New Jersey Coastal Report



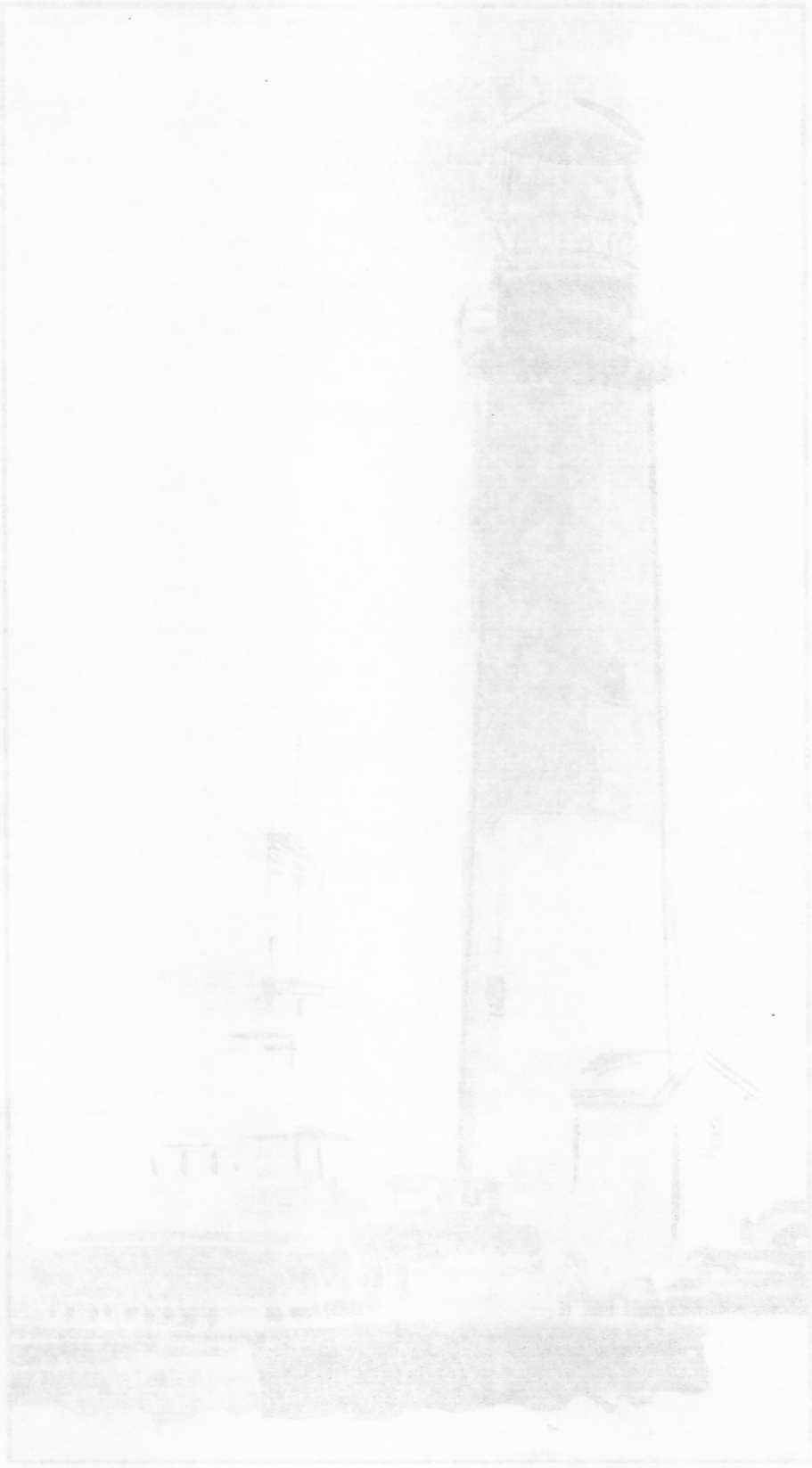
A Framework Document for a Coastal Management Partnership

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New Jersey Coastal Report

A Framework Document for a Coastal Management Partnership

COASTAL ALLIANCE

1997

April 29, 1997

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Executive Summary

New Jersey is blessed with a unique and irreplaceable natural resource -- its coast. Its estuaries, backbays, beaches and shallow marine shelf make up a natural system that has for centuries provided both residents and visitors with an unparalleled bounty of recreation, seafood, forestry and agriculture. This has helped to create a special quality of life available at the shore, and explains why so many of the State's residents live within close proximity of the coast and many hundreds of thousands more visitors take frequent trips to the Jersey Shore.

Given the importance of the State's coastal region to the residents and visitors of the shore, Governor Whitman directed the New Jersey Department of Environmental Protection (NJDEP) to prepare *The New Jersey Coastal Report: A Framework Document for a Coastal Management Partnership* as a discussion piece, a springboard, for renewed cooperation among all of the parties who have a stake in the continued protection and management of New Jersey's coastal areas. One purpose of this Report is to compile and describe in one location the diverse activities and initiatives that are being pursued in the coastal area, which will in turn allow for increased coordination and sharing of information to foster future decisions on behalf of the coast and its beneficiaries.

The Report is intended to provide insight in three basic areas. They are:

1. an understanding of the natural functions of land, air and water types;
2. the interdependency among the components of the coastal ecosystem; and
3. a balanced analysis of the often competing objectives of protecting the health and welfare of the people, the natural functions of the ecosystem and the economic interests of the citizenry.

These concepts provide a foundation to analyze the success of multiple efforts to manage and protect the coastal environment. All of the coastal stakeholders are then challenged to build a comprehensive and effective shore management strategy onto this foundation.

Throughout the Report, information is presented so that it keys in on the coastal management issues that most require focused discussion and debate. The intent of the Report -- along with the Coastal Alliance 1997 being held on April 29, 1997 -- is to provide the background for an informed discussion among stakeholders. The NJDEP then plans to continue the consensus-building process involving all stakeholders, ultimately leading to an adopted New Jersey Coastal Partnership Management Plan.

The majority of *The New Jersey Coastal Report: A Framework Document for a Coastal Management Partnership* describes the conditions of the coastal region and the efforts being implemented to protect and enhance this unique area. The Report is divided into three chapters. They are:

1. Introduction: A Snapshot of New Jersey Shore Protection & Management

This chapter provides a general overview of the current state of the coastal region and the condition of its environment. It also outlines the rationale behind producing this Report and for holding Coastal Alliance 1997. In addition, this chapter lays out the importance of an integrated approach in coastal management and protection that will involve all levels of government and other stakeholders in a cooperative and coordinated effort.

2. The Components of Shore Protection and Management

This chapter comprises the bulk of the Report. Much of it is informational in nature, providing background and scientific findings on the specific aspects of the shore environment. In addition, it looks to highlight the past, present and future initiatives to protect and enhance the coastal area. While constantly emphasizing the interdependence and interconnection that exist between the various components of the shore environment, this chapter is logically ordered into the following sections:

Managing the Land -This section describes the various efforts being pursued to ensure that land use in the coastal area is managed in such a way as to minimize the impacts to the environment and to promote public safety. The Coastal Area Facility Review Act (CAFRA), as amended in 1993, and the need to coordinate its implementation with the State Plan receive special attention. A second discussion item in this section is the status of the public's access to the waterfront and recreational areas. Lastly, the impacts of coastal storms on coastal municipalities and how these impacts are exacerbated by sea level rise is discussed. The shore protection projects that are implemented to mitigate these hazards are also described at length.

