-point source discharges.

3) To develop a "public awareness" publication for general distribution which would point out significant wetlands in the study area and explain their importance as part of the natural environment and their usefulness as natural pollutant mitigation mechanisms; and

4) To investigate the feasibility of creating additional wetlands in a selected area in exchange for the disruption of existing wetlands for some useful purpose.

Who Can Use This Document

The document is intended to be used by municipal governing bodies, planning commissions, engineers, and planners as a guide to developing policies and actions which will lead to the reduction of nonpoint source pollutants introduced into the Neshaminy Creek. Although the study was specific to the lower reaches of the Neshaminy Creek watershed from Bridgetown Pike (PA Route 213) to the Delaware River, the recommendations of the study, found in Chapter Six, are also intended for application elsewhere in the watershed and the county.

Application Of Study Results

The application of the results of the study and any follow-up studies are intended to lead to the improvement of the water quality of the Delaware Estuary through the identification and ultimate use of specific best management practices (BMPs) for the management of stormwater. The study is supported by the research and recommendations in the *Neshaminy Creek Stormwater Management Plan* regarding the use of best management practices for stormwater control.

The report provides a variety of information on natural resources (e.g., wetlands, habitat) intended for use by municipalities in updating municipal comprehensive plans, zoning ordinances, and/or subdivision regulations. For example, Chapter Six recommends specific municipal policies and actions for wetland protection which, if implemented, would foster wetland conservation and be consistent with the objectives of the CZM program. This document will be distributed to the study area municipalities and the recommendations of the study will be advocated for implementation.

The educational brochure developed as part of the study (found in the pocket at the end of this document) will be distributed to local municipal officials, conservation groups, and the public. The purpose of the brochure is to inform the public about coastal concerns and encourage wise management of coastal resources. Increased public awareness of the connection between wetland protection, stormwater management, and the improvement of water quality in the Delaware Estuary and its tributaries will also be an outcome of the distribution of the brochure.

Resource Inventory, Database Maintenance, And Study Area Map

In collecting data for the study, information was received from other agencies and compiled by the BCPC staff. For example, information was solicited regarding wetlands and endangered species in the study area from both the Pennsylvania Natural Diversity Inventory (a department in the Pennsylvania Bureau of Forestry) and the Morris Arboretum of the University of Pennsylvania. Information received from both sources was used to identify locations of important wetlands and species. The information was

used to develop policy in the study area encouraging protection of these critical natural resources as discussed in Chapters Four and Six.

By retaining records of the locations of wetlands in the study area and a list of species associated with it, future impacts or improvements can be recorded to monitor the vitality of the area. The identified locations provide the municipalities with a starting point to enable planning activities aimed at reducing the nonpoint source pollutant loading by limiting specific uses in sensitive areas. For example, databases containing the location and site descriptions of wetlands and species habitat will help in the development of specific protection policies addressing wetlands and habitats in municipal comprehensive plans and ordinances. As information is updated by federal, state, and other agencies, the BCPC can update internal files which can be shared with municipalities. These databases will be maintained by the BCPC until further research and study is warranted.

Found in Chapter Three, the study area map, Figure 7, was created on the BCPC Geographic Information System (GIS) starting with a base map of study area that included major roads, minor streets, street names, municipal boundaries, municipal names and the main stem of the Neshaminy Creek. Subsequent "coverages" or "layers" were added to the base map including a one mile wide corridor along the Neshaminy Creek, field locations of wetlands areas greater than one acre (estimated from the latest available National Wetland Inventory (NWI) maps), Pennsylvania Natural Diversity Inventory (PNDI) sites, and Morris Arboretum rare and endangered species locations. The numerical code identifier on Figure 7 corresponds with the numbers assigned to each field-identified wetland location description in Appendix D and the PNDI and Morris Arboretum information in Appendices F and G, respectively.

Wetlands Educational Brochure

One purpose of the study was to develop a "public awareness" publication for general distribution which would point out significant wetlands in the study area and explain their importance as part of the natural environment and their usefulness as natural pollutant mitigation mechanisms. Thus, the educational brochure developed as part of the study will be distributed to local municipal officials, conservation groups, and the public. The purpose of the brochure is to inform the public about coastal concerns and encourage wise management of coastal resources. The brochure is expected to increase public awareness of the connection between wetland protection, stormwater management, and the improvement of water quality in the Delaware Estuary and its tributaries. A copy of the brochure may be found in a pocket inside the back cover of this report.

How The Report Is Organized

The report comprises two documents, *Volume One — Study Report* and *Volume II — Technical Supplement.*

Within Volume I, Chapter One, "Regulatory Background," provides a brief overview of the various legislation, regulations, and programs that are directly or indirectly related to coastal zone management. Chapter Two, "Description of the Study Area," defines the study area, and describes its land use characteristics, demographics, and development trends. Chapter Three, "Overview of Wetlands," gives the reader general background information on wetlands, setting the stage for Chapter Four, "Wetlands Protection and Mitigation," which discusses the importance of wetland protection, existing governmental policies, and wetland protection techniques. Chapter Five, "Nonpoint S Pollutant Generation, Characterization, and Management," provides a toolbox of techniques for managing nonpoint source pollutants. Chapter Six outlines policies and activities for state agencies, the county, and municipalities to protect wetlands and reduce the overall effects of nonpoint source pollution. Finally, inside the back cover there is the educational brochure, *Wetlands in Coastal Areas of Bucks County.*

The companion document, *Volume II — Technical Supplement,* contains various appendices that provide additional information, data, and technical material related to techniques for managing nonpoint source pollutants. Volume II should be used in conjunction with Chapters Five and Six of Volume I to facilitate wetland protection and nonpoint source pollution reduction in the watershed.

CHAPTER ONE

Regulatory Background

CHAPTER ONE

REGULATORY BACKGROUND

This chapter is intended to provide the reader with a brief overview of the various legislation, regulations, and programs that are directly or indirectly related to coastal zone management. Appendix A provides a directory of governmental agencies that the reader may wish to contact for more information on various topics discussed in this report.

The Coastal Zone Management Act

In response to concern over development pressures affecting the shorelines of our nation's oceans, estuaries, and Great Lakes, the U.S. Congress in 1972 enacted the Coastal Zone Management (CZM) Act (P.L. 92-583). The CZM Act encourages states to develop comprehensive programs to effectively manage valuable land and water resources in designated coastal zone areas. To comply with the act, states may choose management approaches which are best suited to their particular problems and issues.

The Coastal Zone Management Act established the following national policies:

- To preserve, protect, develop, and, where possible, restore coastal resources;
- To help states manage their coastal responsibilities wisely through the development of appropriate management programs;
- To facilitate coordination between federal and state agencies responsible for administering coastal management programs; and
- To encourage cooperation among local, state, and regional agencies.

In addition, Section 306 (c)(8) of the Coastal Zone Management Act requires that states identify issues within the national interest. The Pennsylvania CZM Program considers wetlands to be of ". . . long-range, comprehensive importance as to be in the national interest" and has established its own objectives (discussed in Chapter Three) to assure that in the national interest wetlands will be protected.

At the federal level, the responsibility for administering the CZM Act rests with the Office of Coastal Zone Management within the National Oceanic and Atmospheric Administration (NOAA). NOAA's primary responsibilities involve the establishment of program guidelines and the disbursement of grant funds.

Defining Coastal Zone Boundaries in Pennsylvania

The Coastal Zone Management Act defines the coastal zone as: ". . . coastal waters . . . and the adjacent shorelands . . . including transitional and intertidal areas, salt marshes, wetlands and beaches." The designated zone extends inland from the shoreline only to

the extent necessary to control shorelands, since the land uses there have a direct or significant impact on the coastal waters.

According to the definition in the Coastal Zone Management Act, Pennsylvania qualifies as a "coastal state" because of two diverse and widely separated areas as shown in Figure 1. The two areas are the Lake Erie Coastal Zone in northwestern Pennsylvania and the Delaware Estuary Coastal Zone in southeastern Pennsylvania. Pennsylvania's portion of the Delaware Estuary Coastal Zone, shown in Figure 2, extends 57 miles from the fall line at Morrisville, Bucks County to the Pennsylvania/Delaware state line at Marcus Hook, Delaware County, Pennsylvania.

The Pennsylvania Coastal Zone Management (PaCZM) Program within the Pennsylvania Department of Environmental Resources (DER) has determined that the following activities fall under its jurisdiction:

- Activities associated with the placement and design of structures in coastal erosion and flood hazard areas, including the expenditure of state funds for public infrastructure in flood hazard areas;
- Dredging and spoil disposal activities which could negatively impact navigation, flood flow capacity, wetlands, environmental quality, and public interest;
- Activities which cause both positive and negative impacts upon coastal fishery populations and their aquatic habitat;
- Activities, such as the placement of water obstructions and encroachments, that could result in the degradation or destruction of tidal or freshwater wetlands, or impact the beds of Lake Erie or the Delaware River;
- Activities which possess the potential for providing public access sites for both passive and active forms of recreation;
- Activities which enhance the restoration and/or preservation of historic sites and structures;
- Activities in port areas which directly affect overall port planning development, enhancement, and revitalization;
- Activities related to energy production and energy facility siting that have the potential to cause adverse environmental impacts to sensitive ecological areas;
- Activities which affect air quality and water quality in the coastal zone.

Pennsylvania's coastal zone boundaries were established to include the above uses as they relate to coastal waters. Figure 3 is a schematic which graphically depicts a hypothetical coastal zone boundary which includes all of the above uses.

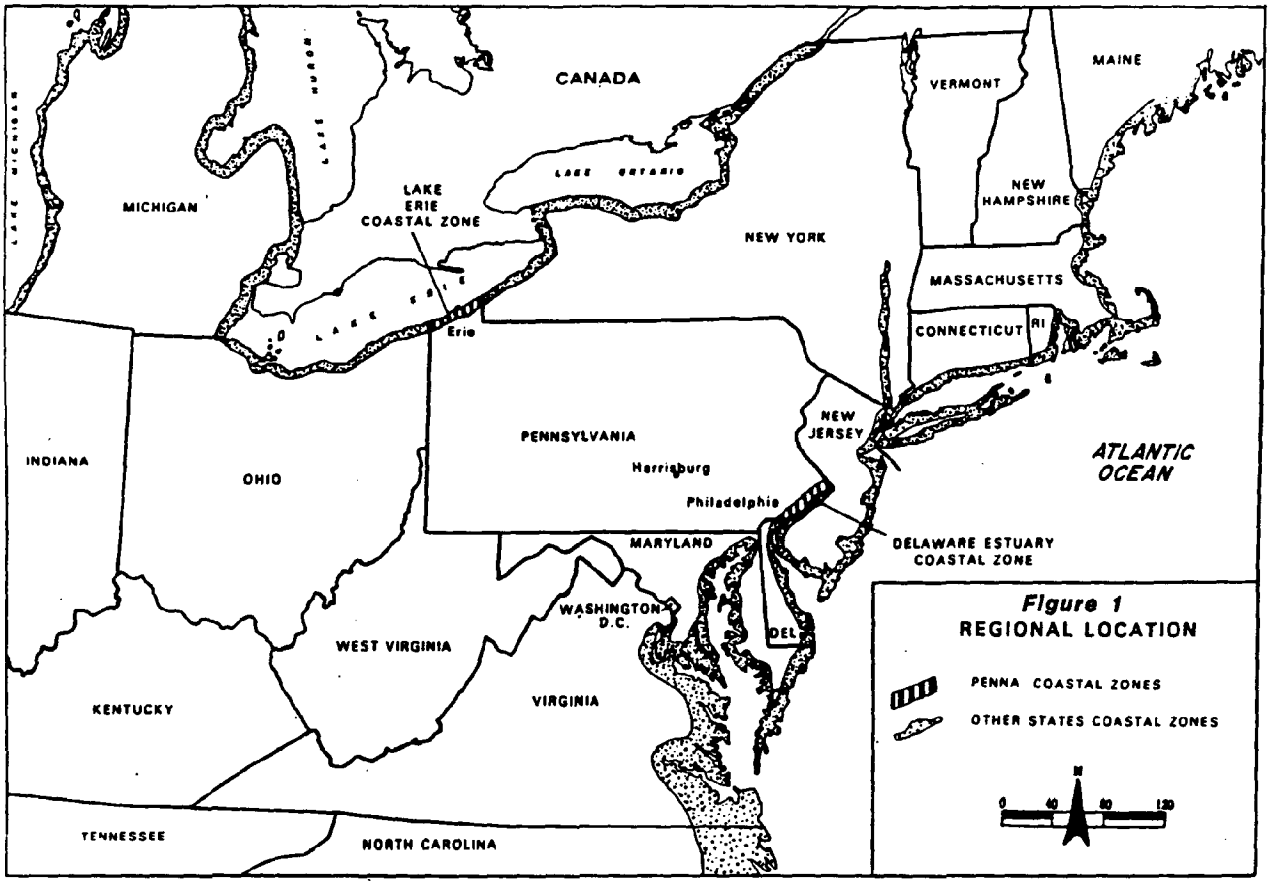


Figure 2

DELAWARE ESTUARY COASTAL ZONE

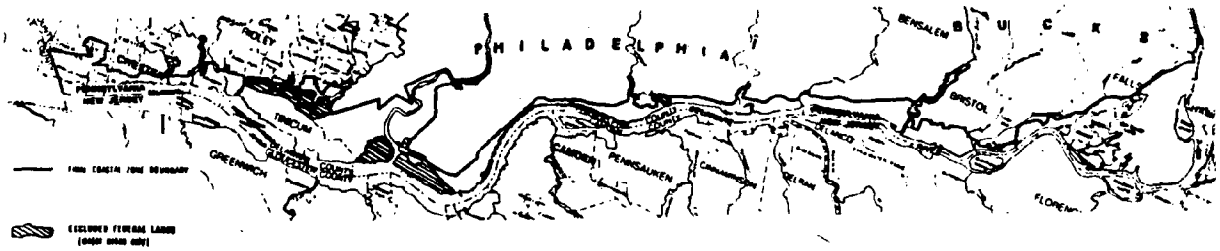
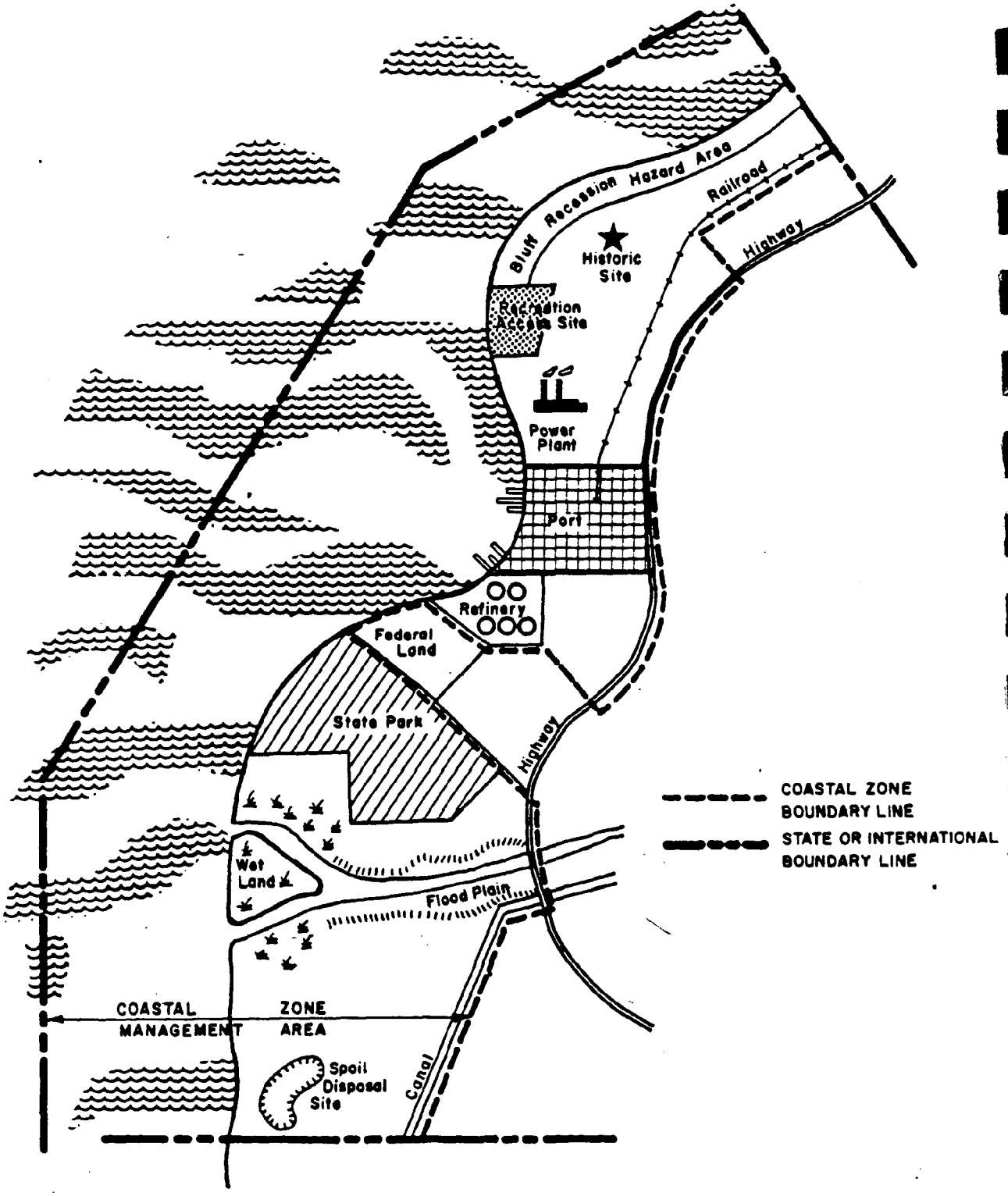


Figure 3

SCHEMATIC DIAGRAM OF THE
PENNSYLVANIA COASTAL ZONE BOUNDARY



Geographic Areas of Particular Concern

In addition to establishing coastal zone boundaries to delineate areas of importance of the entire coastal zone, the Coastal Zone Management Act also declares that certain areas, known as Geographic Areas of Particular Concern, are of greater significance. Within the study area of this report (described in Chapter Two), there is only one such designated area. The Neshaminy State Park, located on 356 acres at the confluence of the Neshaminy Creek and the Delaware River in both Bensalem and Bristol townships, qualifies as a designated Geographic Area of Particular Concern by virtue of its state ownership.

The Delaware Estuary Program

Another program related to but separate from the CZM Program is the Delaware Estuary Program (DELEP). The DELEP is designated as part of the National Estuary Program established by Congress in 1987. At that time, Congress declared that the nation's estuaries are of great importance for fish and wildlife resources, recreation, and economic opportunity and that maintaining the health and ecological integrity of these estuaries is in the national interest. Congress recognized that increasing coastal population, development, and other direct and indirect uses of estuaries threaten their health and ecological integrity. Therefore, Congress decided that long-term planning and management would contribute to the continued productivity of estuary areas, and that better coordination among federal and state programs affecting estuaries would increase the effectiveness and efficiency of the national effort to protect, preserve, and restore these areas.

Of the 21 estuary programs nationwide, DELEP is the only tri-state effort. The overall goal of the program is to develop and implement a Comprehensive Conservation and Management Plan (CCMP) that addresses the protection of natural resources, while striking a balance with economic activities in the region.

The Coastal Zone Act Reauthorization Amendments

In the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA), Congress recognized that nonpoint source (NPS) pollution is a key factor in the continuing degradation of many coastal waters and established a new program to address that form of pollution. Congress also recognized that the solution to NPS pollution needed to take place at the state and local levels. Thus, CZARA calls upon states to develop and implement State Coastal Nonpoint Pollution Control Programs. To assist in that effort, Congress assigned to the U.S. Environmental Protection Agency (EPA) the responsibility of developing a technical guidance document from which states could begin to develop their programs. The document, *Guidance Specifying Management Measures For Sources of Nonpoint Pollution In Coastal Waters* (commonly referred to as "Section 6217

Guidance"), specifies management measures for controlling NPS pollution using the best economically achievable measures available.