Managing the Waters -This section outlines the multiple issues and problems confronting the waters at the shore. Bacterial and toxic contamination, eutrophication, the effects of nonpoint source pollution are examples of the problems that are discussed. There is also a discussion of the State's comprehensive program to monitor and test recreational waters so as to protect public health from exposure to contaminants while bathing. This section discusses the multiple initiatives being pursued by various levels of government to address these problems. The State's plan to assess water quality and quantity in a watershed management framework is the prime example of a newly emerging initiative examined in the document. The Report also provides descriptions of the many ongoing initiatives to improve water quality in the coastal area, some of which have been in place for years, such as the Sewage Infrastructure Improvement Act. While the majority of this section focuses on issues related to water quality improvements, there is

also discussion of water supply, primarily on the issue of aquifer recharge in the Cape May Peninsula, and the dredging of navigational channels throughout the coastal area.

Managing the Living Resources -Since fish and shellfish are such a vital component of both the coastal ecology and its economy, a special section was created to focus on efforts to protect and enhance these natural resources. The newly expanding aquaculture industry is highlighted here. It should be noted that various other efforts (and the effects of those efforts) to protect and enhance fish and shellfish are discussed throughout the **Managing the Waters** chapter. The concluding portion of this section focuses on the efforts to protect migratory birds and endangered species and their habitats in the shore area.

Tools for Successful Shore Protection and Management -This section provides information on several of the tools available to promote many of the efforts and initiatives highlighted throughout this Report. The Geographic Information System (GIS) has become an integral tool to assist environmental decision-making through the State and the coastal region. As this system has grown, the State has developed the ability to take various bits of information and overlay them upon each other, thereby allowing decision-makers to make the most informed judgments possible for a given site. In addition, municipal and local governments have increased their capabilities for instantaneous access to this information. The numerous initiatives in the area of public education are also reviewed. Many programs to protect and enhance the shore environment will only be successful if the public is adequately informed and actively involved.

3. Challenges for the Future

While this chapter is the shortest in length, in many ways it is the most crucial because it sets the stage for future discussion that is to begin at the Coastal Alliance 1997. In five key areas, this chapter attempts to take all of the pieces of information provided previously in the Report and focus them into a series of challenges and questions that can only be answered through dialogue and the development of consensus.

- First, this section asks the pertinent question, *Do We Need a Coastal Advisory Organization?* It is a prime objective that dialogue and consensus-building not end with this Report or the Coastal Alliance 1997 but continue into the future. This reports asks the question whether a formal Coastal Advisory Organization to advise the NJDEP Commissioner as we move forward on a shore master plan is appropriate.

- The second key area focuses on land use and the implementation of State policies such as CAFRA and the State Development and Redevelopment Plan. It is obvious that the manner in which land is used and developed has a profound influence on the coastal environment and on the quality of life for those who live, work and recreate at the shore. As such, it is crucial that the policies pursued to influence and guide land use-related decisions be properly discussed and coordinated so that all stakeholders have an appropriate opportunity for input into the process.

- Third, projects intended to reduce risks to humans and property from coastal storms and other hazards have been the subject of much public debate in recent years. Since the importance of the Jersey Shore as an environmental, economic and social asset is widely recognized, the NJDEP is committed to continuing to pursue projects that will best protect the environment, people and property located in the coastal region. These projects, however, need to be pursued in such a way that local and public involvement and input is recognized.

- Fourth, as New Jersey has made significant improvements to its coastal water quality through control of point sources of pollution, primarily through upgrading sewage treatment in coastal communities, it has become increasingly obvious that augmented efforts are needed to address nonpoint source and stormwater pollution in coastal waters. Because of the diverse and scattered nature of these sources of pollution, the mechanisms to address them will need to be handled through cooperation and management by local governments and the public itself. As such, dialogue between the State and the various stakeholders to address this problem through a watershed management strategy is appropriate.

- Lastly, this section touches upon the relationship between tourism as a component of economic development and environmental protection with a prime focus on promoting eco-tourism.

In conclusion, the reader will find much information in *The New Jersey Coastal Report: A Framework Document for a Coastal Management Partnership*. It is recognized that, due to the many controversies surrounding the future of New Jersey's coast, there is much information and mis-information in the public domain regarding the future outlook for our coast. This report and the Coastal Alliance 1997 meeting are intended to provide focus and momentum to complete a consensus-based master plan for the future management of our coast.

Chapter 1.
Introduction: A Snapshot of New Jersey Shore Protection and Management

Description of this Report

The New Jersey Coastal Report: A Framework Document for a Coastal Management Partnership is intended to be a discussion piece, a springboard, for renewed cooperation among all of the parties who have a stake in the continued protection and management of New Jersey's coastal areas. It is further intended that this will be a template to foster coastal zone management refinement.

One purpose of this Report is to simply compile and briefly describe in one location the multiple and diverse activities and initiatives that are being pursued in the coastal area. Consolidating these activities into one document promotes coordination and sharing of information, which will build the framework for the Plan and a view of the "big picture".

This Report has been created to provide up-to-date information and a snapshot of the status of many accomplishments as well as new initiatives begun by the NJDEP over the past few years. It is not designed to impose government-mandated solutions on coastal management. Rather, it will be used to explore the methods and issues that will lead to a shore protection master plan. Nor should it be considered a rigid "State knows all" approach. Rather, it is the goal of *The New Jersey Coastal Report: A Framework Document for a Coastal Management Partnership* to promote discussion and ultimately consensus and cooperation of state, local and federal government agencies, private businesses and landowners, environmental and tourist interests, and all the other coastal stakeholders.

Finally, this Report is designed to be a resource tool to be used at the Coastal Alliance 1997 on April 29, 1997. It is designed so that the reader will be informed and challenged to participate, not only in this forum, but in the larger process of developing a strategy for shore protection based on sound science and on the input of those who reside,

work and recreate in the area. In this way, the Coastal Alliance 1997 will then provide the basis for a plan to improve the management of New Jersey's coastal resources and waterfront area.

The Need for an Integrated Approach

The New Jersey Coastal Report: A Framework Document for a Coastal Management Partnership -- and the resultant planning of land and water use in the coastal region -- must be based on:

1. an understanding of the natural functions of land, air and water types;
2. the interdependency among the components of the coastal ecosystem; and
3. a balanced analysis of the often competing objectives of protecting the health and welfare of the people, the natural functions of the ecosystem and the economic interests of the citizenry.

This Report will demonstrate how this State has done in meeting these objectives and offers suggestions for efforts that we may want to pursue in the future. Throughout the Report, information is presented so that it keys in on the issues that would most benefit from focused discussion and debate. Namely, in reading the information presented in this Report, the following questions should be continually asked:

1. What is the nature and degree of the problem related to a given issue?
2. What is being done presently to address this problem?
3. Can we do better; are there opportunities for better integrated long-term planning?
4. What are the respective roles of Federal, State and local governments in pursuing these opportunities? and,
5. What is the best method to develop consensus to achieve progress?

In reading *The New Jersey Coastal Report: A Framework Document for a Coastal Management Partnership*, one must constantly keep in mind that the New Jersey coastal area -- with its barrier islands, wetlands, back bays, tidal rivers and all its other natural components -- is a complex mix of interdependent and interconnected systems. The lands, waters, wildlife and even the air of the coast are all intricately linked. Impacts to one particular realm have to be considered and evaluated very carefully as they may create or exacerbate a problem in another.