The Section 6217 Guidance addresses five source categories of NPS pollution (agriculture, silviculture, hydromodification, urban, and marinas) and provides a menu of management measures for each source. The document also contains tools for the protection, restoration, and construction of wetlands, riparian areas, and vegetated treatment systems.

SUMMARY

The above-mentioned legislation, programs, and technical guidance have established a framework for the development of policies and activities to protect and enhance the natural and built environments in the coastal zone. In addition, funding from programs such as the PaCZM Program has been used to improve the coastal zone with projects such as waterfront park improvements in Morrisville and Bristol boroughs.

CHAPTER TWO

Description of the Study Area

CHAPTER TWO

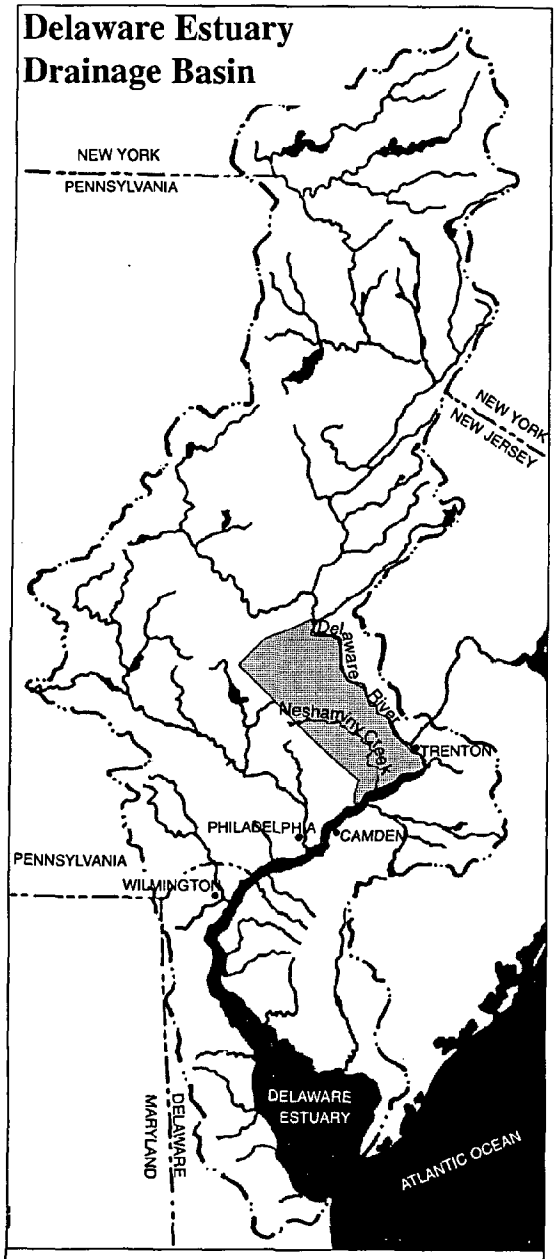
DESCRIPTION OF THE STUDY AREA

The study area, shown in Figure 4, is located along the lower-most portion of the Neshaminy Creek in Bucks County, Pennsylvania. Only a small portion of the study lies within the official "Coastal Zone Boundary" established by the PaCZM program. The portion of the watershed most directly connected to the Delaware Estuary Coastal Zone is that area delineated in the *Neshaminy Creek Watershed Stormwater Management Plan* as the "Lower Reaches." The Lower Reaches is defined as that area of the watershed which is tidally influenced by, and directly discharges into, the Delaware River. The Neshaminy Creek and its tributaries traverse several municipalities in the Lower Reaches. These are: Bensalem, Bristol, Lower Southampton, and Middletown townships, and Hulmeville, Langhorne, Langhorne Manor, and Penndel boroughs.

Land Use

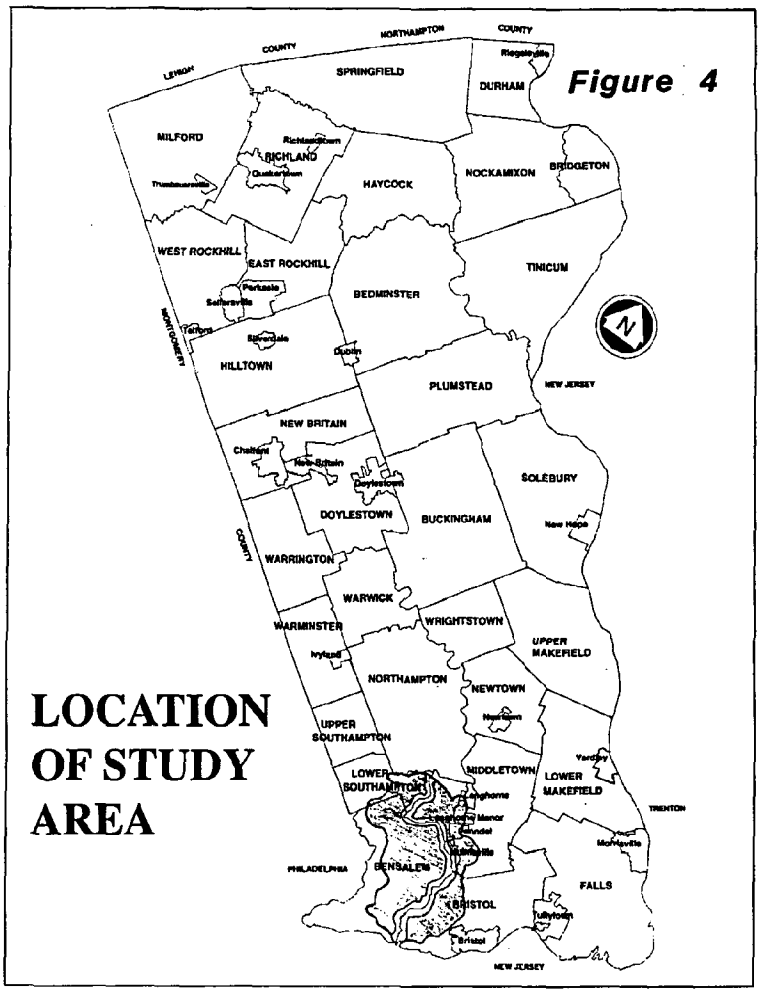
The study area is also part of the region of Bucks County commonly known as Lower Bucks, which is the most urbanized region of the county. The urbanization of Lower Bucks is generally attributed to the concentrations of industry, infrastructure (e.g., public water and sewer), and major transportation corridors (e.g., I-95, I-276, U.S.-1, U.S.-13, PA-413, PA-132, PA-213). Development pressures radiating out from Philadelphia and spilling over from the New Jersey side of the Delaware River create a demand for residential, commercial, industrial, and institutional land uses. The portions of the study area that are located in Lower Southampton Township and the four boroughs are intensely developed with about 50 percent of the area containing single-family detached residential land use. The Bensalem, Bristol, and Middletown Township portions of the study area have about one-third of the area composed of single-family detached residential land use. Multi-family residential and commercial land uses also make up a significant portion the land area in the study area, especially along the major transportation corridors.

Table 1 presents the 1990 land use characteristics for the municipalities within the Lower Reaches study area. The study area municipalities encompass 40,757 acres of land, or approximately 10 percent of Bucks County's total land area. Residential uses comprise 36 percent of the study area municipalities; nonresidential uses, 39 percent; agricultural/vacant, 16 percent; and parks/recreation, 9 percent. Figure 5 graphically presents the relationship of these land use percentages.

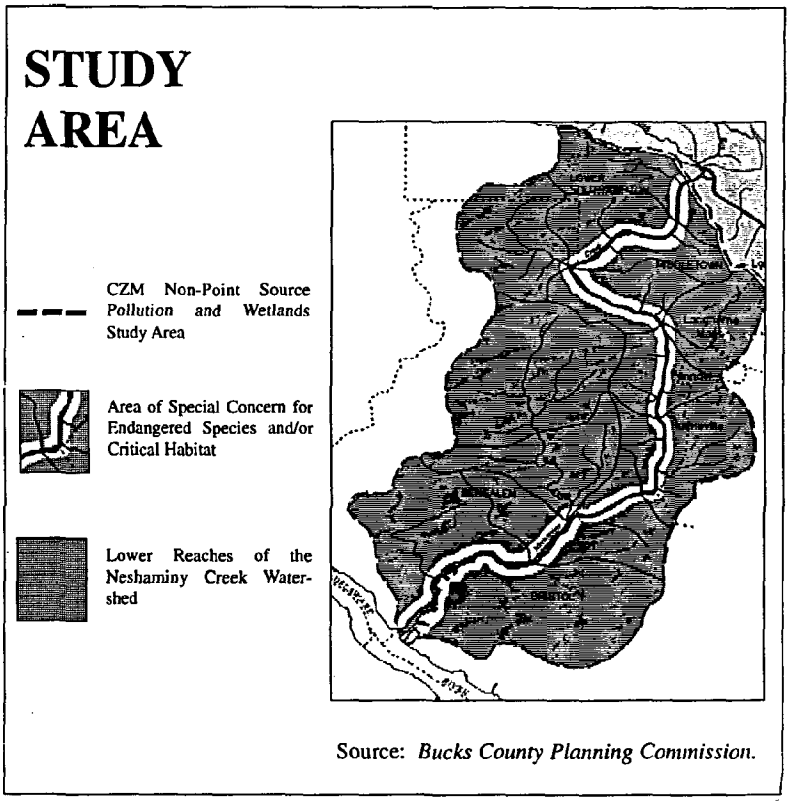


Delaware Estuary Drainage Basin. *The drainage basin of the Delaware Estuary covers more than 13,500 square miles. From this region many sub-tributaries contribute water to the two major freshwater tributaries—the Delaware and Schuylkill rivers.*

Source: ***THE DELAWARE ESTUARY:*** *Rediscovering a Forgotten Resource.*
Courtesy: University of Delaware, Sea Grant College Program.



Source: *Bucks County Planning Commission.*



Source: *Bucks County Planning Commission.*

Table 1
1990 Land Use Characteristics (in acres)

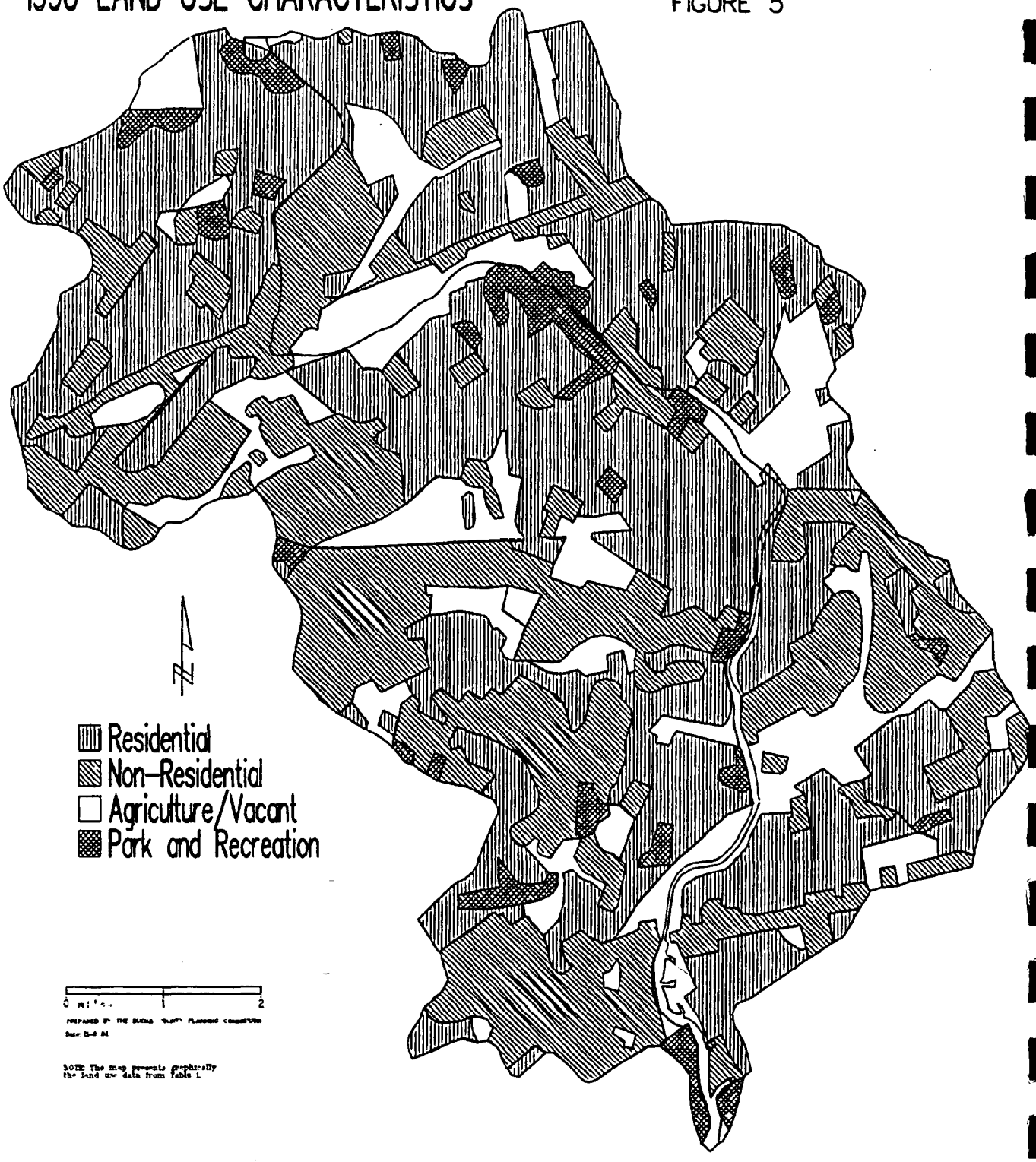
Municipality	Residential	Agriculture/ Vacant	Nonresidential	Park & Recreation
Bensalem Twp.	4,311	1,825	5,824	815
Bristol Twp.	3,498	1,430	4,734	592
Hulmeville Boro.	120	60	62	1
Langhorne Boro.	167	26	99	21
Langhorne Manor Boro.	164	70	144	0
Lower Southampton Twp.	2,424	320	1,316	209
Middletown Twp.	4,005	2,693	3,385	2,167
Penndel Boro.	126	23	120	6
Lower Bucks Total*	22,794	14,352	27,854	5,339
Study Area Total	14,815	6,447	15,684	3,881
BUCKS COUNTY	**154,562**	**147,155**	**62,383**	**24,613**

*Lower Bucks includes all of the municipalities within the table, as well as the following municipalities: Bristol Boro., Falls Twp., Lower Makefield Twp., Morrisville Boro., Tullytown Boro. and Yardley Boro.

Source: U.S. Census, 1990.

1990 LAND USE CHARACTERISTICS

FIGURE 5



NOTE: The map presents graphically the land use data from Table 1.

Table 2 shows a comparison of major categories of land use and the changes in those land uses between 1970 and 1990. (See Appendix B for more detailed information.)

Table 2
1970–1990 Land Use Comparison Percentage

Municipality	Residential			Agriculture/Vacant		
	1970	1980	1990	1970	1980	1990
Bensalem Twp.	35%	34%	32%	39%	25%	16%
Bristol Twp.	43%	35%	34%	33%	17%	14%
Hulmeville Boro.	45%	45%	45%	36%	31%	29%
Langhorne Boro.	55%	50%	53%	15%	8%	9%
Langhorne Manor Boro.	47%	37%	43%	19%	20%	19%
Lower Southampton Twp.	56%	52%	53%	26%	18%	11%
Middletown Twp.	31%	26%	32%	30%	36%	23%
Penndel Boro.	62%	51%	46%	8%	9%	8%
Lower Bucks Total*	32%	30%	31%	44%	29%	22%
BUCKS COUNTY	**22%**	**27%**	**28%**	**65%**	**55%**	**50%**

Municipality	Non Residential			Park & Recreation		
	1970	1980	1990	1970	1980	1990
Bensalem Twp.	23%	34%	46%	2%	6%	6%
Bristol Twp.	23%	40%	46%	1%	8%	6%
Hulmeville Boro.	13%	21%	25%	5%	3%	0%
Langhorne Boro.	25%	33%	32%	6%	9%	7%
Langhorne Manor Boro.	34%	38%	38%	0%	5%	0%
Lower Southampton Twp.	16%	25%	31%	2%	5%	5%
Middletown Twp.	15%	25%	28%	23%	13%	18%
Penndel Boro.	26%	37%	44%	4%	2%	2%
Lower Bucks Total*	18%	33%	40%	6%	8%	8%
BUCKS COUNTY	**7%**	**11%**	**16%**	**5%**	**7%**	**6%**

*Lower Bucks includes all of the municipalities within the table, as well as the following municipalities: Bristol Boro., Falls Twp., Lower Makefield Twp., Morrisville Boro., Tullytown Boro. and Yardley Boro.

Source: U.S. Census, 1990.

Development Trends

A majority of the study area is considered to be intensely developed. Less than one-quarter of the study area is composed of a combination of agricultural and vacant land uses with the remainder of the area made up of restrictive natural resource areas. Development is expected to continue in the study area, although at a slower pace than in the past. Eventually, as land area available for development becomes even more scarce and various areas reach build-out capacity, growth will become minimal. Beyond that time, future growth will be in the form of infill development, adaptive reuse, and redevelopment in the more urban areas.

As Table 3 indicates, the study area municipalities contained 182,627 residents in 1990, living in an area of 64 square miles, or over 2800 persons per square mile. The study area municipalities accounted for 68 percent of the total population in lower Bucks and 58 percent of the land area. In addition, the study area municipalities contain 33 percent of the county's population and 11 percent of the county's land area.

Table 3
Bucks County Population Density

Municipality	1990 Census Population	Land Area Square Miles	Persons per Square Mile
Bensalem Twp.	56,788	20.0	2839.4
Bristol Twp.	57,129	16.0	3570.6
Hulmeville Boro.	916	0.4	2290.0
Langhorne Boro.	1,361	0.5	2722.0
Langhorne Manor Boro.	807	0.6	1345.0
Lower Southampton Twp.	19,860	6.7	2964.2
Middletown Twp.	43,063	19.4	2219.7
Penndel Boro.	2,703	0.4	6757.5
Study Area Total	182,627	64.0	2850.5
Lower Bucks Total*	267,554	110.2	2427.9
BUCKS COUNTY	**541,224**	**607.9**	**890.3**

*Lower Bucks includes all of the municipalities within the table, as well as the following municipalities: Bristol Boro., Falls Twp., Lower Makefield Twp., Morrisville Boro., Tullytown Boro. and Yardley Boro.

Source: U.S. Census, 1990.

Despite continued high levels of growth during the 1980s, land consumption for residential development generally appears to be occurring at a slower pace. That can be attributed, in part, to the trend toward the concentration of residential development at

higher densities (e.g., smaller lots and attached development). The trend is reflected in the data which shows that the average acreage per dwelling unit in ower Bucks dropped from 0.332 acres per dwelling unit in 1970 to 0.218 in 1990.

Nonresidential development, (e.g., industrial/office parks, shopping centers, and expansion of existing commercial areas) showed the largest increase between 1970 and 1990 in ower Bucks (over 14,000 acres), some of which occurred in the study area.

Future Growth Trends

Table 4 presents population projections by decade to the year 2020. The population in the study area municipalities is projected to grow by 12.6 percent (from 182,627 to 205,600 people) between 1990 and 2020. Despite the projected strong population growth county-wide, the study area municipalities as a group are expected to continue to account for approximately one third of the county's population. The greatest growth pressures are anticipated to occur in Bensalem and Middletown which together will account for 93 percent of the projected growth in the study area.

Table 4
Bucks County Population Projections

Municipality	1990 Census	2000 Middle	2010 Middle	2020 Middle
Bensalem Twp.	56,788	60,960	64,550	64,580
Bristol Twp.	57,129	56,340	55,690	55,670
Hulmeville Boro.	916	960	950	960
Langhorne Boro.	1,361	1,190	1,130	1,100
Langhorne Manor Boro.	807	810	810	800
Lower Southampton Twp.	19,860	21,420	22,380	23,000
Middletown Twp.	43,063	47,000	52,380	56,750
Penndel Boro.	2,703	2,730	2,740	2,740
Study Area Total	182,627	191,410	200,630	205,600
Lower Bucks Total*	267,554	279,690	293,060	300,780
BUCKS COUNTY	**541,224**	**606,500**	**665,800**	**709,600**

*Lower Bucks includes all of the municipalities within the table, as well as the following municipalities: Bristol Boro., Falls Twp., Lower Makefield Twp., Morrisville Boro., Tullytown Boro. and Yardley Boro.

Source: U.S. Census, 1990.

Table 5 shows that, as of 1990, the study area municipalities contained 67,161 housing units which accounted for 67 percent of the units in lower Bucks and nearly 34 percent of the county's housing units. Between 1990 and 2020, the study area is expected to add approximately 17,000 more units. This projected growth will account for 71 percent of the total growth in lower Bucks and 20 percent of the county's total projected growth. Middletown is expected to grow the fastest, and will account for approximately 43 percent of the housing unit growth to the year 2020. Bensalem is expected to be a close second by absorbing nearly 39 percent of the total projected growth in the study area municipalities. Thus it is significant to note that Middletown and Bensalem together will account for about 82 percent of the growth in the study area municipalities.

Table 5
Bucks County Housing Projections

Municipality	1990 Census	2000 Middle	2010 Middle	2020 Middle
Bensalem Twp.	22,713	25,460	27,940	29,220
Bristol Twp.	20,073	20,670	20,860	21,400
Hulmeville Boro.	333	340	330	330
Langhorne Boro.	545	500	490	520
Langhorne Manor Boro.	304	290	260	230
Lower Southampton Twp.	7,263	8,100	8,640	9,110
Middletown Twp.	14,942	17,380	19,980	22,240
Penndel Boro.	988	1,000	1,000	1,010
STudy Area Total	67,161	73,740	79,500	84,060
Lower Bucks Total*	99,634	108,800	116,650	123,460
BUCKS COUNTY	**199,959**	**232,900**	**260,600**	**283,900**

*Lower Bucks includes all of the municipalities within the table, as well as the following municipalities: Bristol Boro., Falls Twp., Lower Makefield Twp., Morrisville Boro., Tullytown Boro. and Yardley Boro.

Source: U.S. Census, 1990.

In 1990 the study area municipalities had 54 percent of their population in the labor force. As the figures in Table 6 indicate, 67 percent of the 1990 labor force in lower Bucks and 33 percent county-wide were residents of the study area municipalities. It is expected that growth in the labor force in the study area between 1990 and 2000 will account for nearly 69 percent of the labor force growth in lower Bucks.

Table 6
Bucks County Labor Force Projections

Municipality	1990 Census	2000 Middle	2010 Middle	2020 Middle
Bensalem Twp.	31,532	33,850	35,880	35,880
Bristol Twp.	30,259	29,840	29,510	29,490
Hulmeville Boro.	518	540	540	540
Langhorne Boro.	755	660	630	610
Langhorne Manor Boro.	449	450	450	450
Lower Southampton Twp.	11,122	11,990	12,540	12,880
Middletown Twp.	23,121	25,220	28,100	30,460
Penndel Boro.	1,532	1,550	1,560	1,550
Study Area Total	99,288	104,100	109,210	111,860
Lower Bucks Total*	146,124	152,840	160,290	164,460
BUCKS COUNTY	**296,484**	**332,300**	**364,800**	**388,800**

*Lower Bucks includes all of the municipalities within the table, as well as the following municipalities: Bristol Boro., Falls Twp., Lower Makefield Twp., Morrisville Boro., Tullytown Boro. and Yardley Boro.

Source: U.S. Census, 1990.

Table 7 reflects the anticipated growth in employment in the study area. Although the study area municipalities account for only 10 percent of the county's total land area, they account for over 25 percent of the nonresidential land use in the county. Thus, it can be concluded that the study area municipalities constitute a significant employment center. By 2020, the municipalities in the study area will have an additional 11,872 residents employed. It is likely that the municipalities in the study area will accommodate the majority of jobs to fulfill this additional employment.

Table 7
Bucks County Employment Projections

Municipality	1990 Census	2000 Middle	2010 Middle	2020 Middle
Bensalem Twp.	29,965	32,120	34,020	34,020
Bristol Twp.	28,595	28,170	27,840	27,820
Hulmeville Boro.	498	520	520	520
Langhorne Boro.	741	650	610	600
Langhorne Manor Boro.	434	440	430	430
Lower Southampton Twp.	10,777	11,610	12,130	12,460
Middletown Twp.	22,305	24,300	27,090	29,330
Penndel Boro.	1,427	1,440	1,450	1,440
Study Area Total	94,742	99,250	104,090	106,620
Lower Bucks Total*	139,370	145,690	152,750	156,740
BUCKS COUNTY	**284,984**	**319,300**	**350,500**	**373,600**

Source: Bucks County Planning Commission 5/93

*Lower Bucks includes all of the municipalities within the table, as well as the following municipalities: Bristol Boro., Falls Twp., Lower Makefield Twp., Morrisville Boro., Tullytown Boro. and Yardley Boro.

Source: U.S. Census, 1990.

SUMMARY

The population, housing, and employment trends and projections discussed in this chapter give a strong indication that the study area municipalities will continue steady growth for the foreseeable future. Such growth will likely translate into additional potential impacts on the local environment and its natural resources. The remaining chapters in this report discuss ways of reducing the effects on the environment of continued population and employment growth, especially as it relates to nonpoint source pollution and wetland protection.

CHAPTER THREE

Overview of Wetlands

Chapter Three

OVERVIEW OF WETLANDS

While the overall population density of lower Bucks and the study area is higher than the rest of Bucks County (as discussed in Chapter Two), numerous natural resources still remain. Most of these natural resources are associated with the Neshaminy Creek and the Delaware Estuary, including riverine wetlands, i.e., freshwater marshes and the associated flora and fauna. For example, within the Neshaminy State Park, located in the study area where the Neshaminy Creek meets the Delaware River (see Figure 6), there are numerous wetland plant species of special concern found in an inter-tidal freshwater mudflat.

Figure 6

Confluence of Neshaminy Creek and the Delaware River

at Neshaminy State Park

Wetlands and the Coastal Zone

The *Final Environmental Impact Statement* for the Pennsylvania Coastal Zone Management Program (1980) contains the following statement regarding wetlands from its list of ten identified "problems and issues":

Wetlands: Wetlands constitute a critical natural resource of national and statewide significance, providing fish and wildlife habitats, natural flood control, improved water quality, groundwater recharge, and environmental diversity. However, the environmental value of wetlands has not been appreciated until recently. Many coastal wetland areas have been lost to bulkheading, [dredge] spoil disposal, and development. Thus, effective management and protection of the remaining wetlands is vital.

The Pennsylvania CZM Program has established the following objectives to assure that wetlands are protected in the national interest:

1. Avoid to the extent possible the long- and short-term adverse impacts associated with the disruption or modification of wetlands.

2. Provide the means for preserving ecosystems upon which endangered and threatened species depend.

3. Make use of wetlands as outdoor classrooms through the acquisition and/or development of appropriate sites.

Wetlands Definition

The federal government's current definition of wetlands, promulgated on December 24, 1980 (40 CFR 230.3) is the following:

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

Wetlands Identification

Identifying wetlands requires skill and experience. This is because the regulatory definition of wetlands refers to three basic factors — vegetation, soils, and hydrology — that together determine the presence of wetlands. On-site assessment by qualified experts is the surest method of delineation.

Wetland plant identification is generally the first step in the process. When more than 50 percent of the plants in the subject area include certain wetland species, the site may be classified with some confidence as a wetland. (See Appendix C for a list of common wetland species in Bucks County, reproduced from the BCPC publication, *Wetlands*

Regulation in Bucks County.) Secondly, the presence of hydric soils, or soils that in their natural, undrained state are saturated at or near the surface during much of the growing season. In Bucks County there are six soil series where hydric soil conditions are most prevalent: Bowmansville, Doylestown, Fallsington, Hatboro, Towhee, and Towhee (stony). The first four of these soil types are found in the study area. Finally, hydrology, i.e., saturated soil and drainage characteristics, is the underlying cause of a wetland condition. Hydrologic indicators such as flooding, standing water, and high groundwater levels can be useful in delineating a wetland site. (The *Soil Survey of Bucks And Philadelphia Counties, Pennsylvania*, published by the USDA Soil Conservation Service (SCS) provides more detail on soil drainage characteristics.)

National Wetland Inventory

The U.S. Fish and Wildlife Service produces the National Wetland Inventory (NWI) maps which are based on interpretations of high-altitude photographs superimposed over U.S.G.S. 1:24,000 topographic maps. Wetlands of one or more acre in size are identified and approximate boundaries are drawn. The NWI maps were used to identify wetland sites in the study area and those sites were field checked during the study to assess the general conditions and pollution factors. Wetlands occurring along the main channel of the Neshaminy Creek, which may be adversely affected by nonpoint source discharges, were inventoried. From that inventory was developed a map of the study area, Figure 7 on the following page, indicating the location of wetland areas. (The numerical sequence of the site listing with Figure 7 of the report is for determining the approximate location only and is not intended as a priority listing.) Municipalities can use that wetland information, in conjunction with NWI maps, in their comprehensive planning efforts. Further discussion of the field work is presented in Chapter Five.

Wetlands Types in the Study Area

There are many different types of wetlands in Bucks County. They include tidal marshes, freshwater marshes, upland marshes, and riparian (along rivers and streams) wetlands. Although their properties and functions differ depending upon their environment and location, they all play an important role as natural buffer areas. Some common names for wetland areas include swamps, bogs, marshes, and mud flats.

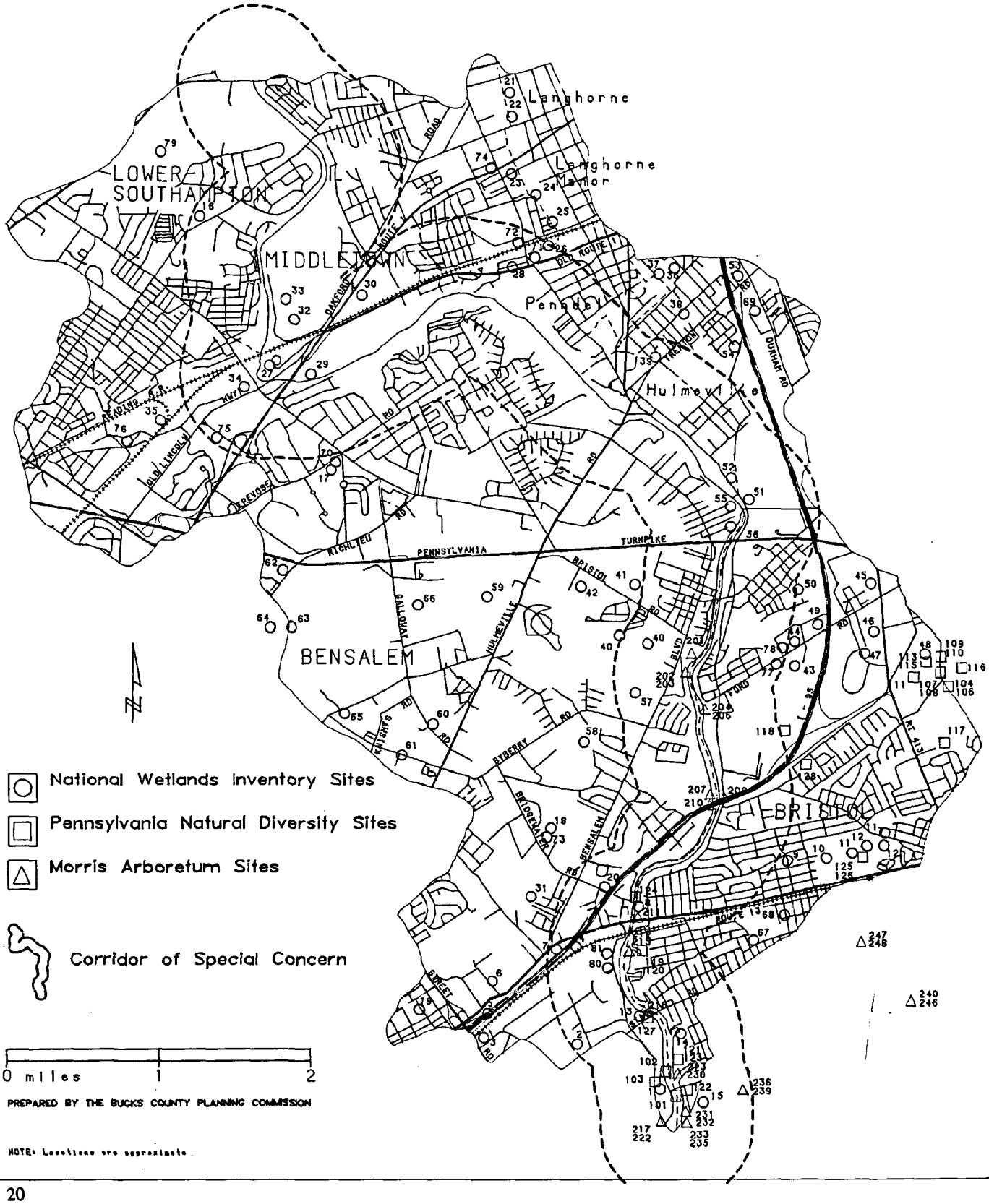
As defined earlier in this chapter, wetlands include areas commonly known as marshes. Along the Delaware Estuary from the farthest tidal influence at Trenton/Morrisville to its mouth at Cape May/Cape Henlopen, three distinct types of tidal marshes are found: salt marshes, brackish-water marshes, and freshwater marshes. All three types vary greatly as to salinity, vegetation, and wildlife. A tidal marsh may be defined as an area of grasses, sedges, rushes, and other plants that have adapted to continual, periodic flooding.

Freshwater marshes line the shores of the upper estuary and the tributary streams along the estuary, thus they are the focus within the study area of this report. As the name

Figure 7

Locations of Wetland Sites

Coastal Zone Management
Nonpoint Pollution and Wetlands Study 1994



FIELD OBSERVATION SITES

The numerical sequence of the following information corresponds to the numbers on Figure 7 and is not intended as a priority listing. See Appendix D for the field notes from each site.

1. Neshaminy State Park, Bensalem Township.: Wetlands Area
2. State Rd., Bensalem Township. (Industrial Park) : Wetland Area
3. Expressway @ I-95 area, Bensalem Township. (Industrial Park): Wetland Area
4. Industrial Park, Bensalem Township. (Railroad tracks): Wetland Area
5. Expressway @ I-95, Bensalem Township.: Wetland Area
6. Route 13, Bensalem Township.: Wetland areas
7. Route 13, Bensalem Township.: Wetland Areas
8. Route 13, Bensalem Township.: next to Seven-Eleven store
9. Spencer St., Bristol Township.: Wetland Area
10. Garfield St., Bristol Township.: Wetland area
11. Newport Rd. and Park Ave., Bristol Township.: Wetland area
12. Newport Rd. and Route 13, Bristol Township.: Wetland Area
13. State Rd. and Totem Rd., Bensalem Township. Wetland Area
14. Jack's Marina, Bensalem Township.: Wetland Area
15. Neshaminy State Park Marina, Bristol Township.: Confluence of the Neshaminy Creek and the Delaware River
16. Brownsville Rd., Lower Southampton Township.: Wetland Area
17. King David Cemetery and Rosedale Cemetery, Neshaminy Ave. and Bristol Rd., Bensalem Township.: Wetland Area.
18. Timber Lane & Bensalem Blvd.: Wetland Area
19. Beverly/Forest and Forest/Lavender, Bensalem Township.: Wetland area
20. Bridgewater Road, Bensalem Township.: Wetland
21. N. Gillam Avenue, Langhorne Borough : Wetland Area
22. S. of Gillam, Langhorne Borough: Wetland Area
23. South of Route 1, Middletown Township.: Wetland area
24. Poplar Street and Walsh Avenue, Langhorne Manor Borough: Wetland area
25. Virginia Street
26. Park Ave., Langhorne Manor Borough (Industrial Site): Wetland area
27. No Information Available
28. Parker Ave. along U.S. Route 1, Penndel Borough: Wetland
29. N. River Drive, Middletown Township.: Wetland area
30. Highland Ave. and Route 281, Middletown Township:
31. Middletown Township, Idlewood on the Neshaminy: Wetland area
32. Old Lincoln Highway, Middletown Township
33. Middletown Township
34. Old Lincoln Highway, Bensalem Township
35. Industrial Center, Bensalem Township
36. Jefferson Avenue, Bristol Township: Wetland area
37. Washington St., Bristol Township: Wetland area
38. Longview Avenue/Lime Avenue, Bristol Township: Wetland area
39. Longview/Cyprus/Fernwood, Penndel Borough and Bristol Township
40. Bristol road, Bensalem Township.: Wetland area
41. Bristol road, Bensalem Township.: Wetland area
43. Wetland-Industrial Park. Bensalem
44. Bartram Road, Bristol Township, Industrial Park (Keystone); Wetland area
45. Route 413, Bristol Township: Wetland area
46. Industrial Commercial area, Bristol Township: Wetland area
47. Bristol Township: Wetland area
48. Bristol Township.: Wetland area
49. Bristol Township.: Wetland area
50. Bristol Township.: Wetland area
51. Bristol Township.: Wetland area
52. Newportville Rd., Bristol Township.: Wetland area
53. Bristol Township.: Wetland area
54. Middletown Township./Hulmeville Borough: Wetland area
55. Fernwood & Bensalem Blvd., Bristol Township. : Wetland area
56. Leonard Ave., Bristol Township.: Wetland area
57. Bristol Township.: Wetland area
58. Bensalem Township.: Wetland area
59. Glenn Avenue, Bensalem Township.: Wetland area
60. Hulmeville Rd., Bensalem Township.: Wetland area
61. Byberry Rd., Bensalem Township.: Wetland area
62. Richilieu Road, Bensalem Township., Country Common Apts.: Wetland area
63. Richilieu Rd., Bensalem Township., Philadelphia Park Racetrack
64. Richilieu Rd, Bensalem Township, Philadelphia Park Racetrack (main entrance)
65. Mechanicsville Road, Bensalem Township.: Wetland
66. Grace Ave., Bensalem Township.: Wetland

Stormwater Detention Basin Field Location Notes

69. Trenton Rd., Middletown Township., Middletown Trace Apts.
70. Trevose Rd., Bensalem Township., Neshaminy Square Shopping Center : Detention Basin
71. Route 1, Middletown Township., The Commons at Middletown: Detention Basin
72. Highland Ave., Middletown Township.: Detention Basin
73. Timber Lane & Bensalem Blvd.: Stormwater Detention Basin
74. S. of Gillam, Langhorne Borough: Detention Basin
75. Old Lincoln Highway, Bensalem Township, Northbrook Office Park.: Detention Basin
76. Old Lincoln Highway near Reading Railroad, Bensalem Township.: Detention Basin
77. Bensalem Township.: Detention Basin
78. Pearl Buck & Bartram Rd., Bensalem Township.: Detention Basin
79. Bridgetown Pike, Lower Southampton Township., Sweetwater Farms: Detention Basin
80. Haunted Lane, Bensalem Township.: Detention Basin
81. Haunted Lane; Bensalem Township: Retention Basin @ Water's Edge Office Park

implies, freshwater marshes are dominated by water draining toward the estuary from upland creeks and rivers. Freshwater marshes are usually found in bowl-like depressions in the landscape and around lake fringes. They are extremely valuable wildlife habitats and natural pollutant filters.