Human activity also tends to have a range of influences as well. For example, as the Shore is developed, travel to and from the Shore becomes more difficult, greater demands are placed on the region's water supply and access toor parking at beaches may be more difficult. Waters are more crowded with boats and the beaches are more crowded

with bathers. An increase in the human population can also have adverse effects on the area's biological community.

These examples highlight the fact that not only are the natural systems closely interconnected with each other, but they are also inextricably linked to the social, economic and governmental arenas as well. The interlocking network that is created makes it essential that any changes to the management of the shore and its resources must be accomplished through cooperative partnerships involving all public and private stakeholders.

Traditionally, various levels of government, as well as other public and private entities, have each operated under separate mandates, and with different priorities and diverse agendas, particularly where coastal issues are concerned. Federal laws to protect water resources and manage the coastal zone are joined in a complex regulatory mix with state statutes that promote implementation of the state development and redevelopment plan and protect the coastal zone, freshwater and marine wetlands, flood plains and the Pinelands. Lastly, these must be coordinated with local soil erosion, sediment control, subdivision and site plan ordinances.

The regulated public often expresses concern and frustration about the overlapping (and sometimes contradictory) rules, regulations and policies between federal, state, county and municipal governments and the use of standards which are inconsistent among agencies. There is general agreement between the agencies and the regulated public (and their elected representatives) that there is a need to improve the efficiency of the regulatory process, while maintaining and promoting environmentally sensitive growth.

While significant progress has been achieved, incremental loss and degradation of coastal resources nevertheless continues. Much remains to be done to protect the coastal and marine environment for our future. Just as the coastal environment is complicated and ever changing, management approaches must grow and adapt successfully, responding to the natural shore processes and the unique problems presented by people living in the coastal area.

Overview: The Jersey Shore

New Jersey is blessed with a unique and irreplaceable natural resource-- its coastal area. Its estuaries, backbays, beaches and shallow marine shelf make up a natural system that has for centuries provided both residents and visitors an unparalleled bounty of recreation, seafood, forestry and agriculture.

The natural resources of the Shore include shallow ocean and bay waters, the ocean and bay bottoms themselves, estuaries, beaches and dunes. In the bays and offshore waters lie beds of sand and gravel that are periodically mined for beach fill, or dredged during maintenance of the intercoastal waterway. The coastal area is habitat for waterfowl, shore birds, fishes, shellfish and marine mammals and for valuable vegetation including algae, wetland plants like white cedar and salt marsh grass, the dune and other upland plants like beach grass, bayberry, and holly. Coastal vegetation serves as a buffer between the ocean and the uplands by tempering the effects of wave action. Coastal wetlands absorb floodwaters, lessen the impact of extra high tides and act as natural treatment plants by treating and storing pollutants. Coastal waters provide cooling waters for power generation and act as receiving waters for both treated and untreated wastes.

As is the case throughout the nation, the coastal area has for some time been the fastest growing region of New Jersey. The "Jersey Shore", with its 127 miles of oceanfront beaches and temperate climate, is one of the nation's most important and heavily utilized resources (see **Figure 1**). The Shore is the major outdoor recreation area in the State. Ocean swimming and beach sunning alone account for more recreation hours than any other single activity. In addition, it is estimated that more than a million residents fish or crab at the Shore each year. There is a special quality of life available at the shore, which explains why so many of the State's residents live within close proximity of the coast and many thousands more visitors take trips to coastal areas in New Jersey. It is said that one-sixth of the U.S. population can drive to the New Jersey coast on a tank of gas.

Surrounded by water on all sides except on the most northern border with New York, 14 of New Jersey's 21 counties have estuarine or marine shorelines. The coastal environment and marine waters are the basis for tourism, recreation, boating, fishing, bird-watching activities, and commercial fish and shellfish harvesting.

The Jersey Shore is a tremendous economic engine. Last year, travel and tourism in 5 coastal counties (Atlantic, Cape May, Cumberland, Monmouth and Ocean) generated over 12 billion dollars and were responsible for 161,000 tourism-related jobs which have a payroll of over 3 billion dollars. If indirect jobs due to tourism are included, the number increases to 231,800 jobs with a payroll of over 4.8 billion dollars. Marine recreation fishing plays an important role in tourism with approximately one million anglers taking some five million fishing trips from New Jersey's ports annually. Travel and tourism to the shore communities are highly dependent upon the actual and perceived health of the marine environment. Tourism drops conspicuously when there are widespread reports of solid waste, oil or other hazardous substances contamination in the coastal waters, even if these reports are not entirely true.