The freshwater marsh environment supports a high diversity of plant life. The freshwater wetland is generally a mixed community of plants, such as:

- spatterdock
- pickerelweed
- common reed
- broadleaf arrowhead
- common cattail

In addition, the upland borders of these wetlands support the growth of certain trees and shrubs, such as:

- willows
- buttonbush
- red maple

Riparian (stream bank) wetlands occur along rivers and streams, are occasionally flooded, but can be seasonally dry. As these areas flood, nutrients flow in and cause diverse vegetation and wildlife flourish. Upland wetlands are usually found in areas of poor drainage and can be identified by the presence of occasional standing water, wet soils, and plant and animal life adapted to wet conditions. Many small pockets of upland wetlands are found in the study area, e.g., in residential areas where building was avoided because of depressions in the landscape.

Field-Observed Wetlands in the Study Area

During the months of April through July 1994, staff visited most of the wetlands identified on the U. S. G. S. National Wetlands Inventory (NWI) maps in the CZM study area. By observing and recording the conditions of the wetlands, it was documented where wetlands may be in distress or where pollutants like trash, sediment, and debris were affecting them. (The field notes from staff observations are presented in Appendix D.) Such a record of wetland locations and conditions gives local municipal officials a database which may help establish zones or areas of concern within the municipality for protecting all remaining wetlands.

Several of the wetlands delineated on the NWI maps could not be located. Others could not be observed due to lack of access to the area. The physical condition of these wetlands is uncertain. However, any protection policies or recommendations for wetland protection found in Chapter 6 of this report should still be considered and applied to unobserved wetlands per their locations on the NWI maps. These areas may be able to be

accessed in future studies so that protection policies or actions can be more firmly established.

Wetlands and Endangered Species

The Pennsylvania Natural Diversity Inventory (PNDI) is maintained within DER's Bureau of Forestry. PNDI keeps an ongoing database of rare, threatened, or endangered species and their habitats so that their survival status can be monitored. When contacted regarding the Neshaminy Creek study area, PNDI responded with a list of protected plant species. Each location designated as habitat for these species is shown on Figure 7.

The Morris Arboretum of the University of Pennsylvania catalogs endangered flora species and periodically its staff does field observations to update species status. Appendix G has been compiled from study area specific data collected by the Morris Arboretum. Each location designated as a species habitat is shown on Figure 7.

The PNDI and Morris Arboretum data are significant for local officials and agencies. The species on both lists are protected under federal and state endangered species laws which means that their habitats are also protected. It is the responsibility of local governments, both county and municipal, to develop policies and enact ordinances and other management measures which will preserve and protect the environment of these species.

Based upon field observations within the study area and information from the PNDI and Morris Arboretum natural resource inventories, it was determined that a significant number of endangered, threatened, and rare plants grow in the study area. Examples of endangered plant species in the study area are:

- Walter's barnyard grass
- Wright's spikerush
- willow oak
- purple sandgrass
- long-lobed arrowhead
- Smith's bullrush

In addition, several reptiles, amphibians, birds and mammals are now endangered due to habitat loss and pollution. Examples include:

- coastal plain leopard frog
- bog turtle
- osprey

The Need for Protection of Wetland Species

The Delaware Estuary and the freshwater and tidal wetlands found along the Neshaminy Creek are valuable natural resources in Bucks County. While these and certain upland wetlands occur in the study area, urbanization has taken its toll on valuable plant and

wildlife habitats. Preservation of the remaining wetland habitats is essential for the continuation of these unique plant and animal species in the Neshaminy watershed. The chapters which follow provide information on regulations, structural techniques, and policy decisions which are all part of an overall strategy for wetland protection, not only in the study area but for all of Bucks County's coastal zone municipalities.

SUMMARY

As Bucks County has developed, wetland areas have decreased. Laws, policies, and management plans protecting wetlands are common, but wetlands are still being lost or negatively affected by certain types of harmful human activities. For example, when wetlands are drained, filled or polluted beyond their natural filtering capacity, the overall environment is compromised. Thus, the natural benefits once afforded to humans and wildlife are lost. The study produced an inventory the remaining wetlands in the study area. The educational brochure developed as part of the study points out significant wetlands in the study area and explains their importance as part of the natural environment and their usefulness as natural pollutant mitigation mechanisms. The next chapter focuses on the importance of wetland protection and discusses regulations and policies at all levels of government necessary to foster such protection.

CHAPTER FOUR

Wetlands Protection

Chapter Four

WETLANDS PROTECTION

In recent years, wetlands have become the focus of protection and management efforts as their value to humans and wildlife continues to be further recognized. In the last two decades, state and local involvement in wetland protection has increased to foster water quality improvement, flood management, and species protection.

The Importance of Wetlands

The ability of wetlands to naturally cleanse water is well documented. For example, stormwater runoff contains various pollutants because as water runs over roads, parking lots, lawns, farm fields, and other natural and man-made surfaces, it picks up a number of materials including dirt, fertilizers, pesticides, oil, grease, and heavy metals. If not properly managed, such pollutants can end up in surface water bodies and groundwater. Wetlands act as pollution filtration systems and have the ability to intercept the flow of sediments, nutrients, and other contaminants. Thus, wetlands can protect surface and ground water sources from natural and human pollutants.

Wetlands also reduce flooding and related problems because they naturally store runoff after heavy rainfalls. By slowing the flow of water to streams and rivers, wetlands reduce the seriousness of flooding events. Therefore, in their natural state, wetlands are a critical flood control element.

Wetland habitats are home to many types of plants and wildlife. When abundant water and an adequate buffer are provided, waterfowl, mammals, and reptiles have an area to nest and feed. Because a significant amount of wetland habitat has been lost due to draining and filling of those areas, certain flora and fauna have become rare, threatened, or endangered.

Wetlands Protection and Mitigation

Wetlands in the study area are some of the most valuable in the Bucks County. They include the increasingly rare tidal wetlands, home to many rare or endangered species of plants. Some of these species remain only as a few plants. Because these wetlands support an environmental diversity and richness of habitats it is critical to protect the remaining sites.

The restriction and limitation of their use have been the two most common strategies for protecting wetland areas. However, there has been a recent trend toward *mitigation* or

lessening the adverse environmental impact upon wetlands. Examples of mitigation techniques include:

- Avoiding activities in wet areas;
- Minimizing damage to wetlands from human activities; and
- Restoring, enhancing, or creating new wetlands to compensate for wetland losses.

Existing Governmental Policies

Federal, state, and local environmental agencies are involved in the management and protection of wetland areas. Although regulation of land use is generally a local power, several federal and state programs are designed to protect wetland resources. Depending on the land development proposal and the type of wetland affected, five federal agencies may be involved. These include: the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the Federal Emergency Management Agency, the U.S. Fish and Wildlife Service, and the U.S.D.A. Soil Conservation Service.

At the state level, the Pennsylvania Department of Environmental Resources and Pennsylvania Fish and Boat Commission will be involved to some degree. Some of the programs prohibit activity in certain types of wetlands, some require permits for other activities, and others provide funds for federal or local acquisition of wetlands. Other protection strategies include directing development through financial penalties or financial incentives.

Federal Regulations and Policies

Section 404 of the Clean Water Act is the federal law that regulates the discharge of pollutants into the nation's waters and limits the filling or dredging of wetlands. Other applicable regulations include:

- Rivers and Harbors Act
- Coastal Zone Management Act
- Endangered Species Act
- Federal Farm Bill
- Emergency Wetlands Resources Act
- Federal Emergency Management Act
- National Wild and Scenic Rivers Act
- National Environmental Policy Act

Generally, the regulations require that those planning to develop in wetland areas, obtain permits or other types of review and approval prior to construction.

Several policies that have been developed and are common to all agencies include:

- The achievement of no net loss of wetland acreage;

- Increased quantity and quality of overall wetland acreage; and
- Adherence to and improvement of wetlands regulatory and acquisition programs.

At the federal level, wetlands are managed by a combination of laws intended for other purposes and the jurisdiction over wetlands is shared among several agencies. In addition, the federal government has delegated much of its authority to state governments and many of the traditional functions of state agencies (e.g.. fish and wildlife protection) are related to wetland protection. Because watersheds and wetlands cross local government boundaries, and because land use and development is controlled at the local level, municipal governments are becoming more involved in wetland protection activities.

State Regulations and Policies

Pennsylvania has several regulations and planning/acquisition programs that are related to wetland protection including:

- Dam Safety and Encroachment Act (Chapter 105);
- Clean Streams Act; and
- Sewage Facilities Act (Act 537).

Other programs include floodplain management, stormwater management, erosion and sedimentation control, the coastal zone management program, and the state's responsibility to administer the National Pollutant Discharge Elimination System (NPDES) program.

The Pennsylvania Dam Safety and Encroachments Act is considered the primary program for regulating the use of wetlands. Any activity disturbing a wetland requires a Chapter 105 permit. The permit applications are reviewed by DER using several criteria. Recommendations and comments are then solicited from the primary federal agencies, the Pennsylvania Game Commission, and the DER's Coastal Zone Management Program. The program also grants special protection to wetlands classified as "exceptional value." DER will not issue a permit for a dam, water obstruction or encroachment in "exceptional value" wetlands or within 300 feet of them.

Under Section 401 of the Clean Water Act, state water quality certification is required for federal licenses or permits which may result in a discharge into navigable waters. As a result, DER can grant or deny certification to any federally permitted or licensed activity which does not comply with state water quality provisions.

The Sewage Facilities Act is administered by DER. It requires municipalities to plan for adequate sewage management and to acquire permits for new on-site sewage disposal

facilities. Local governments can apply this law to wetland protection by identifying drainage and sewage problems which result from building on wetlands.

As discussed in Chapter One, the PaCZM Program promotes natural resources management on the shores of Lake Erie and in the Delaware River Estuary. The Division of Coastal Zone Programs monitors coastal wetlands, conducts wetland site investigations, provides wetland identification maps, and operates a matching grants program. The program funds wetland identification and management plans and is the funding source for this study.

While federal agencies are implementing a policy of "no net loss" of wetlands, Pennsylvania has made the following policy commitments through the DER's Wetlands Protection Action Plan:

- Protect wetlands through existing permitting programs;
- Coordinate federal, state and local efforts;
- Train DER staff, local governments, the regulated community, and the general public about wetlands protection;
- Reduce delays caused by lengthy permit processing time;
- Develop educational materials.

Many wetland researchers have noted an increased state interest and increased responsibility in wetland protection. This trend is expected to continue.

Local Planning, Policies, and Regulations

Local governments, both county and municipal, can implement wetland policies, regulations, and protection techniques to augment federal and state regulations. For example, long-range planning can serve as an anticipatory management technique used to direct future growth patterns. Such planning can have a direct effect on natural resources including wetlands. Planning tools include local comprehensive plans and natural resource plans. Regulatory tools, including zoning ordinances and subdivision/land development ordinances, can protect wetlands by modifying and shifting land use activities to less sensitive land areas. A number of public and private organizations purchase wetlands, which is an example of a nonregulatory protection approach.

County Level

The 1986 *Natural Resources Plan* provides more in-depth guidance to municipalities by describing applicable wetland regulations, identifying wetlands larger than ten acres and advising 100 percent preservation of tidal marshes, mud flats, upland swamps, and

riverine and nonglacial bogs. The plan also suggests a vegetative buffer and recommends that those protective standards be adopted by municipalities into their regulations.

The recently adopted *Bucks County Comprehensive Plan* (1993) provides planning and policy guidance for the development and implementation of municipal policies and regulations. The county comprehensive plan describes the value of wetlands and advises that municipalities preserve and manage them as well as the vegetative buffer area around them.

The Bucks County Conservation District is the county agency involved in regulating certain types of wetland uses through the Dam Safety and Encroachment Act. Consistent with the trend of the regulation of wetlands increasingly becoming a local responsibility, the Conservation District is now handling a portion of the Chapter 105 program as well as Streambank Rehabilitation and Protection. Permits for several land use activities, including agricultural crossings, minor road crossings, and private recreational docks are administered by the agency as are stormwater permits under the NPDES program.

Municipal Level

Currently, 75 percent of the municipalities of Bucks County use the county policy of complete protection of wetlands and 20 percent all communities had adopted the county's vegetated buffer policy. In the study area, most of the municipalities have adopted the county-suggested wetlands protection policy. However, none of the study area municipalities protect wetland buffers.

The Pennsylvania Municipalities Planning Code enables local governments to create zones for wetlands preservation, although many municipalities choose to set performance zoning standards rather than specifying permissible uses. The most common approach is to set a percentage of an area that must be left undisturbed as in a cluster development. Performance zoning and site capacity calculations can be a highly effective tools because they allow a portion of a tract be developed while limiting the impact on the existing wetlands. Other municipal regulatory techniques that can be used to protect wetlands include the limitation of development in floodplain areas and erosion and sedimentation control plans.

Wetland Acquisition

The outright purchase of a wetland is one way to completely protect an area from encroachment. There are different acquisition options. One approach is to purchase all of the property rights, known as "fee simple acquisition". A less expensive approach allows for the purchase of certain rights that restrict future uses of the land through conservation easements. Finally, a property owner may wish to donate an entire parcel, or perhaps an easement on the portion of the parcel containing the wetland.

Usually, wetland acquisition is the result of a combined effort between private and public concerns. The Nature Conservancy, an international environmental group, has purchased land in Bucks County and then donated it to municipalities for management. The Heritage Conservancy is another local conservation group that has acquired several wetland areas in Bucks County. Their holdings are donated from individual property owners and preserved in their natural state through fee simple donation or by conservation easement.

Local government officials and private groups are in the best position to protect wetlands, since the power to control land use is vested at the local level. Therefore, local planning for wetland protection is critical and local actions should continue to guide growth and development away from delineated wetland areas.

Wetland Creation

One of the purposes of this study was to investigate the feasibility of creating replacement wetlands in the study area in exchange for allowing the disruption of existing wetlands. During the study an extensive review of the literature showed that there has been an ample amount of research which has generated a plethora of information on the subject. Staff has identified several excellent sources on wetland creation which will serve as a springboard for further study. Those sources are listed in the bibliography of this report.

During the research phase of the study, staff found that the EPA's Wetlands Research Program (WRP) has developed an approach for decision making on wetland restoration and creation projects. The approach is based on the development of performance criteria using data obtained from various natural and constructed wetland areas. The WRP approach was developed for freshwater wetland systems; thus, the monitoring techniques and examples given will readily transfer to freshwater nontidal wetlands, such as those found in the upland portions of the study area of this report. However, EPA feels that the approach is not limited to freshwater wetlands. Therefore, applicability to tidal wetlands in the study area appears feasible. The WRP approach includes the following types of recommendations for undertaking a wetlands creation project:

- Gather information about the site;
- Identify wetlands at risk of being lost to development or pollution;
- Use the characteristics of natural wetlands as a guide to developing created wetlands; and
- Set performance criteria and define design guidelines.

The WRP approach also provides a very good basis for answering management questions related to the project, such as: what functional level is achievable for natural wetlands and wetland projects in a particular land use setting; do the projects achieve the level of

function of natural wetlands in similar settings; and how long does it take for projects to achieve the desired level of function?

The approach relies on the philosophy that there will be a better chance for long-term success when designing a created wetland if factors such as surrounding land use, comparable natural wetlands, and similar projects are considered. Such a common sense approach should be applied to any wetland creation project undertaken in the study area.

Staff concluded from its research and field observations that many of the natural wetland sites shown on Figure 7 and listed in Appendix D have potential as demonstration sites for a wetlands exchange project. And, although many stream corridor sites appear to be feasible for wetland creation, the specifics of exactly where and to what extent were beyond the scope of the study. Assistance by professional engineers, hydrologists, and wetland designers will be necessary to further define the details of a wetland creation project.

Furthermore, the actual creation of new wetlands remains a potential tool for water quality enhancement and wetlands preservation within the study area, as well as county-wide. Creating wetlands on a certain site in exchange for a loss of wetlands on another site should be further explored and applied within the context of coastal zone management.

Study Area Corridor of Special Protection

As described in Chapter Two, the study area of this report covers the lower reaches of the Neshaminy Creek watershed. For purposes of the study and to create awareness and engender protection of the remaining wetlands, an overlay corridor was established within the study area. As Figure 7 in Chapter Three shows, the corridor is centered on the Neshaminy Creek and extends a half mile on each side of its banks. Municipalities are encouraged to adopt policies to stringently protect wetlands within the corridor.

Special protection policies and activities (e.g., amending zoning ordinances) within the study area corridor are critical because land use within the corridor includes some of the heaviest residential, commercial, and industrial uses in the county. The impacts on wetlands from these uses can be severe. Wetland vegetation can succumb to sediments, oils, greases, nutrients, and debris. Water contamination in wetlands can threaten groundwater sources. Critical habitat for wildlife, plants, amphibians and reptiles can be destroyed by accidental chemical spills, motor oil dumping by vehicle owners, or inappropriate applications of pesticides or herbicides on residential lawns. By establishing the study corridor along the main stem of the creek, where most of the critical wetlands occur, the study considered additional regulation or protection measures which can be applied to protect sensitive areas as discussed in the next section.

Recommended Protection Policies and Actions

Preservation and management of wetlands in the study area will lead to an improvement in their quality and reduce the loss wetland areas. Therefore, municipalities in the study area are encouraged to adopt the following policies for wetland protection and management in the study area:

- Develop local policies that are consistent with federal and commonwealth wetland policies;
- Strengthen or develop municipal zoning and land development ordinances that are consistent with federal and state wetland protection laws;
- Minimize the loss of wetlands by encouraging alternatives to development projects that alter or degrade wetlands;
- Ensure proper implementation of wetland policies and regulations through adequate enforcement measures;
- Increase wetland acquisition in significant areas for their preservation and management;
- Support wetland creation and restoration projects;
- Increase public education concerning wetland values and the status of wetlands;
- Support policies, plans and projects aimed at the conservation of the Delaware Estuary and the Coastal Zone.

Once the above policies have been adopted municipalities are encouraged to develop an action plan to address protection of the corridor. Actions which municipalities should consider include:

- Implement a new zoning overlay district where the corridor of special concern is shown on the study area map (Figure 7). This district should require specific drainage and stormwater management controls which would eliminate, or reduce and control, source generation of nonpoint pollutant;
- More stringent regulation of existing drainage or stormwater management facilities;
- Require upgrades to existing stormwater management facilities using Best Management Practices (BMPs) to reduce nonpoint source pollution from these facilities;
- Require environmentally sensitive site development;
- Rezoning or down-zoning vacant or empty lots.

SUMMARY

Many wetlands have already been lost in the lower reaches of the Neshaminy Creek watershed. Public agencies, citizens, and the private sector must work cooperatively to protect and conserve wetlands, reduce pollution, and improve water quality. Government, private landowners, and developers can protect wetlands and promote proper stormwater management.

Development regulations and the purchase of development rights are the two most common wetland protection tools. Conservation groups, government agencies, and private individuals often acquire wetlands in order to protect them from development and to keep them in their natural state. Many municipalities in Bucks County recognize the importance of wetland protection and have adopted policies, ordinances, and regulations designed to restrict development in and around them. Chapter Six recommends more specific actions that municipalities can take to reduce nonpoint source pollution and protect wetlands. Such specific actions, when coupled with general policies listed in this chapter, can be used to establish an action plan for implementing wetland and stream protection programs in the study area.

Local regulations are supported by federal and state laws. Depending upon the land development proposal and the type of wetland affected, several agencies such as the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, the Pennsylvania Department of Environmental Resources, and the Pennsylvania Fish and Boat Commission may be involved in the enforcement of regulations and the granting of permits prior to construction.

CHAPTER FIVE

NPS Generation, Characterization, and Management

Chapter Five

NONPOINT SOURCE POLLUTION GENERATION, CHARACTERIZATION, AND MANAGEMENT

For many years, the battle against widespread degradation of surface water focused mainly on point source discharges from wastewater treatment plants and industrial facilities and regulation of those types of facilities became increasingly stringent. Now, for example, all municipal wastewater treatment plants must treat effluent to the secondary or advanced secondary stage, which primarily addresses oxygen demanding pollutants and pathogens. In spite of the trend in regulation, pollutant levels in many surface waters, especially in urbanized areas, remain problematic, sometimes containing levels of pollutants that can be toxic to fish and wildlife. More and more evidence shows that chemicals and toxins found in the urban environment (e.g., oil, grease, lead, zinc, pesticides, herbicides) are ending up as pollutants in surface water. There are many possible sources of nonpoint pollutants such as gas stations, industrial parks, shopping mall parking lots, highways, and railroads. There are many different pathways that nonpoint pollutants can take into surface waters and the study area was found to have a variety of potential pollutant sources.