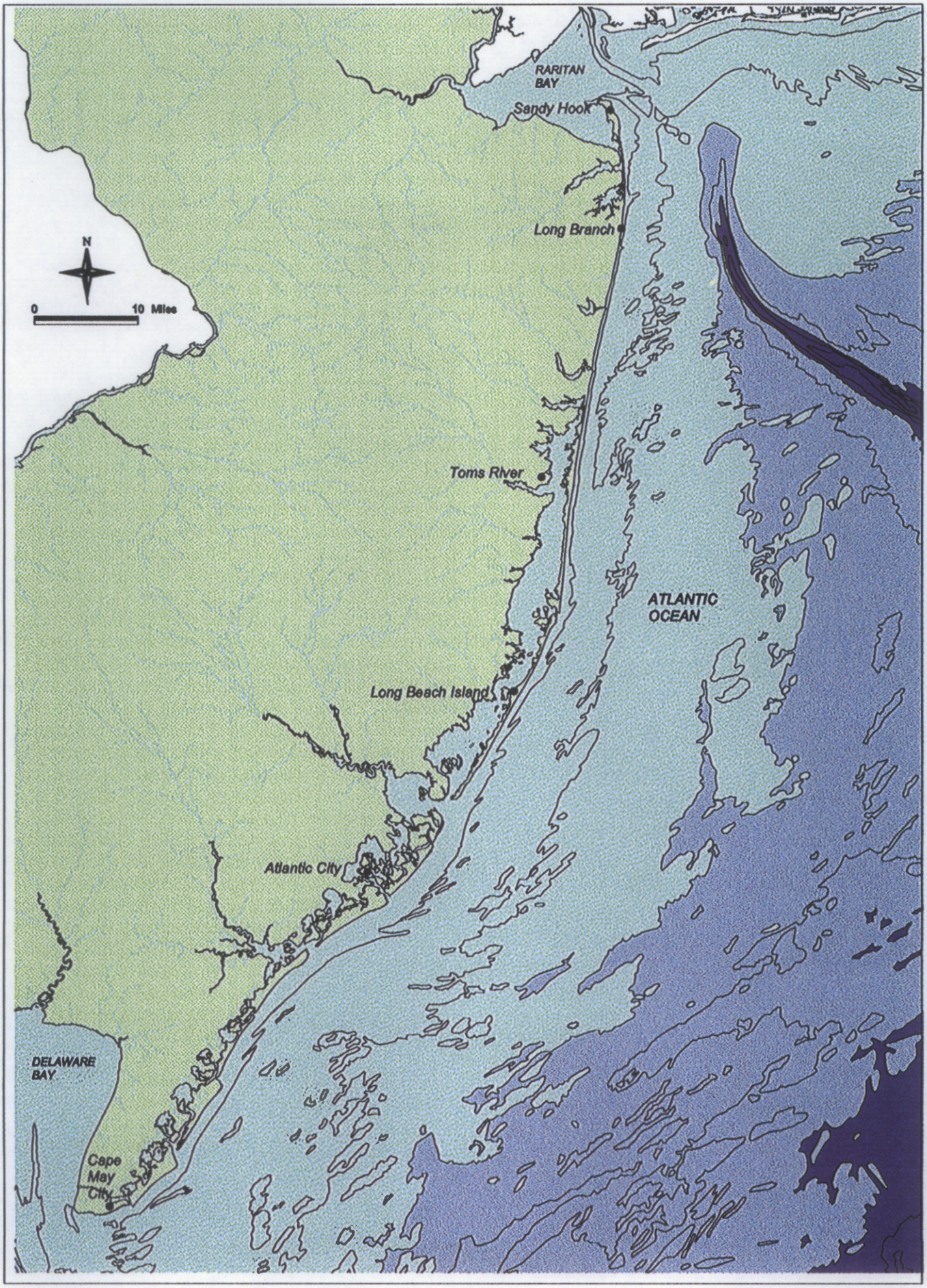


Figure 1. New Jersey Coast



In addition to tourism and recreation, commercial uses of the marine waters are a significant component of New Jersey's coastal economy. Based on 1990 landings data, New Jersey is the largest shellfish producing state in the United States with estimated landings of more than 75 million pounds per year, with a dockside value of over 55 million dollars. Commercial fish harvesting is also important to New Jersey's economy with a total value of over 40 million dollars. The total value is much higher if jobs related to processing and retailing of seafood are included.

In order to protect public health, New Jersey places restrictions on shellfish harvesting in areas of degraded water quality, such as in areas impacted by sewage treatment plants, combined sewer overflows and municipal stormwater discharges, as well as in areas where commercial or recreational docks are constructed due to the contamination from boating activities. (The effects of recreational docks is currently the subject of a study by the NJDEP in conjunction with Rutgers University.)

Given the importance of the State's coastal region, residents and visitors of the New Jersey shore share particular concerns and regularly ask the following questions:

Can I swim in the waters?
Can I eat the fish and shellfish?
How healthy are the waters and the biological community?
Can I get to, park at and use the beaches?
Is my house and family safe in the event of a storm?

In the last few decades, the ocean coastal counties of Monmouth, Ocean, Atlantic and Cape May have been experiencing unprecedented residential and service sector growth. As a result, in addition to more people and property potentially being vulnerable to coastal storms, the Shore natural environment continually experiences pressure from the increased population growth and human activity. In New Jersey, pollution from human activity and various land use activities is known to cause water quality and water use impairments in the coastal zone. Sometimes the effects are direct and immediate, such as beach closures or the downgrading of shellfish harvesting waters due to bacterial contamination. More fundamentally, though, there is a deep concern that the capacity of the coastal environment to function as a healthy, productive ecosystem is declining as a result of the cumulative effects of increasing, accelerated population growth and densities.

Consequently, there must be constant vigilance to ensure that a healthy balance is struck between the use and preservation of coastal resources.

New Jersey was among the first states to recognize that its coastal resources needed special care and attention. This involved recognition that competing uses and intensive development pressure could, if not properly managed, destroy the very features that make the Shore so attractive. With federal approval of the New Jersey Coastal Zone Management Program in 1980, the State embarked on a comprehensive effort to manage its coastal resources by pursuing eight specific goals:

1. Protect and enhance the coastal ecosystem;
2. Concentrate rather than disperse the patterns of coastal residential, commercial, industrial, and resort development, and encourage the preservation of open space;
3. Employ a method of decision-making which allows each coastal location to be evaluated in terms of both the advantages and disadvantages it offers for development;
4. Protect the health, safety and welfare of people who reside, work and visit the coastal zone;
5. Promote public access to the waterfront through linear walkways and at least one waterfront park in each waterfront municipality;
6. Maintain active port and industrial facilities, and provide for necessary expansion in adjacent sites;
7. Maintain and upgrade existing energy facilities, and site additional energy facilities consistent with the policies of the Coastal Zone Management Program;
8. Encourage residential, commercial, and recreational mixed-use redevelopment of the developed waterfront;

This Report and the occasion of the Coastal Alliance 1997 provide not only an opportunity to reflect on our accomplishments in meeting these goals but, more importantly, it forces us to thoughtfully consider the lessons we have learned and to begin to chart new directions based on consensus.

With this said, the following is an evaluation of the various shore protection initiatives and efforts, starting with those related to land use planning and management.

Chapter 2.
The Components of Shore Protection & Management

Managing the Land

Effective and thoughtful land use planning in the coastal zone will allow for both environmentally sensitive growth as well as preservation of the shore's natural resources. One key step in this process is to establish and maintain lines of communication to promote resolution of issues of conflict or inconsistency at their earliest stages. Through the formation of partnerships between federal, state, county, and municipal governments and the private sector, there are opportunities to improve land use management in the coastal zone within the existing framework. This section will now provide a description of the main components of this existing framework -- including both its regulatory and non-regulatory aspects -- starting with the Coastal Area Facility Review Act or CAFRA.

CAFRA

In 1973, the Legislature found that "New Jersey's bays, harbors, sounds, wetlands, inlets... together constitute an exceptional, unique, irreplaceable and delicately balanced physical, chemical and biologically acting and natural environmental resource called the coastal area..." Furthermore, the Legislature recognized that "...the legitimate economic aspirations of the inhabitants of the coastal area and wishes to encourage the development of compatible land uses in order to improve the overall framework of a comprehensive environmental design strategy..." (N.J.A.C. §13:19-2)

Based on these findings, and also that "...certain portions of the coastal area are suffering serious adverse environmental effects...", the Legislature enacted the Coastal Area Facility Review Act, commonly known as CAFRA as the primary mechanism to oversee and coordinate the State's interest in development of the coastal region. This Act was then substantially amended by the Legislature in 1993.

The CAFRA zone (see **Figure 2**) extends from the confluences of the Cheesequake Creek and Raritan Bay in Middlesex County, along the Atlantic Ocean and coastline and Delaware Bay, northwest along the Delaware River to Pennsville, Salem County. Its width

ranges from a few thousand feet to 24 miles from the waterline. In total, it encompasses 1,376 square miles of land area in Atlantic, Cape May, Cumberland, Middlesex, Monmouth, Ocean and Salem counties. The 1993 amendments to the Act made several technical corrections to the description of the boundaries and removed a small area in the Mullica River basin which was in the overlap area of CAFRA and Pinelands jurisdiction.

CAFRA was originally designed to control the development of energy-related or public and industrial facilities along coastal areas as well as commercial developments with 300 parking spaces or residential developments of 25 units or more. In recent years, though, CAFRA had been the subject of criticism since, because developments of 24 units or less were unregulated, there had been a proliferation of small residential developments. As a result, in July 1993 legislative amendments to CAFRA were enacted that effectively closed this "loophole" and made several other changes to the jurisdictional thresholds and administrative requirements of CAFRA. The amendments became effective July 19, 1994.

The 1993 amendments:

- replace the definition of "facility" with a definition of "development" that broadens the types of residential, commercial, industrial and public developments subject to regulation under this Act, eliminating the "loophole" and other exemptions for residential, some industrial and public developments and many commercial developments.

- exempts from regulation the reconstruction of any development that was damaged or destroyed by fire, storm, natural hazard or Act of God, enlargements which do not increase the footprint of the development or the number of dwelling units of the development; the construction of patios, decks or similar structures at a residential development; the routine reconstruction maintenance or repair of a public highway, including safety and repaving improvements; the construction of seasonal or temporary structures related to the tourism industry; and, the expansion of an existing, functional amusement pier provided such expansion is located 150 feet landward of the mean high water line, beach or dune.

- require that developments be subject to a tiered system of review based upon the proximity of that development to the mean high water line of tidal waters, beach or dune.

- require that any new development proposed on a beach or dune is subject to permit review. (This change was made in recognition that developments on or in close proximity to sensitive areas require more intensive review than those further from these areas.)

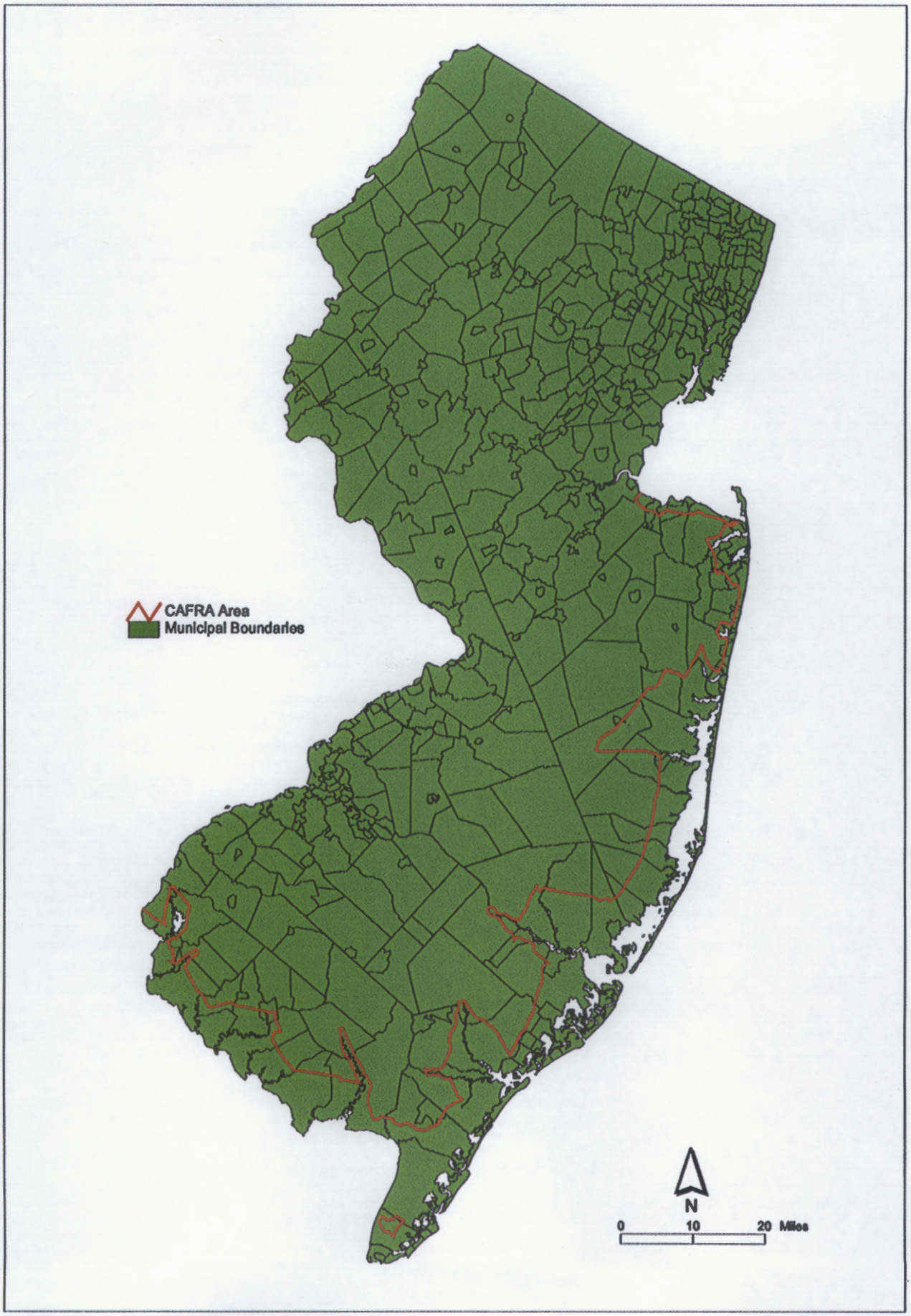


Figure 2. CAFRA Area



- require that, for municipalities classified as "qualifying municipalities" (commonly known as urban aid municipalities) pursuant to section 1 of P.L. 1978, c. 14 (c.52:27D-178), the thresholds are further modified for sites located more than 500 feet from the mean high water line or landward limit of a beach or dune. In these areas, CAFRA permit review will be required for residential developments of 75 or more units and commercial developments with 150 or more parking spaces.

- eliminate the requirement for a public hearing to be held on all CAFRA permit applications. In lieu of the public hearing, the Department has the discretion to provide a public comment period.

- authorize the NJDEP to issue general permits in lieu of an individual permit.

- require the NJDEP to adopt regulations identifying the activities subject to the general permits and establish the criteria for approval or disapproval of the permit.

- abolish the Coastal Area Facility Review Board, allowing CAFRA permit decision appeals to only go to the Commissioner and then the courts.

- amend the NJDEP's jurisdiction under the Waterfront Development Law by eliminating upland Waterfront jurisdiction in the CAFRA area (based on an Appellate court decision of December 26, 1990).

- require the NJDEP to revise its rules to implement these amendments in consultation with the State Planning Commission within one year of the enactment date. The Rules on Coastal Zone Management (N.J.A.C. 7:7E) and the Coastal Permit Program Rules (N.J.A.C. 7:7) continue to be the basis for reviewing applications under CAFRA. The legislation also provides that the State Planning Commission may adopt the coastal rules as the State Plan for the coastal area.

CAFRA and the State Plan

As indicated above, the 1993 amendments authorizes coordination between CAFRA and the State Development and Redevelopment Plan. In 1986, the CAFRA region was specifically omitted from the jurisdiction of the newly created State Planning Commission but coastal county Planning Directors subsequently asked to be included and participate in the State Planning Cross-acceptance process. The coastal counties were apprehensive that

concerns of coastal residents, including funding for infrastructure needs and resource protection, would be neglected if coastal communities did not get an opportunity to participate in the State Planning process.

As a result, the Department of Environmental Protection is in the process of developing proposed revisions to the rules on Coastal Zone Management to guide permit decisions, development and land use. These revisions would be designed to both ensure consistency with the State Planning process and replace the current process which is complex, expensive, time-consuming and uncertain.

Determining the acceptable level of development under the current Rules on Coastal Zone Management is a three step process. The first step is to determine the Coastal Growth Rating, a system which divides the coastal zone into three broad classifications. Each region has a range of acceptable development intensities. The Development Region is largely developed and is the place where location of future development would be preferred. The Extension Region is the area where future growth should be channeled after the Development Region is fully developed and available land is scarce. The Limited Growth region contains large tracts of environmentally sensitive land where only limited infill development is prescribed.

The second step of the process is to determine the Environmental Sensitivity Rating of the site. Sensitivity is based on soil type and the depth to groundwater. The third step is to determine the Development Potential of the site based on the site's proximity to surrounding development, sewers and roads. Together, the three steps create a development matrix to determine the maximum allowable site coverage.