This chapter presents a discussion of nonpoint source pollutant generation in the study area and suggests management techniques that can be employed to reduce such pollutants. By highlighting the most typical potential pollution sources and recommending potential management practices, this chapter will help the reader distinguish likely cause and effect factors for nonpoint source pollutants in the study area. It also serves to recommend those steps required by the PaDER Coastal Zone Management office to prevent or control the generation of such pollutants.

Nonpoint Source Pollutants

A critical factor in protection of coastal areas is the reduction of nonpoint source (NPS) pollutants. Nonpoint source pollutants are characterized as those pollutants that do not have an easily identifiable source of generation that enter surface water and groundwater systems.

Nonpoint source pollutants may have no specific or consistent point of entry into the water which makes remediation or correction measures very difficult to enforce and tracing NPS pollutants back to a specific point of generation is often impossible. However, certain types of pollutants in water are associated with specific types of human activities, such as land development or farming practices. By narrowing down the potential sources for specific kinds of pollutants, a management plan can be developed.

The study area within the coastal zone coincides with some of the heaviest urbanization found in the county. Concentrations of specific pollutants (e.g., lead, mercury) may be associated with urban land practices. Pollutants commonly associated with urbanization include sediment, nutrients, road salts, heavy metals, petroleum hydrocarbons, pathogenic bacteria, pesticides, oils and greases, lead, viruses and trash/debris. Although actual quantification of such pollutants was beyond the scope of the study, it is likely that all of those substances can be found in the study area in varying amounts due to the wide range of land uses.

The following is a general overview and description of the detrimental impacts of urban pollutants as delineated by EPA. Such impacts result from common activities in populated areas, thus they are all applicable as pollutants of concern in the study area municipalities.

Sediments:

Sediments are generally soil particles dislodged from the main soil body during construction or other earth moving/disturbance activities. Among the detrimental affects of sediments are: increased turbidity, reduced light available for photosynthesis, reduced oxygen levels causing impaired respiration of aquatic invertebrates and fish. Heavy sediments may smother benthic communities and reduce the amount of oxygen available for respiration. Sediments are also responsible for movement of other pollutants into waterways. For example, nutrients such as phosphorous chemically bond with sediments, and oils and greases adhere to the particles. In that way, the sediments carry these other toxic substances into the water.

Oxygen-Demanding Substances:

Dissolved oxygen in water is critical to the healthy function of the aquatic environment in that it is used by aquatic life to sustain basic biological functions. Decomposing organic materials (e.g., dead vegetation, sewage effluent) exert a demand for oxygen and can depress oxygen levels in the water, which leaves less oxygen for fish to and plants to use.

Nutrients:

Nitrogen and phosphorus are nutrients. High nutrient levels in surface waters are often the result of farming activities such as fertilization and can be a result of landscaping activities in residential or commercial areas. Nutrients are often responsible for algal blooms, which exert a demand for dissolved oxygen, which, in turn, can further stress the ecosystem.

Pathogens, Bacteria, Viruses:

Pathogens are disease producing organisms that include certain bacteria and viruses. Pathogens associated with human and animal wastes can be extremely dangerous.

Pathogens in surface water systems are often the result of malfunctioning septic systems and stormwater runoff (e.g., pathogens associated with animal wastes) and can be found in elevated levels.

Road Salts:

Road salts are a serious problem in areas where winter weather events cause periods of snow and ice. Runoff from melting snow carries road salt compounds into surface waters where they can be toxic to benthic aquatic communities. Groundwater aquifers are also at risk of contamination from salt compounds. According to EPA studies, road salts have been linked to well, lake, and stream contamination in New England.

Hydrocarbons:

Oils and greases are petroleum hydrocarbons. Petroleum hydrocarbon pollution is generated from various oil products, including gasoline, which are in abundance in heavily developed areas. Gasoline and oil leaks from cars and trucks as well as waste oil dumping by residents provide ample opportunity for hydrocarbon contamination into surface water and groundwater. When released into the environment, hydrocarbons often adhere to sediments, where they can become enmeshed in the bottom layer of waterbodies and can cause damage to benthic communities.

Heavy Metals:

Heavy metals, such as cadmium, lead and mercury, are often present in stormwater runoff. Heavy metals may cause threats to aquatic life and may be especially dangerous to fish and shellfish. Heavy metals may accumulate in the flesh of these organisms, which in turn, as part of the food web, may be toxic to higher forms of wildlife and humans.

Herbicides and Pesticides:

Herbicides and pesticides can cause problems in surface waterways because in water they breakdown into toxic chemical components. These two pollutants are generally associated with everyday lawn care and maintenance. Some of the larger subdivisions and apartment complexes have extensive expanses of manicured lawn and recreational open space. Proper application and avoidance of over application and accidental spills of herbicides and pesticides would reduce the risk these chemical pose to the environment. An overall reduction of these types of areas and a return to natural shrub or vegetative states would reduce the need for chemical application of those potential pollutants.

Source Generation of Nonpoint Pollutants

Proximity of certain types of land uses to waterways increases the odds that the waterway will be affected by the nonpoint source pollutants described above. The traditional

proximity of dense urban development to rivers and streams makes such locations particularly vulnerable to nonpoint source pollutants. The study area contains land uses associated with the occurrence of nonpoint source pollutants. Table 8 below identifies potential sources of several nonpoint source pollutants.

Table 8

Sources of Urban Runoff Pollutants

Source	Pollutants of Concern
Erosion	Sediment and attached soil nutrients, organic matter, and other adsorbed pollutants
Atmospheric deposition	Hydrocarbons emitted from automobiles, dust, aromatic hydrocarbons, metals, and other chemicals released from industrial and commercial activities
Construction materials	Metals from flashing and shingles, gutters and downspouts, galvanized pipes and metal plating, paint, and wood
Manufactured products	Heavy metals, halogenated aliphatics, phthalate esters, PAHs, other volatiles, and pesticides and phenols from automobile use, pesticide use, industrial use, and other uses
Plants and animals	Plant debris and animal excrement
Non-storm water connections	Inadvertent or deliberate discharges of sanitary sewage and industrial wastewater to storm drainage systems
Onsite disposal systems	Nutrients and pathogens from failing or improperly sited systems

Source: *Guidance Specifying Management Measures For Source of Nonpoint Pollution In Coastal Waters*, EPA Office of Water, 1993.

According to EPA, the most widely recognized contributing sources for nonpoint pollutants that threaten coastal areas are:

- Agricultural runoff;
- Urban runoff (both existing and future development);
- Silvicultural (Forestry) runoff;
- Marinas and recreational boating; and,

- Channelization/channel modification, dams, stream bank and shoreline erosion.

For the Neshaminy Creek study area, the most pertinent of the five major categories are urban runoff, marinas and recreational boating, and, to some extent, stream bank and shoreline erosion. Currently, there is little agricultural activity and no known forestry practices in the study area.

During the 1980s, the EPA conducted the National Urban Runoff Program (NURP) study, which concluded that urban runoff was contaminated primarily by its contact with urban land uses. There is somewhat of a new trend in current theory which points to a lack of evidence that pollutants in urban runoff are solely dependent on land uses within a certain area. There are, however, what are referred to as "hotspots" within the urban landscape.

Hotspots are directly attributable to substantial contributions of pollutants such as hydrocarbons and trace metals. Hotspots appear to be primarily associated with vehicles, such as their maintenance, repair and traffic circulation. In other words, hotspots are more likely to be found in proximity to businesses that service and repair vehicles (e.g., gas stations, auto body shops), commercial ventures that rely on public parking (e.g., malls, supermarkets, convenience stores), and even public transportation areas (e.g., commuter parking lots, airport parking). All of these areas provide continual opportunity for vehicles to deposit petroleum or oil related pollutants in a wide variety of locations. These types of potential contaminant situations are in abundance in the study area due to the urbanized nature of the development.

In addition to those hotspots, land use in general plays a critical role in contributing nonpoint source pollution to surface waters. Land uses in the study area include, for the most part, residential, commercial, industrial, recreational and government facilities (some vacant land does exist, but is relatively small and noncontiguous). Pollutants associated with these types of land uses in a highly urbanized setting are primarily generated through runoff from construction sites, existing development, on-site sewage facilities, and roadways. Primary problems in the lower Bucks region may well include pollutants associated with all of the above, except for on-site sewage facilities since much of the lower Bucks region is sewered, thereby reducing the risk from on-site facilities.

Potential Nonpoint Sources in the Neshaminy Creek Study Area

Opportunities for the generation of nonpoint source pollutants can be found throughout the study area. Potential hotspots abound, such as large commercial strips along Route 13, many densely developed industrial parks, several major transportation routes, and recreational marinas along the banks of the Neshaminy Creek.

The municipalities of Bristol and Bensalem townships are located on opposing banks of the Neshaminy Creek where it empties into the Delaware River. As Figure 8 shows, the

lower reaches of the Neshaminy Creek are fairly densely developed. A core of dense residential development lines the banks of the Neshaminy Creek in many parts of the study area. Further upstream, Langhorne, Langhorne Manor, Hulmeville, and Penndel boroughs are also densely populated. Some properties in the boroughs are located in close proximity to the creek banks, older sites appear to be directly in the 100-year floodplain, and because they are heavily populated, very little land remains in open or vacant conditions. Residential developments further upstream in the Middletown, Lower Southampton, Bristol, and Bensalem townships are newer and are not as dense. The newer developments contain large areas of grass or common open space which is maintained as lawn.

Figure 8

Development Along the Lower Reaches of Neshaminy Creek

The study area contains significant industrial and storefront commercial uses. Corridors found along or accessible to some of the major transportation routes (e.g., Route 13, Route 413, Interstate 95, the Pennsylvania Turnpike, and Route 132) are predominantly areas of commercial strips and industrial parks. Nonpoint source hotspots result from those activities associated with vehicular circulation (e.g., oil leaks); therefore, target areas for mitigation exist within those corridors. For example, industrial parks in this area of the county house some of the larger freight trucking lines, in many locations abutting the Neshaminy Creek and some of the most valuable wetlands remaining in the county. Thus, there is a great potential for contamination from petroleum hydrocarbon, chemical, and roadway pollutants.

Another source of runoff pollution in the study area are dredge spoil mounds, some abutting the Neshaminy Creek. Stormwater runoff from at least one of these dredge spoil mounds in Bristol Township is collected and released through an outlet, which moves the runoff directly into the Neshaminy Creek. Stream banks observed at the site appeared distressed, covered with a thick grayish muck layer which had trapped debris such as sunken marine craft, paper and other litter, and rusting machinery. An oil sheen was also observed at the site on the day of visitation. Little or no vegetation was observed growing on the immediate banks of the creek where the muck has settled.

Expanding development with its associated impervious surfaces creates opportunities for pollutants to collect and travel rapidly into the stream. Land that once was penetrable by stormwater runoff water is covered with impenetrable materials, such as houses, concrete sidewalks, asphalt driveways, and streets. These hard surfaces collect sediments, grit and petroleum pollutants. The pollutants are then washed off during a rainfall into surface waters or stormwater management facilities (detention basins). Impervious surfaces also tend to be smooth, further creating little resistance to flowing runoff.

Increased amounts of water moving across the land creates additional opportunities for the movement of pollutants. Table 9 highlights how an increase in the amount of impervious surface on a site subsequently increases the amount of water running off of the site.

Table 9

Example Effects of Increased Urbanization on Runoff Volume

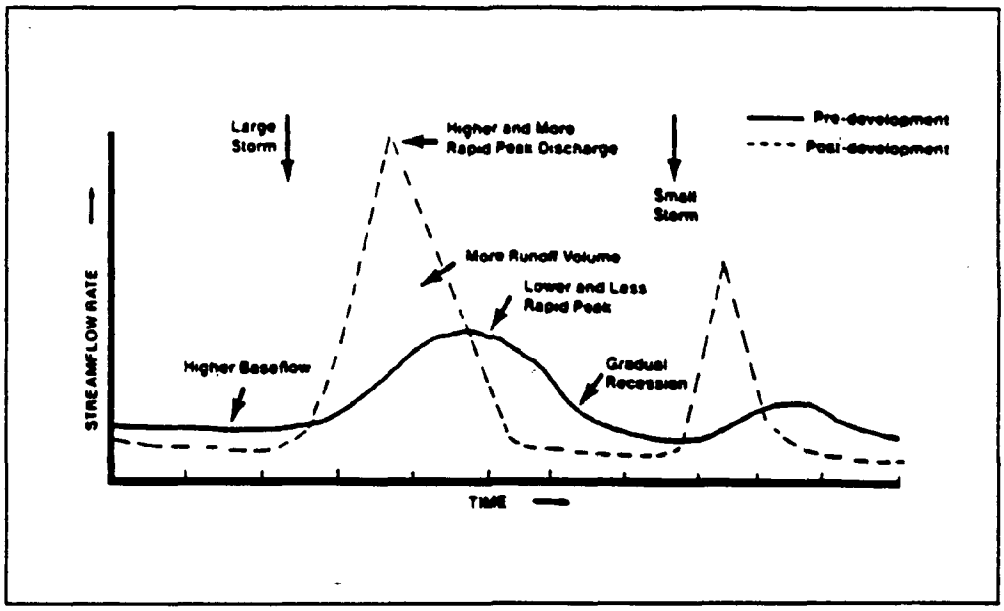
Development Scenario	Predicted Runoff
100 percent open space	2.81 inches (baseline)
70 percent of the total area divided into ½-acre lots; each lot is 25 percent impervious; 30 percent of the total area is open space	3.28 inches (24 percent increase)
70 percent of the total area is divided into ½-acre lots; each lot is 35 percent impervious; 30 percent of the total area is open space	3.48 inches (24 percent increase)
30 percent of the total area is divided into ½-acre lots - each lot is 25 percent impervious and contiguous; 40 percent is divided into ½-acre lots - each lot is 50 percent impervious and discontinuous; 30 percent of the total area is open space	3.19 inches (14 percent increase)

Source: *Guidance Specifying Management Measures For Source of Nonpoint Pollution In Coastal Waters*, EPA Office of Water, 1993.

Pollutant-laden stormwater runoff further disrupts the hydrology of the receiving stream. There is a reduction in the amount of water percolating into the groundwater table. There are larger volumes of water moving at a faster rate into the stream, which causes damage to the integrity of the stream banks and vegetation. Figure 9 presents examples of changes in stream hydrology due to urbanization. The speed at which stormwater runoff travels may be a major contributing factor in the generation of pollutants such as sediments.

Figure 9

Changes in Stream Hydrology as a Result of Urbanization



Source: *Guidance Specifying Management Measures For Source of Nonpoint Pollution In Coastal Waters*, EPA Office of Water, 1993.

New development generates a need for new services to the community (e.g., additional gasoline stations, commercial shops, and various community services such as hospitals, libraries, emergency response operations). Unfortunately, new development and

community services also increase the potential for generation and transportation of contaminants into the water system. Although it is assumed that new development and associated activities are conducted under the most current regulations and permit requirements, more activities generally will translate to more potential pollution "hotspot" areas. Therefore, a need exists at all levels of governement to ensure that regulations are followed which will minimize the pollution hazard to the greatest extent possible.

The outlet of the Neshaminy Creek is substantially affected by boating and marina operations. For example, Neshaminy State Park, located at the confluence of the Neshaminy Creek and the Delaware River, includes a public marina that currently has no sewage disposal facilities. Other commercial and private marinas lie directly upstream from Neshaminy State Park. Their locations are important because marinas have the potential for the discharge of pollutants directly into the Neshaminy Creek. Marina sites typically support various activities such as repair/maintenance operations for marine craft, dredging operations, fuel tanks and pumps located on the dock, and public service facilities such as rest rooms and restaurants. While not intentional on the part of marina owners, employees, and customers, simple day-to-day accidents or oversights may allow pollutants to enter the waterway. For example, the impacts from dredging (i.e., erosion and sedimentation) and oil or gasoline spills may be dangerous to the habitat of endangered species found in adjacent wetlands.

Stormwater Management Techniques and Water Quality

The use of stormwater management basins for the detention and release of runoff has gained popularity over the past two decades. New stormwater management facilities designed to address water quality, or the upgrade (retrofit) of existing stormwater detention facilities, will primarily occur in the upstream sections of the watershed (i.e., Lower Southampton, Middletown, and/or upper Bensalem). New stormwater management technology in those portions of the watershed will provide a general benefit of pollutant reduction.

Due to the heavily developed nature of the study area, upgrades to existing storm sewer facilities or the implementation of stormwater management basins to provide extended detention of stormwater runoff would improve water quality. However, upgrades to existing facilities may not become the rule since such and undertaking may be cost-prohibitive and administratively unfeasible. Thus, opportunities to upgrade may be limited in the older, existing development in the study area, especially the boroughs of Langhorne Manor, Langhorne, Hulmeville, and Penndel, which have very few stormwater management basins.

In areas of older dense development, relatively inexpensive methods of protecting the drainage system could be retrofitted, including grassed buffer strips on highly impervious

sites or water quality inlets on storm drains to pretreat runoff before it enters the main part of the drainage system. Such methods should be required for new development and encouraged for existing development within the corridor of special protection as delineated on the study area map, Figure 7. Those methods would protect those tidal wetlands along the banks of the Neshaminy Creek from direct contact with nonpoint source pollutants and, in general, reduce pollutant loadings entering the stream. Appendix E presents a more detailed discussion regarding stormwater runoff, nonpoint source pollutants, and pollutant transport and contains excerpts from the EPA technical guidance document, *Guidance Specifying Management Measures For Sources of Nonpoint Pollution In Coastal Waters* (commonly referred to as "Section 6217 Guidance") concerning the advantages, disadvantages, effectiveness, and costs of various stormwater management practices.

Best Management Practices

A Best Management Practice (BMP) is usually a structural facility designed to control stormwater runoff and thereby reduce the negative effects of runoff. BMPs are typically designed to reduce negative impacts such as sediment loading or hydrocarbon contamination by using innovative technology. For example, sand filter inlets in parking lots or grassed buffer strips surrounding industrial sites are BMPs that could be employed in the study area for stormwater control and water quality benefits. Table E-3 in Appendix E outlines various considerations when planning to use structural BMPs.

Field observations by staff indicated that the primary method of stormwater runoff control in the study area consisted of stormwater detention basins. Several stormwater retention basins were also noted. In the more densely populated sections of the study area (e.g., the four boroughs and the southern portions of Bristol and Bensalem townships) very few above ground facilities existed. Storm drains that direct runoff into the stream appeared to be the primary method of control.

BMPs for the control of stormwater runoff and water quality are relatively new to Bucks County, although certain management techniques such as wet ponds and seepage areas (for infiltration) have been used in the past. Many of these facilities have a negative association for both the engineering community and local residents, due in part to improper design and/or poor on-site management. Technological advances over the last 15 years have made strides towards facility design that is more cost effective and less maintenance intensive.

BMPs can be beneficial in the study area if used to remediate areas which have little or no runoff controls. As land is developed or redeveloped, BMPs can be instituted to reduce nonpoint source pollutants. While this will not entirely eliminate pollutants from runoff, it will provide a greater degree of treatment. Stormwater management facilities in the upper portion of the study area, where land remains in vacant or open conditions, are necessary for pollutant reduction and can be more easily implemented. Practices in the

lower portions of the study area, where little or no vacant land remains, must rely on the retrofitting of systems to address nonpoint source pollutants. Areas with storm collection drains may consider the use of water quality inlets or oil/grit separators to provide a measure of pretreatment.