By contrast, the envisioned process would be easier, clearer and faster. Expensive consulting will no longer be required to determine development suitability. The envisioned process will also be predictable with no negotiations over subjective criteria. In addition, the envisioned revisions to the Rules on Coastal Zone Management incorporate concepts from the New Jersey State Development and Redevelopment Plan, including the State Plan map. In doing so, the revisions would promote a regional process. To be effective, planning and environmental protection must use a regional perspective rather than the current site-by-site basis.

The entire state was delineated into Planning Areas during the Cross-acceptance process in the creation of the State Plan. Under the State Plan, the coastal zone is divided into five different Planning Areas. Each Planning Area is geographically delineated to reflect certain common characteristics. These characteristics suggest that growth and development should be guided to certain locations and in certain patterns within the Planning Area to take advantage of existing infrastructure, or to protect sensitive coastal

resources. They also refine and reinforce existing and planned development patterns. Each Planning Area has a single development intensity. The five Planning Areas are consistent in application, intent and objectives with the Resource Planning and Management Structure established in the New Jersey State Development and Redevelopment Plan, adopted in June 1992. The Policy Objectives for each Planning Area provide vision and future direction for the coastal area, in addition to guiding the application of the Statewide Policies of the State Development and Redevelopment Plan.

Within Planning Areas are central places, or Centers, where growth should be encouraged or discouraged, depending on opportunities and constraints within the Center and Planning Area. Centers are the organizing principle for achieving more effective and efficient patterns of development in the coastal area. Each Center has a single development intensity but the size and function of Centers will vary, depending of the unique conditions along the New Jersey coast. Consistent with the State Development and Redevelopment Plan, the material contained in the Interested Party Review help to promote new growth and development into compact developments in the form of Centers, and to protect open space and sensitive coastal resources in the environs.

As mentioned above, the envisioned revisions would incorporate the State Plan map. The map was prepared and negotiated with local and county governments to be compatible with local zoning. The State Planning process requires public input, discussion and negotiation for preparation of the Plan and the map. The Plan and map are to be reexamined every three years as part of the State Planning Process. This would ensure the map and CAFRA permitting process better reflect local zoning, changes in the characteristics of the coastal region and new initiatives in regional protection and environmental protection (see **Figure 3**).

Hazard Mitigation and Post-Storm Planning

Shore management strategies must pay close attention to the impacts of storms on the region. Coastal storms and associated flooding present a significant hazard along the New Jersey shore and have resulted in loss of life and extensive damages to public and private property. The heavily developed nature of the New Jersey shore and the barrier islands increases this vulnerability to hurricane and northeast storm hazards. The effect of these storm events may be exacerbated in the future, as sea level rises and protective beaches and dunes erodes.

Coastal storms impact the New Jersey oceanfront in several ways, as described below:

- Storm Surge: During storms, reduced atmospheric pressure and strong onshore winds pile water up along the coast, causing a temporary local rise in sea level known as storm surge. Combined with high energy storm waves and extraordinarily high tides, storm surges can be extremely destructive.

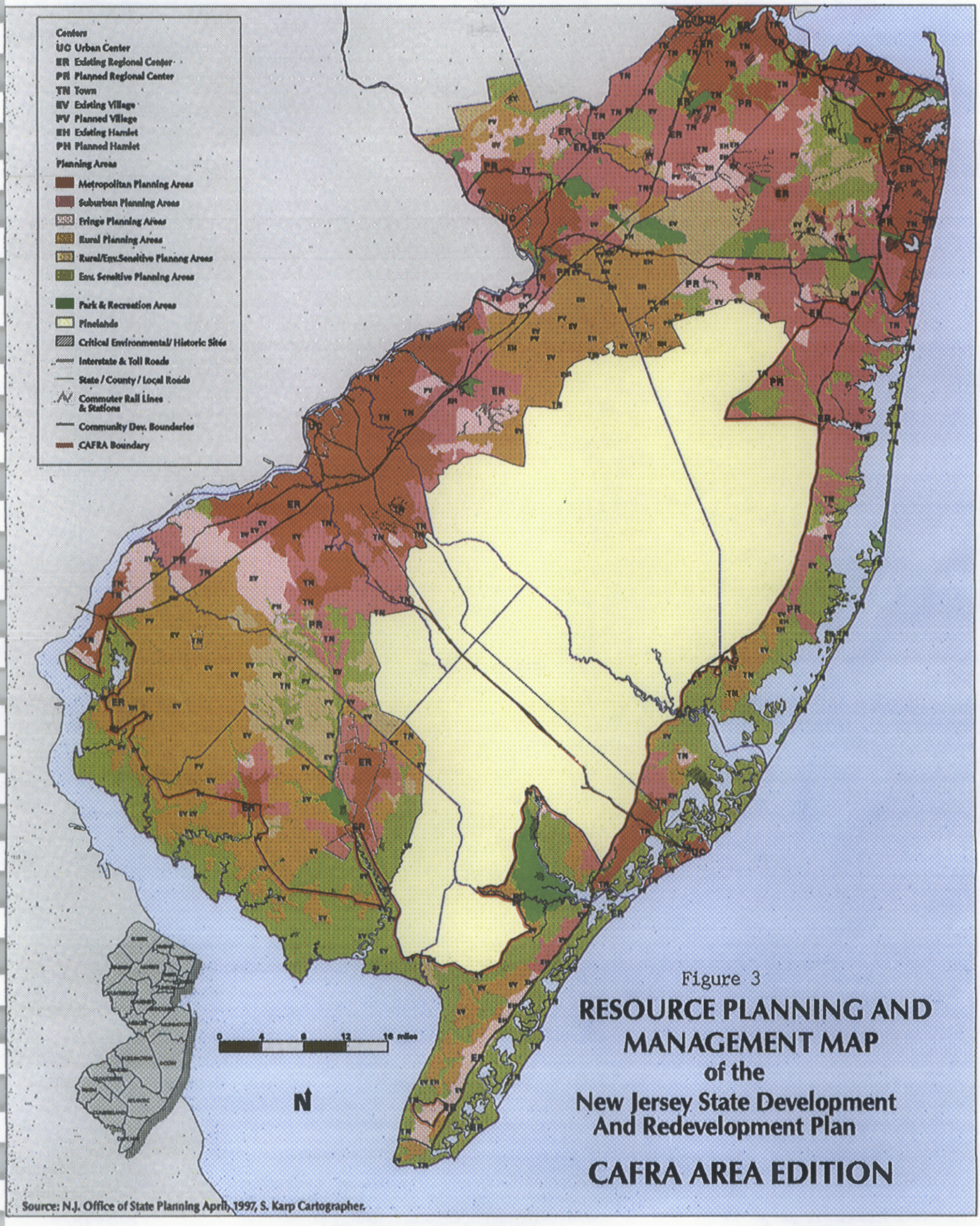
- Waves: Because wave heights and wave periods are increased during storms, the resulting high energy waves reach the shore in quicker succession, thereby speeding up the process of beach erosion and coastal flooding. As more beach is eroded, more property is exposed to storm waves, and the risk of damage greatly increases. As storm waves destroy beachfront structures, this creates another storm hazard: debris propelled by waves and currents, battering other structures along the way.

- Tidal Flooding: Coastal flooding in New Jersey is primarily caused by high tides, waves from strong on-shore winds and storm surge. Tidal floods can also be caused by the combination of storm waves and runoff resulting from heavy rains that accompany hurricanes and northeast storms. The most severe tidal floods are caused by high winds superimposed on the normal or spring cyclic tides.

- Wind: Sustained high winds, associated with hurricanes and northeast storms, exert tremendous pressure on buildings and threaten their basic structural integrity. Roofs, siding, decorative edging and windows are especially vulnerable to wind damage. Strong winds also transfer energy to the sea surface, resulting in increased wave heights, periods and energy.

- Sea Level Rise: Compounding the effects of these natural forces is the relative rise in sea level along the New Jersey coast. Three major effects of sea level rise can be anticipated: (1) increased shoreline erosion and associated storm damages; (2) increased flooding and inundation of low-lying areas; and (3) landward movement of salt water (both surficial and underground). A complete discussion of sea level rise begins on page 43.

Vulnerability of coastal areas to storm and flood hazards has been well documented over the past century by coastal residents and numerous local, state and federal agencies. The Army Corps of Engineers has documented the vulnerability of the New Jersey shore through a number of studies, including flood studies, shore protection studies and hurricane studies. The State of New Jersey has also identified areas vulnerable to coastal storms and flooding through numerous vulnerability studies, hazard mitigation studies and most


Centers
UC Urban Center
ER Existing Regional Center
PR Planned Regional Center
TN Town
EV Existing Village
PV Planned Village
EH Existing Hamlet
PH Planned Hamlet
Planning Areas
Metropolitan Planning Areas
Suburban Planning Areas
Fringe Planning Areas
Rural Planning Areas
Rural/Env.Sensitive Planning Areas
Env. Sensitive Planning Areas
Park & Recreation Areas
Pinelands
Critical Environmental/ Historic Sites
Interstate & Toll Roads
State / County / Local Roads
Commuter Rail Lines & Stations
Community Dev. Boundaries
CAFRA Boundary
0 4 8 12 16 miles
N
Figure 3
RESOURCE PLANNING AND MANAGEMENT MAP
of the
New Jersey State Development And Redevelopment Plan
CAFRA AREA EDITION
Source: N.J. Office of State Planning April, 1997, S. Karp Cartographer.



notably, the New Jersey Hazard Mitigation Plan (406 Plan). Post-storm aerial photography clearly illustrates the destructive power of hurricanes and northeast storms, as manifested in severe beach and dune erosion and property damage. Much of this damage has also been documented and recorded by FEMA and NJDEP through post-storm damage surveys.

The Federal Emergency Management Agency (FEMA) has identified and mapped flood hazard areas in the implementation of the National Flood Insurance Program (NFIP). These Flood Insurance Rate Maps (FIRMs) identify flood hazard areas which are subject to a 100-year flood, as well as areas which are subject to the 100-year flood with associated high velocity waters (waves). This 100-year flood or storm surge has been adopted by FEMA as a national standard with the result that every municipality located along the New Jersey oceanfront contains areas identified and mapped by FEMA as flood hazard areas (A Zones) and flood hazard areas with velocity waters (V Zones).

While there is considerable debate about development policy, public expenditures, and shoreline management plans in these vulnerable coastal areas, there is recognition that coastal hazards do exist. How these hazards are managed, in the context of an overall shore management plan, is the focus of continuing efforts by a number of local, state and federal agencies.

"Retreat": Not the Answer

The term "retreat" is often used -- and misused -- in the debate over how to manage areas of New Jersey's eroding oceanfront shoreline. Because of the plain meaning of this word, the term "retreat"tends to impair meaningful discussion of appropriate land use management and shore protection options along the oceanfront. The mere use of the word serves to divide people into two separate camps: those who believe that every effort should be made, at any cost, to hold the line on shoreline erosion everywhere along New Jersey's oceanfront, and those who believe that pulling back from the shore is a more realistic, cost-effective response to shoreline erosion in specific oceanfront areas.

Depending on one's point of view, "retreat" can mean government-imposed prohibition on construction or reconstruction of oceanfront development, or "retreat" can mean the voluntary acquisition of hazard-prone property, with compensation to the property owner. The first of these ideas often fuels the divisive "retreat" debate, and tends to draw attention and discussion away from hazard mitigation, while the latter is generally recognized as a more acceptable approach.

Rather than focusing on "hot button" words, it is more helpful to concentrate on the larger issue of shoreline management, including the evaluation of management options for site-specific oceanfront areas. These options include shore protection (beach nourishment,

structures, etc.), land use management (zoning, setbacks, etc.) and "Blue Acres" type voluntary acquisition and relocation, all of which have been successfully implemented in New Jersey over the past fifty years.

Under this strategy, the New Jersey oceanfront is evaluated as distinct shoreline sections, each with its own set of problems and potential solutions. This philosophy allows for site specific evaluation of shoreline management options which consider the full range of variables, including but not limited to initial and long-term maintenance costs, short and long-term benefits, hazard vulnerability and mitigation, as well as public access to and use of recreational beach areas. Through a cooperative working relationship involving a number of municipal, county, state and federal agencies, a common goal of reducing coastal hazard vulnerability and protecting the lives and property of coastal residents can be achieved.

Mitigation Strategies

Mitigation as discussed here is any activity which serves to minimize the potential adverse impacts of certain events, including coastal storms and floods, with the overall goal of protecting lives and property. Mitigation should be an ongoing process to identify natural hazards, define the region's vulnerability to these hazards and then develop strategies to minimize their adverse impact.

Coastal storm hazard mitigation is not a new idea. The Federal government's coastal hazard mitigation involvement in New Jersey began in the mid-1800's and continues to today. **Figure 4** depicts areas where beach nourishment projects were performed between 1940 and 1992. Starting primarily with structural flood control measures, this involvement has grown to encompass non-structural alternatives (e.g., land use, evacuation and avoidance measures) as well, culminating in the New Jersey Hazard Mitigation Plan, which now serves as the framework for hazard mitigation planning in the state.

The NJDEP has been involved in comprehensive hazard mitigation planning for more than fifteen years. Working in conjunction with FEMA, the State Police Office of Emergency Management and numerous coastal municipalities, this effort has produced the New Jersey Hazard Mitigation (406) Plan, the Shore Protection Master Plan, the Rules on Coastal Zone Management, the Coastal Storm Vulnerability of Analysis of Atlantic County Barrier Islands and Ocean City, as well as several FEMA/NJDEP Interagency Hazard Mitigation Survey Team Reports (prepared in response to, and as required by, Federal Disaster Declarations in New Jersey's coastal counties).

Mitigation is important because it:

- protects the lives of people residing in areas which are subject to coastal storms and associated flooding;

- reduces the level of storm damages to property and infrastructure in vulnerable coastal areas; and
- is a condition for receiving federal disaster assistance, as required by the Robert T. Stafford Disaster Relief and Emergency Assistance Act.

The Federal Emergency Management Agency (FEMA), the lead agency responsible for implementation of the Stafford Act, coordinates post-storm disaster relief efforts for declared disaster areas. FEMA works in conjunction with the State of New Jersey in the development of the Hazard Mitigation Plan, as required by the Stafford Act. FEMA also implements the National Flood Insurance Program, which requires structural mitigation (elevating and floodproofing structures), as a condition of receiving federal flood insurance.

The New Jersey Hazard Mitigation Plan (Section 406 Plan) was prepared by, and is periodically updated by the NJDEP, in cooperation with the New Jersey State Police Office of Emergency Management. The Plan serves as a guide to Federal, State and local government agencies and provides for activities designed to: (1) protect the health, safety and welfare of the citizens of New Jersey who reside in areas vulnerable to coastal storm and flood hazards; and (2) reduce future damage to public and private property caused by coastal storms and flooding.