In order to promote the use of BMPs, a concerted effort on the part of federal, state and local governments must occur. Municipal officials must require the use of BMPs or other runoff reduction and control methods. This can be accomplished through municipal comprehensive plans, subdivision and land development ordinances, and zoning ordinances. Nonstructural techniques which assist in removal or reduction of nonpoint source pollutants can support the use of physical facilities. These techniques include minimum maintenance/minimum disturbance site development and an increase of natural site vegetation rather than lawn areas. Federal and state authorities must enable the local municipalities to fund and promote these types of endeavors. Grants or other sources of capital should be established to allow local authorities to prepare and maintain programs which support a reduction in the generation of nonpoint source pollutants. Educational materials, such as design criteria, developed through governmental studies should be available to all design and construction businesses.

The following types of Best Management Practices are applicable to both stormwater management and water quality enhancement. Details on each of these technologies is presented in Appendices E and H.

- Infiltration Basins
- Infiltration Trenches
- Dry Wells
- Vegetated Swales
- Porous Paving
- Retention, Artificial Wetlands, Detention and Nonstructural BMPs
- Retention (Wet) Ponds
- Artificial Wetlands
- Dual Purpose Detention
- Minimum Disturbance/Minimum Maintenance

Potential Demonstration Site for Water Quality BMP Upgrade

One purpose of the study involved identification of a stormwater detention basin in the study area for a future demonstration project. The intention of selecting a demonstration basin would be to evaluate it for potential water quality problems (i.e., judge if pollutants such as greases or oils might enter it due to its physical proximity to a parking lot). A basin (or basins) which seemed to have the greatest potential water quality problems could then be used in a follow-up feasibility study which would recommend design modifications and/or structural improvements to the basin. The goal of modifications to the basin would be improvement of the water quality of the effluent from the basin before it discharges into the watercourse.

For this aspect of the study, the physical condition of thirteen detention basins in the study area was observed. Several basins showed signs of malfunctioning, such as eroded side banks, sediment build up, standing water, and clogged or broken outlet structures. A description of each basin visited is provided in Appendix D of Volume II — Technical Supplement. The number of each site in Appendix D (numbered 68 through 81) corresponds with a number found on Figure 7 of this report.

In performing the field observations, it became apparent that the selection of one basin over another for water quality considerations would require more assessment than was anticipated for the current study. Questions such as the type and frequency of pollutants entering the basin, or the annual maintenance practices performed on the basin are critical to assessing the water quality potential of one basin over another. Basins which may look fairly healthy may have as many problems with water quality as a basin that does not appear to be healthy. This may be due to the type and nature of individual pollutants each basin may receive. Invisible pollutants such as dissolved nutrients or heavy metals such as lead may cause as much environmental damage as those we can see.

Determining the scope and nature of the necessary design and construction to achieve an upgrade will require the services of an engineering firm with expertise in that type of work. A comprehensive scope of design possibilities, cost factors, water quality goals or expectations, and other planning details must be generated prior to embarking on a demonstration upgrade. Thus, the technical aspects of a feasibility study need to be addressed by an engineering consultant.

Based on the field observation data collected during the study, two basins appeared to have potential for a water quality upgrade. This assumption is based on the location and existing condition of the basins when observed by staff. The basin recommended as the first choice is Basin #80 listed in Appendix D and is located on the western shoulder of Haunted Lane in Bensalem Township. Staff could not approach the wetland area because it is fenced off from public access. Because it is located on private property, the administrative and legal aspects of using the facility for a feasibility study would need to be addressed as part of the follow-up study.

Basin #80 is applicable to a follow-up demonstration study mainly because drainage off the road and the employee parking lot on site appears to flow into the basin, thus the potential for accumulation of pollutant materials (e.g., oil and other petroleum hydrocarbons) is presumably great. In addition, the outlet from the basin appeared to be draining to a wetland on an adjoining down-gradient site.

A second basin (Basin #81 in Appendix D) should also be considered for further study. This basin is also located on Haunted Lane, one site up-gradient from Basin #80. It collects drainage from the Water's Edge Business Campus, a business office park containing approximately 10 businesses. From discussions with Bensalem Township staff, it was determined that complaints have come from surrounding property owners

about odors from the basin. It was also learned that the basin had been designed as a detention basin on site development plans but was in reality acting as a retention facility.

Basin #81 collects runoff from a large parking area. The potential for pollutants associated with vehicles is similar to that described above for the Basin #80. There is also the factor of odors emanating from the basin in warmer weather. Odors associated with pools of water are generally a signal of eutrophication due to a lack of oxygen in the basin and is associated with nutrient (primarily nitrogen) pollution. It is interesting to note that there appears to be a thriving permanent aquatic community present in the basin. Staff observed minnows, frogs, and snapping turtles on each day of the field observation.

Based on the field observations completed during the study, the recommended site for a future demonstration project is Basin #80, with Basin #81 as an alternative site. However, the final decision to use Basin #80 should be made as part of a follow-up study, using the expertise of a engineering consultant.

Management Measures and Practices for Nonpoint Source Programs

In developing methods within this study for the control and reduction of nonpoint source pollutants, the BCPC was required by the Pa CZM to incorporate management measures for nonpoint source pollutants from EPA's *Guidelines Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters,* issued under the authority of Section 6217(g) of the Coastal Zone Act Reauthorization Amendments (CZARA) of 1990. The purpose of the guidelines document is to direct the preparation of state coastal management programs in preparing their own plans in conformance with the established federal guidelines.

CZARA defines management measures as "...economically achievable measures to control the addition of pollutants to our coastal waters, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives." States are required to include management measures in their respective coastal management programs which conform to the CZARA regulations.

Management practices are included in the Section 6217 guidelines for illustrative purposes only. State programs are required only to conform to management measures, but are permitted to recommend practices which can be used to achieve management measures. Thus, individual states can be flexible in implementation of nonpoint source reduction techniques. Rather than require specific technology, facilities or practices to reduce nonpoint source loading, state programs can specify target reductions in nonpoint source loading in state waters overall. Target reductions can be attained in any manner feasible as long as a reduction takes place. This allows municipalities and private interests to utilize technology or methods that are best suited to their individual, or site

specific conditions. Innovative or alternative methods are also encouraged, which may lead to industry-wide standards over time.

Management practices have been included in this report from many different sources. Where available, information has been included to provide comparison data between different types of practices, effectiveness, cost, and maintenance factors. The recommendations presented in Chapter Six are intended to assist municipalities with the implementation of standards or mechanisms which will reduce pollutant loading.

SUMMARY OF MANAGEMENT MEASURES

1. **Management Measures for Reduction of Nonpoint Source Pollutants from Urban Sources**

   - **New Development: Removal and Reduction of sediments**
     - Reduce the average annual total suspended solids (TSS) loading by 80 percent;
     - Reduce post development loading of TSS so that the average annual TSS loadings are no greater than predevelopment loadings;
     - Maintain post development peak runoff rate and average volume at predevelopment levels.
   - **Watershed Protection**
     - Avoid development of areas that are susceptible to erosion and sediment loss;
     - Preserve areas that provide important water quality benefits; and
     - Site development, including roads, highways, and bridges, in ways which protect the natural integrity of natural drainage systems.
   - **Site Development**
     - Protect areas that provide important water quality benefits;
     - Limit increases of impervious areas, except where necessary;
     - Limit land disturbance activities such as clearing and grading, and cut and fill;
     - Limit disturbance of natural drainage features and vegetation.

2. **Management Measures for the Prevention of Pollution**

   - **Pollution Prevention**
     - Prevent and reduce nonpoint source pollutant loadings from activities normally occurring within an urban environment.

- Improper storage, use and disposal of household hazardous chemicals, including; auto fluids, pesticides, paints, solvents etc.

- Lawn and garden activities, including the application and disposal of lawn care products, and leaves and yard trimmings.

- Turf management on golf courses, parks and recreational areas.

- Improper operation and maintenance of on-site disposal systems.

- Discharge of pollutants into storm drains.

- Commercial activities including parking lots, gas stations, and others not required to use the NPDES permitting system.

- Improper disposal of pet excrement.

3. **Management Measures for Roads, Highways and Bridges**

- **Planning, Siting and Developing Roads and Highways**

  - Protect areas that provide important water quality benefits or are particularly susceptible to erosion.

  - Limit land disturbance such as clearing and grading, and cut and fill to reduce erosion and sedimentation.

  - Limit the disturbance of natural drainage features and vegetation.

- **Bridges**

  - Protect sensitive and valuable aquatic ecosystems.

  - Protect areas providing water quality benefits.

  - Maintain stream integrity

- **Operation and Maintenance of Roads, Highways and Bridges**

  - Incorporate pollution prevention procedures into the operation and maintenance of roads, highways and bridges to reduce pollutant loadings to surface waters.

- **Road, Highway and Bridge Runoff Systems**

  - Develop and implement runoff management systems for existing roads, highways and bridges to reduce runoff pollutants concentrations and volumes entering surface waters.

  - Identify priority and watershed pollutant reduction opportunities (e.g., existing structures improvements).

- Establish schedules for implementing appropriate runoff controls where necessary.

4. Management Measures for Marinas and Recreational Boating

- **Marina Flushing**

  - Site and design new or expanding marinas such that the tides and/or currents assist in flushing and renewing its water regularly.

- **Shoreline Stabilization**

  - Where shoreline erosion is a nonpoint source pollution problem, shorelines should be stabilized.

  - Vegetative measures are preferred over structural methods unless cost effectiveness is a factor.

- **Management**

  - Implement effective runoff control strategies which include the use of pollution prevention activities and proper design of hull maintenance areas.

  - Reduce average annual loadings of TSS in runoff from hull maintenance areas by 80 percent. This reduction is determined on an average annual basis, applies to hull maintenance areas only.

- **Sewage Facilities**

  - Install pumpout, dump station and restroom facilities where needed at new and expanding marinas to reduce the release of sewage to surface waters. Design these facilities to allow ease of access of access and post signage to promote use by the boating public.

  - Provide adequate and reasonably available pumpout facilities for all boaters.

  - Conduct a comprehensive boater education project.

- **Solid Waste Management**

  - Properly dispose of solid wastes produced by the operation, cleaning, maintenance and repair of boats to limit entry of solid wastes into surface waters.

SUMMARY

Based on the highly developed nature of the area delineated for this study, urban runoff is considered the primary contributing factor to nonpoint source pollution. It is fairly certain that land use and nonpoint source pollutants are intrinsically tied together. Retaining the valuable natural resources in the coastal zone of Bucks County becomes increasingly more difficult as increasing population impacts the remaining open and undisturbed land.

Dense residential neighborhoods, highly commercialized strips along major travel corridors and intense trucking operations associated with industrial parks all lend to a build up of dangerous conditions which can produce hotspots of pollution. The critical nature of the remaining wetlands directly along the main stem of the Neshaminy Creek and the Delaware Estuary create an imperative for those areas directly contributing runoff and pollutants to the surface water of that environment. A system of protection — from required structural improvements to special protection regulation to implementation of management measures and practices — can reduce nonpoint source pollutants thereby maintaining and enhancing the rich, productive diversity of the sensitive coastal zone.

CHAPTER SIX

Conclusion and Recommendations

CHAPTER SIX

CONCLUSION and RECOMMENDATIONS

Conclusion

The study gathered much useful information on the natural resources of the study area. Wetlands and species habitats were inventoried and mapped. This type of information, along with information on the use of best management practices for stormwater control, is intended for use by municipalities in updating municipal comprehensive plans, zoning ordinances, and/or subdivision regulations. The specific municipal policies and actions for nonpoint source pollutant mitigation and wetland protection presented in this chapter, if implemented, will foster wetland conservation and be consistent with the objectives of the PaCZM program.

Another result of the study was production of a public awareness publication which focuses on the significance of wetlands in the study area and explains their importance as part of the natural environment and as natural pollutant mitigation mechanisms. The educational brochure will be distributed to local municipal officials, conservation groups, and the public to increase public awareness of the connection among land use, wetland protection, stormwater management, and the improvement of water quality in the Delaware Estuary and its tributaries.

The study set out to identify a demonstration site to investigate the possibility of implementing an upgrade to a standard stormwater detention basin within the study area. Several potential demonstration basins were identified and are listed in Appendix D. Based on the field observations completed during the study, the recommended site for a future demonstration project is Basin #80, with Basin #81 as an alternative site. It is recommended that a follow-up study be conducted to select a demonstration basin to show how such a facility could be retrofitted and brought up to a level of a best management practice for water quality control.

Research during the study found that restriction and limitation of use have been the two most common strategies for protecting wetland areas. The recent trend toward mitigation, or lessening, the adverse environmental impact upon wetlands include techniques such as avoiding activities in wet areas, minimizing damage to wetlands from human activities, and restoring, enhancing, or creating new wetlands to compensate for wetland losses. The study concluded that many of the natural wetland sites shown on Figure 7 and listed in Appendix D have potential as demonstration sites for a wetlands exchange project. While the feasibility of creating wetlands in the study area was established during the study, the specifics of exactly where and to what extent this can be

done should be further explored in a follow-up study using the approach discussed in Chapter Four as a springboard.

The population, housing, and employment trends and projections discussed in Chapter Two indicate that the study area municipalities will continue steady growth for the foreseeable future. That growth is likely to cause additional potential impacts on the local environment and its natural resources. Therefore, advance planning must be done to avoid adverse impacts from the projected growth. The application of the results of this and any follow-up studies are intended to provide the necessary planning which will lead to the improvement of the water quality of the lower reaches of the Neshaminy Creek and the Delaware Estuary. Although the study focused on the lower reaches study area and the recommendations are aimed at those municipalities, there is applicability of most of the recommendations in the remainder of the Neshaminy Creek watershed and county-wide. The following recommendations, in the form of policies and activities, when implemented, will contribute to overall improvement of the environment of the study area.

Recommendations

To promote wetland protection and manage nonpoint source pollutants in the study area, the following polices and activities are recommended for short-term (i.e., within the next one to three years) implementation. Implementation success should be monitored and reviewed by the county and, after three years, new or modified policies and activities and/or a new course of action should be developed.

The policies call for minor amendments to municipal zoning ordinances and/or subdivision and land development regulations. The use of ordinance restrictions is a relatively low cost approach to reducing nonpoint pollutants. Some of the recommended ordinance amendments for zoning or subdivision / land development regulations are specific to the corridor of special protection established along the banks of the Neshaminy Creek (refer to Figure 7).

The recommended municipal activities which follow are in bold face type followed by a brief rationale to clarify the intent of the policy or activity. Rationales are provided for the municipal activities because of the somewhat technical nature of the recommended actions.

Nonpoint Source Pollutant Mitigation Policies

State

- Promote recent EPA guidance specifying NPS pollution management measures as required by Section 6217 of CZARA.

County

- Encourage municipalities to update ordinances and regulations to address the management of NPS pollution.
- Promote the use of best management practices for managing NPS pollution.
- Promote pollution prevention assessments and NPS reduction strategies in the businesses and industries.
- Encourage alternative design and maintenance for impervious parking lots during subdivision and land development reviews under the Pennsylvania Municipalities Planning Code.
- Promote recycling programs for used oil, antifreeze, and household hazardous waste.
- Encourage litter control in commercial and industrial areas as well as in residential communities.
- Promote proper operation and maintenance of on-lot disposal systems (OLDS).
- Promote water conservation.

Municipal

- Encourage the use of cluster development in lieu of large lot subdivisions to reduce the amount of site disturbance and the amount of impervious surface.
- Promote the updating of municipal ordinances to include BMP's for the management of NPS pollution.
- Promote the development of an OLDS management program and ordinance.

Nonpoint Source Pollutant Mitigation Activities

State

- Assist counties and municipalities in NPS pollution control activities by providing funding in the form of grants for further research and assistance in carrying out recommended activities.

County

- Assist municipalities in updating ordinances and regulations that address the management of NPS pollution.
- Implement NPS pollution prevention education programs to encourage the reduction of nonpoint source pollutants.
- Support community programs which develop NPS pollution awareness, such as storm drain stenciling to discourage dumping of pollutants (e.g., used motor oil).

Municipal

The following municipal actions generally involve enacting and/or enforcing municipal ordinances and regulations. Some municipalities have already taken these types of actions but may wish to consider updating based on the following recommended performance standards.

- **Require small lot developments (less than 7500 square feet) to have no more than 10 percent impervious surface.**

  Rationale: A reduction in impervious surfaces reduces runoff and if left in natural vegetative conditions, can reduce pollutants.

- **Require that lots with established vegetation and/or mature trees clear no more than 20 percent when developing and less than 10 percent if slopes over 15 percent exist on site.**

  Rationale: This practice will reduce surface runoff, protect natural slopes, reduce cut and fill practices, promote infiltration and potentially reduce pollutant opportunities.

- **Establish mandatory buffer zones along stream banks where no construction activities or development can occur within 100 feet of the stream, or within the floodplain, whichever is greater.**

  Rationale: This will reduce erosion and sediment generation. Buffer zones are extremely important to maintain and preserve the character of the stream. Minimizing the use of heavy equipment on soils maintains soil body integrity to encourage infiltration.

- **Require no disturbance of steep ridge lines, nor any construction activities within 100 feet.**

  Rationale: This will reduce erosion and sedimentation. It also reduces the need for cut and fill or grading operations which destroy the integrity of the soil and slope.

- **Encourage a 100-foot minimum separation distance between principal structures to allow air, light and maintenance activities in areas containing existing natural resources.**

  Rationale: This encourages circulation of light and air to allow vegetation to thrive, as well as establish a protection zone around the resource from construction activities and equipment.

- **Require a minimum 100-foot buffer yard on stream edge lots.**

  Rationale: This increases the distance that runoff must travel to enter a waterway. Filtering of pollutants is more likely in this event.

- **Require a minimum 150 foot lot width, road frontage or width at setback line for stream edge lots or lots containing or abutting areas of natural resources.**

  Rationale: It increases the distance that runoff must travel to enter a waterway. Filtering of pollutants is more likely in this event.

- **Require 50 foot minimum side yards for stream edge lots or lots containing or abutting areas of natural resources.**

  Rationale: This encourages circulation of light and air to allow vegetation to thrive, as well as establishes a protection zone around the resource from construction activities and equipment.

- **Require minimum disturbance and minimum maintenance site development practices for all activities.**

  Rationale: This reduces the amount of site disturbance when developing land and reduces the amount of impervious surface required. It also maintains established vegetation which can reduce runoff.

- **Require the use of BMPs to address water quality.**

  Rationale: On-site stormwater management practices for new development that are designed to BMP standards would maintain predevelopment runoff rates, protect water quality, and provide mandatory maintenance schedules on a seasonal or annual basis for the effective life span of the facility.

- **Enforce pet leash and clean-up laws.**

  Rationale: Because pet wastes left on the ground contribute significant amounts of nutrients and pathogens to stormwater runoff, removing pet wastes from the environment will help reduce that aspect of NPS pollution.

- **Enforce existing stormwater management regulations.**

Wetland Protection Policies

State

- Maintain current policy of "no net loss" to protect remaining wetland resources in the following order of priority: 1) avoidance of disturbance altogether; 2) reduction of impacts if disturbance must occur; and 3) compensation wetland loss by replacement with newly created wetlands.

- Encourage the federal government to amend Section 404 of Clean Water Act to promote and fund the development of comprehensive wetland management plans at the state, regional, and local levels.

- Adopt a definition of wetlands and a delineation methodology consistent with current federal policy.

- Promote consistent legislation and regulatory actions at all levels of government to enhance, restore, and create wetlands.

County

- Encourage preservation, in 100 percent natural cover, of all wetlands located in tidal marshes and mudflats, upland swamps, adjacent to floodplains, around lake and pond shore margins, and in nonglacial bogs.

- Encourage a buffer (80 percent natural cover) of 100 feet upland from wetland vegetation or to the limit of wet soils (whichever is shorter) to minimize hydrologic modifications and potential for pollution.

- Promote the protection of significant wetlands of Bucks County to preserve critical habitat for species of special concern, valuable storage areas for storm and flood waters, prime natural recharge areas, and stabilizing hydrologic functions.

- Manage county-owned wetlands to maintain and enhance their environmental, scenic, scientific, and educational values.

- Promote increased quantity and quality of wetlands in conjunction with other natural resource protection policies.

- Encourage local governments to adopt wetlands protection policies and regulations in comprehensive plans, zoning ordinances, and subdivision regulations.

- Promote tax-based and other financial incentives to encourage both the protection and acquisition of wetlands.

Municipal

- Promote wetland protection consistent with the *Bucks County Natural Resources Plan* (1986) and the Bucks County Comprehensive Plan (1993).

- Encourage innovative development plans that treat wetlands as a resource rather than a nuisance.

Wetland Protection Activities

State

- Keep legislation and regulations current and consistent with federal regulations.

- Assist counties and municipalities in wetland protection activities by providing funding in the form of grants to enable further research and implementation of the recommended activities listed below.

County

- Inventory wetlands county-wide, review wetland regulations, and develop standards for wetland protection.

- Identify exceptional value and significant wetlands in Bucks County and recommend acquisition and protections strategies.

- Encourage and assist municipalities to update ordinances and regulations.

Municipal

- **Assess remaining vacant land for potential down-zoning or rezoning which would reduce high density activities and create buffers with adequate performance standards to protect sensitive natural areas.**

  Rationale: This is especially important to the remaining wetlands in the study area, or wetland in general. By down-zoning, or reducing the amount and type of use permitted on the site, those lots which are vacant or open may be able to be used to create buffer areas between development and resources.

- **Through the use of performance zoning and natural resource protection standards, create an overlay district in the zoning ordinance for Natural Resource Protection Areas. Reduce densities and restrict impervious surface ratios for sites containing or abutting sensitive sites or corridors.**

  Rationale: By establishing overlay zones on sensitive or protected environmental resources, remaining open land or any redevelopment that occurs must implement restrictions that will benefit natural resources, such as minimum disturbances sites, reduced impervious surfaces and the use of BMPs for the control of stormwater runoff.

- **Modify the zoning ordinance to support a special protection/natural resources overlay district surrounding the main stem of the Neshaminy Creek as delineated for this study.**

  Rationale: Ordinances should reduce impervious surfaces, restrict development densities and uses on remaining vacant or empty sites, adopts buffer standards for wetlands and require a natural resources inventory for all sites being developed.

- **Require endangered species protection inventory.**

  Rationale: Any proposed site development or redevelopement in the corridor would consult any database sources available, (i.e., PNDI files) which may indicate the presence of endangered species on site. Require applicants to submit this information as part of the Act 247 review process.

- **Update municipal comprehensive plans**

  Rationale: The results of this study, the study area map, and species databases in Appendices F and G can be used to help update municipal comprehensive plans to encourage and support the protection of natural resources.

WETLANDS BROCHURE

WETLANDS
in COASTAL ZONE AREAS of BUCKS COUNTY

Bucks County Planning Commission, Neshaminy Manor Center, Doylestown, PA 18901 (215) 345-3400

Wetlands

Wetlands are unique natural systems found where land areas such as forests, beaches, or grasslands meet water bodies such as ponds, lakes, rivers, and oceans. Therefore, they generally combine natural attributes of both land and water. Wetlands are usually identified by the presence of occasional standing water, wet soils, and plant and animal life adapted to wet conditions. Some common names for wetland areas include swamps, bogs, marshes, and mud flats.

The Value of Wetlands

Historically, wetlands have often been thought of as dismal, mosquito-ridden places with little or no economic value. In fact, before the late 1970s, the draining and filling of wetland areas was an accepted practice. However, in recent years as wetlands have been further studied, their value has been recognized. Many of the previous practices that are harmful to wetlands, such as draining and filling, have been reduced. Public attitudes on the value of wetlands are becoming more positive as more information becomes available.

In their natural state, wetlands provide numerous benefits: helping to control floods, reducing loss of eroded soils, improving water quality, helping to preserve fish and wildlife habitat, and providing scientific, educational, and recreational opportunities. However, not all wetlands are of equal value.

For example, some wetlands are not very large or do not contain many different kinds of plants and animals. Such wetlands may be found in heavily populated residential, commercial, or industrial areas. Other wetlands are considered more important or of "exceptional value" because they provide a home to rare or endangered plant and animal species.

***Great Blue Herons** in Bucks County.*

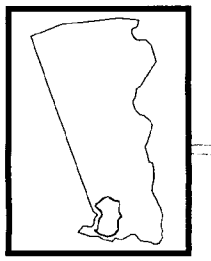
Wetlands In Bucks County

There are many different types of wetlands in Bucks County. They include tidal marshes, freshwater marshes, upland marshes, and riparian (along rivers and streams) wetlands. Although their properties and functions differ depending upon their environment and location, they all play an important role as natural buffer areas.

***Typical upland wetlands** in Bucks County.*

As Bucks County has grown, wetland areas have decreased. Laws, policies, and management plans protecting wetlands are common, but wetlands are still being lost or negatively affected by certain types of harmful human activities. When wetlands are drained, filled, or polluted beyond their natural filtering capacity, the overall environment is affected and their natural benefits and values to humans are lost.

***Riparian wetlands** near the confluence of the Neshaminy Creek and Delaware Riiver.*



Coastal and Inland Wetlands

To better understand Bucks County's wetlands, a look at the bigger picture is helpful. Bucks County is part of the Delaware River drainage basin. The Delaware River flows into the Delaware Estuary which is a semi-enclosed coastal body of water connected to the Atlantic Ocean. Within the estuary, sea water is diluted with fresh water flowing into it from land drainage. Along the estuary, coastal wetland ecosystems are found from the farthest tidal influence at the falls between Trenton and Morrisville to the mouth of the Delaware Bay at Cape May/Cape Henlopen. The most common wetlands found along the Bucks County portion of the Delaware River and its tributaries include tidal salt marshes and tidal freshwater marshes.

In general, a tidal marsh is an area of grasses, sedges, rushes, and other plants that have adapted to continual, periodic flooding. Along the Delaware Estuary there are three distinct types of tidal marshes: salt marshes, brackish-water marshes, and freshwater marshes. All three types are influenced by the ebb and flow of the tides, and vary greatly in salinity, vegetation, and wildlife. Tidal salt marshes are among the most productive ecosystems of the world, and serve to support the spawning and feeding of many valuable marine organisms. Tidal freshwater marshes are close enough to the coast to experience tidal changes, but are not as salty and support different plants and animals than the salt marsh.

Inland wetlands in Bucks County include freshwater marshes and riparian (stream bank) wetlands. Freshwater marshes line the shores of the upper estuary and the tributary streams along the estuary. As the name implies, freshwater marshes are dominated by water draining toward the estuary from upland creeks and rivers. Freshwater marshes are usually found in bowl-like depressions in the landscape and around lake fringes. They are extremely valuable wildlife habitats and natural pollutant filters. Riparian wetlands occur along rivers and streams, are occasionally flooded, but can be seasonally dry. As these areas flood, nutrients flow in and cause diverse vegetation and wildlife to flourish. Both of these inland wetland types occur along the Neshaminy Creek. For example, within the Neshaminy State Park, where the Neshaminy Creek meets the Delaware River, there are numerous wetland plant species of special concern found in an intertidal freshwater mudflat.

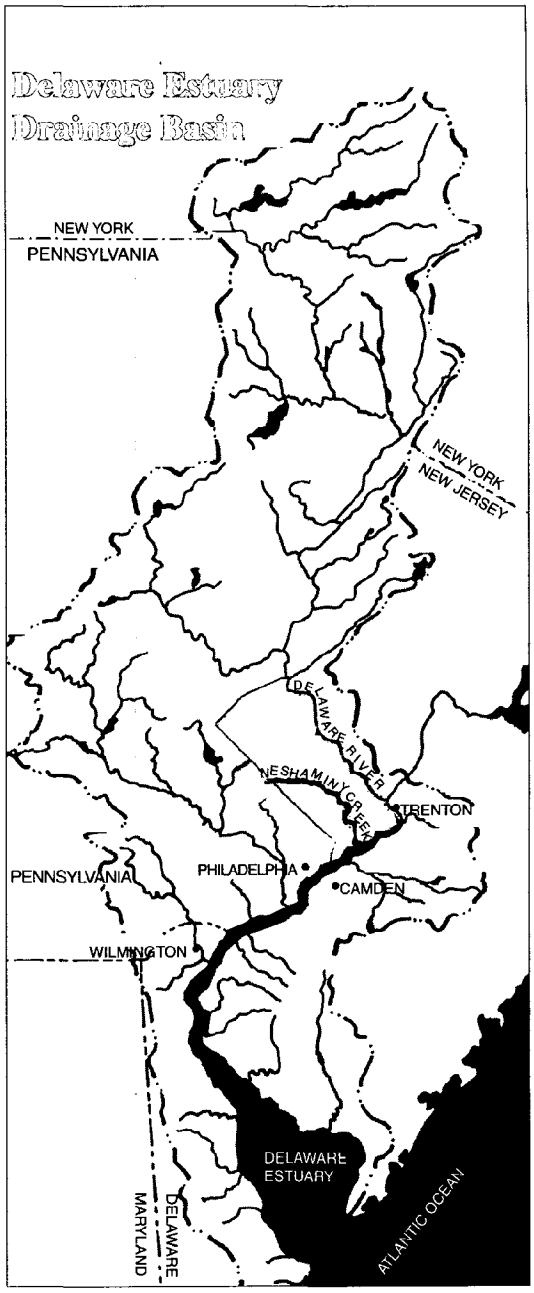
The freshwater marsh environment supports a high diversity of plant life. The freshwater wetland is generally a mixed community of plants, such as:

- spatterdock
- pickerelweed
- common reed
- broadleaf arrowhead
- common cattail

In addition, the upland borders of these wetlands support the growth of certain trees and shrubs, such as:

- willows
- buttonbush
- red maple

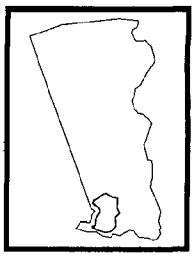
Upland wetlands are usually found in areas of poor drainage and can be identified by the presence of occasional standing water, wet soils, and plant and animal life adapted to wet conditions. Many small pockets of upland wetlands are found in Bucks County, (e.g., in residential areas



Delaware Estuary Drainage Basin. *The drainage basin of the Delaware Estuary covers more than 13,500 square miles. From this region many sub-tributaries contribute water to the two major freshwater tributaries—the Delaware and Schuylkill rivers.*

Source: ***THE DELAWARE ESTUARY:*** *Rediscovering a Forgotten Resource.*

Courtesy: University of Delaware, Sea Grant College Program.



where building was avoided because of depressions in the landscape). While some upland wetlands areas remain, urbanization has taken its toll on these valuable plant and wildlife habits. Preservation of the remaining wetland habitats is essential for the continuation of these unique plant and animal species in the Neshaminy watershed.

The Pennsylvania Coastal Zone Management (PaCZM) Program, a division of the Pennsylvania Department of Environmental Resources, states that wetlands constitute a critical natural resource of national and statewide significance, providing fish and wildlife habitats, natural flood control, improved water quality, groundwater recharge, and environmental diversity. However, many coastal wetland areas have been lost to bulkheading, dredge spoil disposal, and development. Thus, effective management and protection of the remaining wetlands is vital.

The PaCZM Program has established the following objectives to assure that wetlands are protected in the national interest:

1. Avoid to the extent possible the long- and short-term adverse impacts associated with the disruption or modification of wetlands.
2. Provide means whereby ecosystems, upon which endangered and threatened species depend, may be preserved.
3. Make use of wetlands as outdoor classrooms through the acquisition and/or development of appropriate sites.

Wetlands Identification

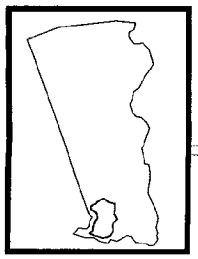
Identifying wetlands requires skill and experience. This is because the regulatory definition of wetlands refers to three basic factors — vegetation, soils, and hydrology — that together determine the presence of wetlands. On-site assessment by qualified experts is the surest method of achieving an accurate delineation. Wetland plant identification is generally the first step in the process. When more than 50 percent of the plants in the subject area include certain wetland species, the site may be classified with some confidence as a wetland. Secondly, the presence of hydric soils, (soils that in their natural, undrained state are saturated at or near the surface during much of the growing season) is an indication of the presence of wetlands. In Bucks County there are six soil series where hydric soil conditions are most prevalent. Finally, hydrology, (i.e., saturated soil and drainage characteristics) is the underlying cause of a wetland condition. Hydrologic indicators such as flooding, standing water, and high groundwater levels can be useful in delineating a wetland site. The *Soil Survey of Bucks And Philadelphia Counties, Pennsylvania*, published by the USDA Soil Conservation Service (SCS) provides more detail on soil drainage characteristics.

***Arrowhead** (Sagittaria latifolia)*

The federal government's current definition of wetlands, promulgated on December 24, 1980:

Wetlands Definition

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



THE NESHAMINY CREEK WATERSHED

Watersheds and Water Circulation

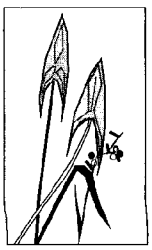
A watershed is simply an area of land that has a certain pattern of natural drainage. All precipitation falling in the watershed either evaporates into the atmosphere, transpires through plants, infiltrates the ground, or runs over the land into watercourses (e.g., streams and rivers). Precipitation running off the land into watercourses creates what is called the "drainage pattern" of a particular watershed.

Freshwater flow contributed by the various watersheds is one of two factors influencing the circulation of water in the Delaware Estuary. The other factor is the tides. The ebb and flow of the tides can move water as much as ten miles up or down the estuary during a single tidal cycle. The tides are responsible for moving a large volume of water into and out of wetlands such as tidal marshes. The tide also divides the marsh into a low marsh and a high marsh. The low marsh floods and drains twice daily with the rise and fall of the tide. The high marsh, which is just slightly higher in elevation, floods less frequently. The division of the marsh into high and low areas accounts for the various types of vegetation found throughout the marsh.

The Neshaminy Creek Watershed

The Neshaminy Creek meets the Delaware River in the southern portion of Bucks County which is densely populated and urbanized with many different land uses. In many areas of Bucks County, this watershed has experienced a substantial loss of wetlands, which began with the draining and ditching of wet areas for farming. In more recent times, they were filled to build housing, industrial facilities, roadways, and recreational areas. Many remaining wetlands within the watershed are now facing new threats from pollution generated by human activities, including stormwater runoff, domestic sewage, household refuse, and industrial wastes. The map on page 5 shows locations of the major wetlands remaining in the lower reaches of the Neshaminy Creek.

The Neshaminy Creek meets the Delaware River at the Neshaminy State Park Marina. *Courtesy of Neshaminy State Park, PaDER.*



Lower Reaches of the Neshaminy Creek.

Watershed Concerns

The Neshaminy Creek Watershed has experienced significant wetland loss which has had negative effects upon the existing plants and wildlife. For example, since the wetland environment supports many types of plants that aid the natural filtering process, the loss of wetlands causes a reduction in the natural pollution control provided in those areas.

Several wetlands within the watershed have been studied and natural resource inventories note the existence of many endangered, threatened, and rare plants. Examples of endangered plant species in the watershed are:

- Wright's spikerush
- purple sandgrass
- Smith's bullrush
- willow oak
- long-lobed arrowhead
- Walter's barnyard grass

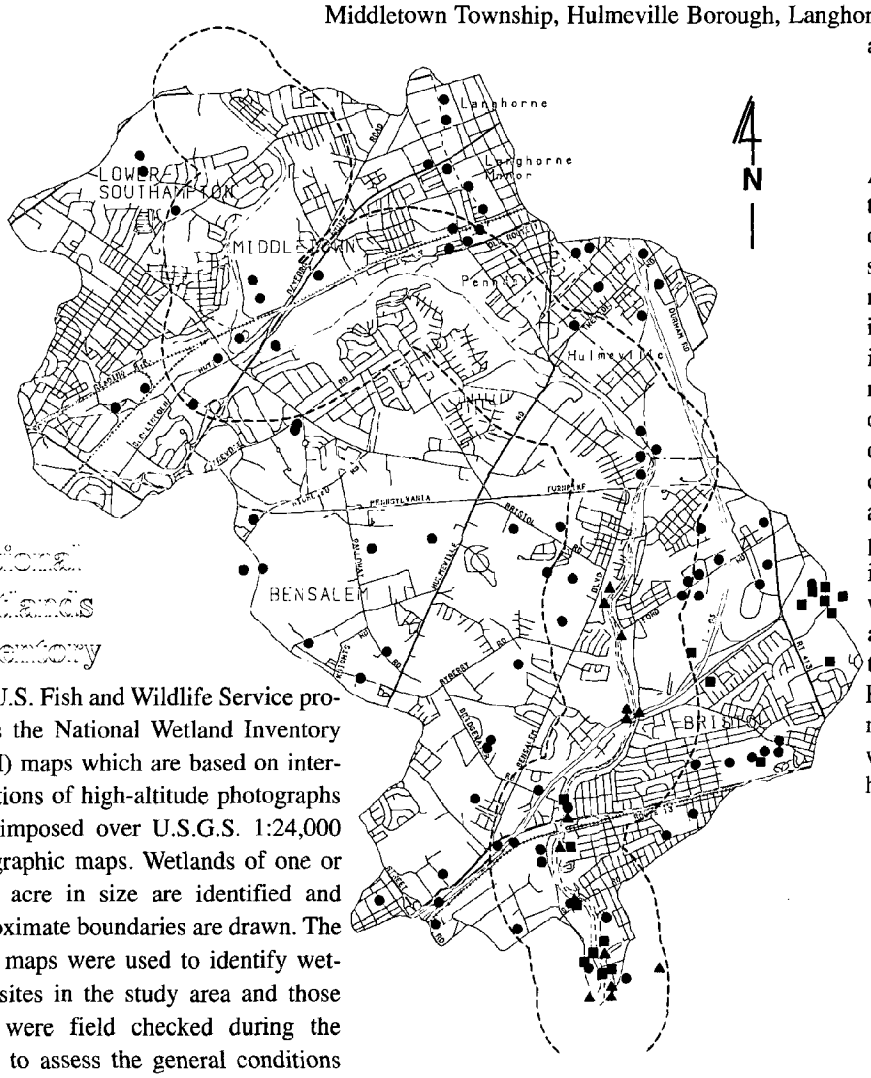
In addition, several reptiles, amphibians, birds, and mammals are now endangered due to habitat loss and pollution. Examples include:

- bog turtle
- osprey
- coastal plain leopard frog

Although much damage has already been done, preservation of the remaining wetland habitats is essential for the continuation of these unique plant and animal species in the Neshaminy watershed.

Wetlands in the Lower Reaches of the Neshaminy Creek Watershed

The map below shows the locations of wetland areas identified in the report, *Neshaminy Creek Nonpoint Pollution and Wetlands Study.* The portion of the watershed most directly connected to the Delaware Estuary Coastal Zone is that area delineated in the *Neshaminy Creek Watershed Stormwater Management Plan* as the "Lower Reaches." The Lower Reaches is defined as that area of the watershed which is tidally influenced by, and directly discharges into, the Delaware River. The Neshaminy Creek and its tributaries traverse several municipalities in the Lower Reaches. These are Bensalem Township, Bristol Township, Lower Southampton Township, Middletown Township, Hulmeville Borough, Langhorne Borough, Langhorne Manor Borough, and Penndel Borough.



Prepared by the Bucks County Planning Commission.
Note: Locations are approximate.

National Wetlands Inventory

The U.S. Fish and Wildlife Service produces the National Wetland Inventory (NWI) maps which are based on interpretations of high-altitude photographs superimposed over U.S.G.S. 1:24,000 topographic maps. Wetlands of one or more acre in size are identified and approximate boundaries are drawn. The NWI maps were used to identify wetland sites in the study area and those sites were field checked during the study to assess the general conditions and pollution factors. Wetlands occurring along the main channel of the Neshaminy Creek, which may be adversely affected by nonpoint source discharges, were inventoried. Municipalities can use that wetland information, in conjunction with NWI maps, in their comprehensive planning efforts. For example, updates of municipal zoning ordinances may include natural resource protection overlay districts based on wetland information derived from the NWI.

Stormwater Management

Another concern in the lower reaches of the Neshaminy Creek watershed and in other urbanized areas of the county is stormwater runoff. Runoff is considered nonpoint source pollution, since pinpointing the varying sources of the pollutants in it can be quite difficult. As precipitation runs over roofs, roads, parking lots, and other hard surfaces, it picks up a variety of pollutants including animal droppings, oil, grease, and heavy metals, such as lead and mercury. If stormwater runoff is not properly managed, pollutants can end up in watercourses, lakes, reservoirs, and wetlands. Wetlands are unique in their ability to tolerate and reduce some of those pollutants by filtering stormwater. However, the increases in housing, commercial activities, and traffic can overwhelm the filtering capacities of even the healthiest wetlands.

***Stormwater runoff** from parking lot and lawns.*

To address stormwater problems, the municipalities of the Neshaminy Creek Watershed have adopted the *Neshaminy Creek Watershed Stormwater Management Plan.* The plan is intended to guide new land development in a manner that will minimize pollution problems related to stormwater runoff and thereby reduce the impact on the natural environment, including wetlands.

Wetland Protection Tools and Regulations

Local regulations are supported by federal and state laws. Depending upon the land development proposal and the type of wetland affected, the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, Pa. Department of Environmental Resources, and Pa. Fish and Boat Commission may be involved in the enforcement of regulations. Current regulations require that those planning to develop in wetland areas obtain permits or other types of review and approval prior to construction.

Federal Regulations and Policies

Section 404 of the Clean Water Act is the federal law that regulates the discharge of pollutants into the nation's waters and limits the filling or dredging of wetlands. Other applicable federal regulations include:

- Rivers and Harbors Act
- National Environmental Policy Act
- Coastal Zone Management Act
- National Wild and Scenic Rivers Act
- Endangered Species Act
- Emergency Wetlands Resources Act

In addition, the federal government has delegated much of its authority to state governments and many of the traditional functions of state agencies (e.g.. fish and wildlife protection) are related to wetland protection. Because land use and development is controlled at the local level, municipal governments are becoming more involved in wetland protection activities. Generally, federal regulations require that those planning to develop in wetland areas obtain permits or other types of review and approval prior to construction.

Several policies that have been developed and are common to all federal agencies include:

- The achievement of no net loss of wetland acreage;
- Increased quantity and quality of overall wetland acreage; and
- Adherence to and improvement of wetlands regulatory and acquisition programs.

Wetlands are managed at the federal level by a combination of laws and the jurisdiction over wetlands is shared among several agencies.

State Regulations and Policies

Pennsylvania has several regulations and planning/acquisition programs that are related to wetland protection including:

- Dam Safety and Encroachment Act (Chapter 105)
- Clean Streams Act
- Sewage Facilities Act (Act 537)

Other related programs include floodplain management, stormwater management, erosion and sedimentation control, the coastal zone management program, and the state program for administering federal National Pollutant Discharge Elimination System (NPDES) requirements.

The Pennsylvania Dam Safety and Encroachments Act is considered the primary program for regulating the use of wetlands. Any activity disturbing a wetland requires a Chapter 105 permit. The permit applications are reviewed by DER using several criteria. Recommendations and comments are then solicited from the primary federal agencies, the Pennsylvania Game Commission, and the DER's Coastal Zone Management Program. DER will not issue a permit for a dam, water obstruction, or encroachment in important wetlands or within 300 feet of them.

The PaCZM Program promotes natural resources management on the shores of Lake Erie and in the Delaware River Estuary. DER's Division of Coastal Zone Management monitors coastal wetlands, conducts wetland site investigations, provides wetland identification maps, and operates a matching grants program. The program funds wetland identification and management plans.

Local Planning, Policies, and Regulations

Local governments, both county and municipal, can implement wetland policies, regulations, and protection techniques to augment federal and state regulations. For example, long-range planning can serve as a management technique used to direct future growth patterns. Such planning can have a direct effect on natural resources including wetlands. Planning tools include local comprehensive plans and natural resource plans. Regulatory tools, including zoning ordinances and subdivision/land development ordinances, can protect wetlands by modifying and shifting land use activities to less sensitive land areas. A number of public and private organizations purchase wetlands, an example of a nonregulatory protection approach.

County Level

The *1986 Natural Resources Plan* provides guidance to municipalities by describing applicable wetland regulations, identifying wetlands larger than ten acres, and advising 100 percent preservation of tidal marshes, mud flats, upland swamps, and riverine and nonglacial bogs. It also suggests a vegetative buffer and recommends that those protective standards be adopted by municipalities into their regulations.

The Bucks County Conservation District is the county agency involved in regulating certain types of wetland uses under the Pa. Dam Safety and Encroachment Act. Consistent with the trend of the regulation of wetlands increasingly becoming a local responsibility, the Conservation District is now handling a portion of the DER's Chapter 105 program and the Streambank Rehabilitation and Protection Program. Permits for several land use activities, including agricultural crossings, minor road crossings, and private recreational docks, as well as NPDES stormwater permits are administered by the agency.

Municipal Level

The Pennsylvania Municipalities Planning Code enables local governments to create zones for wetlands preservation. However, many municipalities choose to set performance zoning standards rather than to specify permissible uses. The most common approach is to set a percentage of an area that must be left undisturbed. Performance zoning and site capacity calculations can be highly effective tools because they allow a portion of a tract to

be developed while limiting the impact on the existing wetlands. Other municipal regulatory techniques that can be used to protect wetlands include the limitation of development in floodplain areas and erosion and sedimentation control plans.

Many municipalities in Bucks County recognize the importance of wetland protection and have adopted policies, ordinances, and regulations designed to restrict development in and around them. In addition, some municipalities require the creation of artificial wetlands when existing natural wetlands must be disrupted.

Wetland Acquisition

The outright purchase of a wetland is one way to completely protect an area from encroachment. There are different acquisition options. One approach is to acquire all of the property rights, known as "fee simple acquisition." A less expensive variation of this approach allows for the purchase of certain rights that restrict future uses of the land through conservation easements. Another scenario is where a property owner donates an entire parcel, or perhaps an easement on the portion of the parcel containing the wetland.

Usually, wetland acquisition is the result of a combined effort between private and public concerns. The Nature Conservancy, an international environmental group, has purchased land in Bucks County and then donated it to the municipality for management. The Heritage Conservancy is another local conservation group that has acquired several wetland areas in Bucks County. Their holdings are donated from individual property owners and preserved in their natural state through fee simple donation or by conservation easement.

Local government officials and private groups are in the best position to protect wetlands, since the power to control land use is vested at the local level. Therefore, local planning for wetland protection is critical and local actions should continue to guide growth and development away from wetland areas.

Funding for Wetland Protection

One of the primary difficulties encountered in protecting natural areas is the lack of financial backing. However, there are several public and private funding sources intended for natural resource protection. For example, the federal Clean Water and Safe Drinking Water acts provide incentive grants that are intended to reduce and eliminate surface and groundwater pollution. Eligible recipients include governments, agencies, businesses, educational institutions and nonprofit groups that are involved in water pollution control, water supply, coastal zone management, watershed protection, wetlands protection, pollution prevention, and environmental education. Eligible activities include pollution control studies, water supply studies, construction of treatment facilities, water quality assessments, planning, wetland conservation plans, watershed protection plans, compliance monitoring programs, restoration projects, and public education. There are also private foundations and corporate giving programs that fund similar conservation efforts.

More information on state and federal regulations and funding sources may be obtained from the agencies listed on the last page of this brochure. Information on municipal regulations may be obtained by contacting the appropriate municipal office.

What We Can Do?

Many wetlands have already been lost in the lower reaches of the Neshaminy Creek watershed. We all can play a part in slowing down the loss of wetlands and reducing the pollution associated with certain types of land development. Public agencies, citizens, and the private sector must work cooperatively to protect and conserve wetlands, reduce pollution, and improve water quality. Government, private landowners, and developers can protect wetlands and promote proper stormwater management. Public support is needed for the following regulations, policies, and actions:

Municipal Government

- Develop or strengthen municipal ordinances to protect wetlands
- Enforce wetland policies and regulations;
- Increase wetland acquisition to ensure their preservation and management;
- Support wetland creation and restoration projects;
- Adopt stormwater management ordinances which control runoff and pollutants;
- Increase public education on the value of wetlands and pollution prevention.

The Private Sector

- Avoid development projects that will alter or degrade wetlands;
- Create new wetlands in exchange for wetlands destroyed during construction;
- Use best management practices to handle stormwater from new development;
- Increase the use of both natural and artificial wetlands for stormwater management;
- Design new land developments with a minimal amount of impervious surface.

The Public

- Encourage municipal officials to take actions necessary to preserve wetlands;
- Reduce the human impacts of pollution on streams, rivers, and estuaries;
- Practice good pollution prevention etiquette. For example, dispose of household wastes (e.g., used motor oil) and boating refuse (e.g., holding tank waste) properly;
- Keep automobiles and boats in proper running condition to reduce emissions.

Reducing nonpoint pollution generated by human activities will improve the water quality of the Neshaminy Creek, its tributaries, and associated wetlands. A cleaner Neshaminy Creek watershed will improve the health of the Delaware River Estuary. The conservation of remaining wetlands, combined with the best possible land management practices, will benefit the environment.

FOR MORE INFORMATION

For more information related to coastal zone management, the Delaware Estuary, stormwater management, and wetlands protection and acquisition, contact the following agencies:

Coastal Zone

Pennsylvania Department of Environmental Resources
Bureau of Land and Water Conservation
400 Market Street, 11th Floor
P.O. Box 8555
Harrisburg, PA 17105-8555
(717) 787-2529

Delaware Estuary

The Delaware Estuary Program
c/o U.S. Environmental Protection Agency
841 Chestnut Street
Philadelphia, PA 19107
1-800-445-4935
(215) 597-9977

Stormwater Management

Pennsylvania Department of Environmental Resources
Bureau of Land and Water Conservation
400 Market Street, 11th Floor
P. O. Box 8555
Harrisburg, PA 17105-8555
(717) 783-7577

Bucks County Planning Commission
The Almshouse, Neshaminy Manor Center
Doylestown, PA 18901
(215) 345-3400

Bucks County Conservation District
924 Town Center
New Britain, PA 18901-5182
(215) 345-7577

Wetlands Protection

U. S. Army Corps of Engineers
Regulatory Branch
Wanamaker Building, 100 Penn Square East
Philadelphia, PA 19107
(215) 656-6734

U. S. Fish and Wildlife Service
Tobyhanna Army Depot
111 Midway Road, Building 1015
Tobyhanna, PA 18466-5031
(717) 894-1275

U. S. Environmental Protection Agency
Region III, Environmental Services Division
841 Chestnut Street
Philadelphia, PA 19107
(215) 597-9301

Pennsylvania Department of Environmental Resources
Water Management Program,
Soils and Waterway Section
555 North Lane
Lee Park, Suite 6010
Conshohocken, PA 19428
(610) 832-6131

Pennsylvania Fish and Boat Commission
Education and Information Office
P. O. Box 67000
Harrisburg, PA 17106-7000
(717) 657-4518

The Nature Conservancy
111 Chestnut Street, 12th Floor
Philadelphia, PA 19107
(215) 963-1400

PENNSYLVANIA DER

Coastal Zone

NOAA

This brochure was partially funded by the Federal Government through the Office of Coastal Management, National Oceanic and Atmospheric Administration, under Section 305 of the Coastal Zone Management Act of 1972 (P.L. 92-583), by the Commonwealth of Pennsylvania, Department of Environmental Resources, Bureau of Land and Water Conservation (DER File No. CZ1:93.04PD — ME#93264), and by the County of Bucks. The brochure was developed by the Bucks County Planning Commission in conjunction with the report, *Neshaminy Creek Nonpoint Pollution and Wetlands Study,* September 1994.

BUCKS COUNTY Planning Commission

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GLOSSARY

GLOSSARY

Benthic: Related to the bottom of a stream, lake, ocean or other body of water.

Best Management Practice: A structural facility designed to control stormwater runoff and thereby reduce the negative effects of runoff.

Bulkhead: A structure or partition to retain or prevent sliding of the land. A secondary purpose is to protect the upland against damage from wave action.

Channel: (1) A natural or artificial waterway or perceptible extent that either periodically or continuously contains moving water, or that forms a connecting link between two bodies of water. (2) The part of a body of water deep enough to be used for navigation through an area otherwise to shallow for navigation. (3) A large strait, as the English Channel. (4) The deepest part of a stream, bay, or strait through which the main volume or current of water flows.

Channelization and channel modification: River and stream channel engineering for the purpose of flood control, navigation, drainage improvement, and reduction of channel migration potential; activities include the straightening, widening, deepening, or relocation of existing stream channels, clearing or snagging operations, the evacuation of borrow pits, underwater mining, and other practices that change the depth, width, or location of waterways or embayments in coastal areas.

Coast: A strip of land of indefinite width (may be several kilometers) that extends from the shoreline inland to the first major change in terrain features.

Coastal area: The land and sea area bordering the shoreline.

Coastline: (1) Technically, the line that forms the boundary between the *coast* and the *shore*. (2) Commonly, the line that forms the boundary between the land and the water.

Constructed urban runoff wetlands: Those wetlands that are intentionally created on sites that are not wetlands for the primary purpose of wastewater or urban runoff treatment and are managed as such. Constructed wetlands are normally considered as part of the urban runoff collection and treatment system.

Erosion: The wearing away of land by the action of natural forces. On a beach, the carrying away of beach material by wave action, tidal currents, littoral currents, or by deflation.

Estuary: (1) The part of the river that is affected by tides. (2) The region near a river mouth in which the fresh water in the river mixes with the salt water of the sea. (3) A semi-enclosed coastal body of water which has a free connection with the open sea and within which sea water is measurably diluted with fresh water derived from land drainage.

Forebay: An extra storage space provided near an inlet of a BMP to trap incoming sediments before they accumulate in a pond BMP.

Freshwater marsh: Wetland areas lining the shores of the upper portions of an estuary and the tributary streams along an estuary, dominated by water draining from upland creeks and rivers. Freshwater marshes may found in bowl-like depressions in the landscape and around lake fringes. They are extremely valuable wildlife habitats and natural pollutant filters.

Gabion: A rectangular basket or mattress made of galvanized, and sometimes PVC-coated, steel wire in a hexagonal mesh. Gabions are generally subdivided into equal-sized cells that are wired together and filled with 4- to 8-inch-diameter stone, forming a large, heavy mass that can be used as a shore-protection device.

Gradient (grade): See *slope*. With reference to winds or currents, the rate of increase or decrease in speed, usually in a vertical; or the curve that represents this rate.

Ground Water: Subsurface water occupying the zone of saturation. In a strict sense, the term is applied only to water below the water table.

Habitat: The place where an organism naturally lives or grows.

Heavy metals: Metallic elements with high atomic weights, e. g., mercury, chromium, cadmium, arsenic, and lead. They can damage living things at low concentrations and tend to accumulate in the food chain.

High tide, high water: The maximum elevation reached by each rising tide.

Hydrologic modification or Hydromodification: The alteration of the natural circulation or distribution of water by the placement of structures or other activities.

Impervious surface: A hard surface area that either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development and/or a hard surface area that causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development.

Load: The quantity of sediment transported by a current. It includes the suspended load of small particles and the bedload of large particles that move along the bottom.

Low tide, low water: The minimum elevation reached by each falling *tide*. See tide.

Marsh: An area of soft, wet, or periodically inundated land, generally treeless and usually characterized by grasses and other low growth.

Marsh, salt: A marsh periodically flooded by salt water.

Marsh vegetation: Plants that grow naturally in a marsh.

Nonpoint source: Any source of water pollution that does not meet the legal definition of "point source" in Section 502(14) of the Clean Water Act. In general, they are diffuse sources of water pollution caused by rainfall or snowmelt moving over and through the ground. (See *point source.*)

Nourishment: The process of replenishing a beach. It may be brought about naturally by long shore transport or artificially by the deposition or dredged materials. .

Percolation: The process by which water flows through the interstices of a sediment. Specifically, in wave phenomena, the process by which wave action forces water through the interstices of the bottom sediment and which tends to reduce wave heights.

Point Source: Any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.

Preexisting: Existing before a specified time or event.

Riparian: Pertaining to the banks of a body of water.

Riparian area: Vegetated ecosystems along a waterbody through which energy, materials, and water pass. Riparian areas characteristically have a high water table and are subject to periodic flooding and influence from the adjacent waterbody. These systems encompass wetlands, uplands, or some combination of these two land forms; they will not in all cases have all of the characteristics necessary for them to be classified as wetlands.

Rip rap: A protective layer or facing of quarry stone, usually well graded within wide size limit, randomly placed to prevent erosion, scour, or sloughing of an embankment of bluss; also the stone so used. The quarry stone is placed in a layer at least twice the thickness of the 50 percent size, or 1.25 times the thickness of the largest size stone in the gradation.

Salt marsh: A marsh periodically flooded by salt water.

Scour: Removal of underwater material by waves and currents, especially at the base or toe of a shore structure.

Shoreline: The intersection of a specified plane of water with the shore or beach (e.g., the high water shoreline would be the intersection of the plane of mean high water with shore or beach). The line delineating the shoreline on National Ocean Servvice nautical charts and surveys approximates the mean high water line.

Sedimentation: The formation of earth, stones, and other matter deposited by water, wind, or ice.

Slip: A berthing space for boats, between two piers.

Slope: The degree of inclination to the horizontal. Usually expressed as a ratio, such as 1:25 or 1 on 25, indicating 1 unit vertical rise in 25 units of horizontal distance, or in a decimal fraction (0.04); degrees (2° 18'), or percent (4 percent).

Soil classification **(size):** An arbitrary division of a continuous scale of grain sizes such that each scale unit or grade may serve as a convenient class interval for conducting the analysis or for expressing the results of an analysis.

Species diversity: The variations between groups of related organisms that have certain characteristics in common.

Stream: (1) A course of water flowing along a bed in the earth. (2) A current in the sea formed by wind action, water density differences, etc.; e.g., the Gulf Stream. See also *current, stream.*

Tidal period: The interval of time between two consecutive, like phases of the tide.

Tidal range: The difference in height between consecutive high and low (or higher high and lower low) waters.

Tide: The periodic rising and falling of the water that results from gravitational attraction of the Moon and Sun and other astronomical bodies acting upon the rotating Earth. Although the accompanying horizontal movement of the water resulting from the same cause is also sometimes called the tide, it is preferable to designate the latter as *tidal current*, reserving the name *tide* for the vertical movement.

Topography: The configuration of a surface, including its relief and the positions of its streams, roads, building, etc..

Upland: Ground elevated above the lowlands along rivers or between hills.

Vegetated buffer: Strips of vegetation separating a waterbody from a land use that could act as a nonpoint pollution source. Vegetated buffers (or simply buffers) are variable in width and can range in function from vegetated filter strips to wetlands or riparian areas.

Vegetated filter strip: Created areas of vegetation designed to remove sediment and other pollutants from surface water runoff by filtration, deposition, infiltration, adsorption, decomposition, and volatilization. A vegetated filter strip is an area that maintains soil aeration as opposed to a wetland, which at times exhibits anaerobic soils conditions.

Wetlands: Those areas that are inundated or saturated by surface water or groundwater at a frequency and duration to support, and the under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions; wetlands generally include swamps, marshes, bogs, and similar areas. (This definition is consistent with the Federal definition at 40 CFR 230.3, promulgated December 24, 1980. As amendments are made to the wetland definition, they will be considered applicable to this guidance.)

Note: Most of the definitions in this glossary were taken from the EPA document, *Guidance Specifying Management Measures For Source of Nonpoint Pollution In Coastal Waters*, published by the EPA Office of Water, 1993.

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RE: DER File No. CZ1:A(93)

Dear Neil:

Enclosed with this letter are two copies of the final plan for the Neshaminy Creek Nonpoint Pollution and Wetlands Study (CZ1:93PD.04). This project was completed with funds provided by a financial assistance award in the Coastal Zone Management Program for the Fiscal Year 1993.

Sincerely,

Robert S. Edwards

Robert S. Edwards
Environmental Planner II
Division of Coastal Programs

Enclosure