Over the past ten years, site-specific hazard mitigation strategies have been developed and incorporated into the Section 406 Plan. These strategies include dune creation and enhancement plans and standards, public acquisition plans for coastal high hazard areas, improved hazard area identification and mapping, beach and dune surveying, improved construction standards for oceanfront bulkheads, hazard area education and awareness training, and technical assistance programs to assist local planners and floodplain managers.

As mentioned previously, there are numerous local, state and federal agencies involved in hazard mitigation, coordinating planning, zoning, regulatory, funding, enforcement and emergency management functions. Coordination and interaction between these agencies is essential for the development and implementation of mitigation activities throughout the shore region.

In addition to the NJDEP, other State agencies are involved in hazard mitigation activities:

- State Police, Office of Emergency Management - coordinates emergency management activities, disaster assistance programs, State Hazard Mitigation Team activities and reviews municipal emergency operation plans throughout the state.

- Department of Transportation (DOT) - through numerous road construction and improvement projects, has the opportunity to facilitate emergency evacuation operations. Mitigation includes elevating roadways and causeway access points.

- Also, in response to the 1992 Presidential Disaster Declaration an Interagency Hazard Mitigation Team, which includes representatives from the NJDEP, NJDOT, State Police Office of Emergency Management, Department of Community Affairs and the Office of the Governor, was created. The responsibilities of this group include the investigation of risk reduction opportunities and the development of strategies for the implementation of mitigation plans. This group also reviews Federal Hazard Mitigation Grant Applications, in accordance with the Stafford Act, and makes recommendations to FEMA regarding these applications.

Several federal agencies are involved in mitigation activities, in coordination with state agencies:

- U.S. Army Corps of Engineers - conducts flood and erosion studies to document coastal hazards and vulnerability and to identify plans for specific structural shore protection projects designed to mitigate these coastal flood and erosion hazards.

- Federal Emergency Management Agency (FEMA) - implements the federal disaster relief program, pursuant to the Stafford Act, and incorporates mitigation into pre- and post-storm planning and post-storm restoration. FEMA also implements the National Flood Insurance Program, which requires mitigation (elevating and floodproofing of structures) as a condition for receiving federal flood insurance. FEMA also provides mitigation insurance to assist property owners in financing structural mitigation activities.

Finally, municipal and county agencies address mitigation through the development and implementation of local emergency operation and evacuation plans. New Jersey municipalities possess a broad range of authority over land use through planning and zoning in accordance with the provisions of the Municipal Land Use Law.

Numerous storm hazard mitigation strategies have been successfully implemented throughout New Jersey. They fall into five categories: shore protection, land use controls, land acquisition, construction standards, and control of infrastructure construction. These strategies are being complemented in Cape May County by a recent installment of a tidal telemetry system. This project, implemented by NJDOT in conjunction with the USGS and



Figure 4. Beach nourishment projects along the coastline from 1940 - 1992

funded through a Federal Hazard Mitigation Grant secured by the State Hazard Mitigation Team, will allow tidal flooding data to be electronically transmitted to local, county and State emergency management officials. It will eliminate the need to manually read the tidal data at gauge stations on the barrier island bridge structures and thereby facilitate emergency evacuation operations in Cape May County.

Not all mitigation strategies are feasible in every coastal municipality. Therefore, it is important to evaluate the storm vulnerability of each specific locality and to define potential hazard mitigation strategies appropriate for specific shoreline areas. These various mitigation strategies, and examples of successful implementation in New Jersey, are discussed below.

Shore Protection & Beach Replenishment

New Jersey's Shore Protection Program is among the most aggressive and well planned programs in the United States. The success of this Shore Protection Program can be attributed to four elements:

- Sound Planning
- Stable Funding
- Public Support
- Education

Throughout the years, the state and federal governments -- and indeed the voters of New Jersey themselves -- have expressed support for this shore protection effort. Evidence of this support includes:

- the overwhelming approval by voters of New Jersey in 1977 of the Beaches and Harbor Bond Act which provided $20 million for shore protection and $10 million for Harbor Cleanup in the New Jersey port area.

- the development in 1981 of a Shore Protection Master Plan as required by the 1977 Bond Act and the recommendations contained in the Master Plan that addressed not only issues of land use management through regulation and acquisitions of property along the shorefront but also implementation of engineering and non-engineering concepts for the management of the beachfront area including beachfill projects that would increase the width of the beaches.

- the reaffirmation of this approval in 1983, when the voters endorsed (with voters of 20 out of 21 counties in favor) a new shore protection bond issue, this time providing $40 million for grants and $10 million for low interest loans to municipalities.

- the creation by the Legislature in 1949 of the State Beach Erosion Commission, which holds periodic meetings at various locations along the shorefront at which speakers update the commission on such subjects as hazard mitigation, new techniques and expenditure of funds. In addition, the commission has been very supportive of the ongoing Army Corps/State beach restoration projects carried out in various locations along the beachfront.

- the enactment, and subsequent amendments, of the federal Water Resource Development Act of 1986 under which the US Army Corps of Engineers was directed by Congress to undertake various shore protection flood control and dredging projects. (In recent proposed federal budgets, the Clinton Administration has declared that beach replenishment projects are local/state responsibilities, not issues of national interest. As such, the funding for these U.S. Army Corps of Engineers projects have been zeroed out. However, the Congress has consistently restored the funding, finding that because of the large regional economic impact involved here, there is indeed a national interest. In each case the President signed the budget bills into law but this has given an indication that Federal policies may change in future years.)

- the enactment of P.L.1992, c.148 by the State Legislature providing $15 million annually from the Real Estate Transfer Tax as a stable source of funding for shore protection that allows the department to plan in an orderly fashion the projects to be undertaken and to provide for the State match for federal funds available through the US Army Corps of Engineers. (Beach restoration projects are currently funded at a ratio of 65 percent Federal and 35 percent non-Federal. The non-Federal share is further broken down into 75 percent State and 25 percent local (municipal).).

In 1995, the National Research Council (NRC) -- internationally recognized engineers and scientists from the National Academy of Sciences, National Academy of Engineering and the Institute of Medicine -- released a report on the effectiveness of beach nourishment and restoration projects. The report clearly indicates that beach nourishment is a viable method for protection of shorelines from erosion and restoration of lost beaches but does caution that beach nourishment may be technically infeasible and too costly at some sites. To be effective, beach restoration projects must be carried out at sites where erosion processes are understood, where uncertainty about design and performance are accounted for realistically and where state-of-the-art engineering standards are used. The report further states that beach nourishment projects can be best accomplished through a

broad based funding coalition of various interests including federal, state and local agencies and the public.

Subsequent to the release of this study, FEMA identified several significant public policy issues which are important to the shore protection debate not addressed in the NRC report. These issues are:

- induced development and redevelopment;
- the risk presented by wind hazards in areas influenced by beach nourishment projects;
- storm evacuation and public safety implications relative to increased development induced by beach nourishment, not only in project boundaries but within a regional context where transportation networks are already overburdened; and
- a need to examine the issue over a timeframe of many decades, during which time funding and sand resources for project maintenance are likely to diminish.

In spite of these shortcomings or a lack of general consensus regarding the effectiveness of beach replenishment, the NRC report provides justification that the shore protection course of action pursued by the State of New Jersey is technically and economically sound. The report reflects many of the goals and objectives of the Army Corps/State beach restoration projects that are currently underway along the Jersey coast.

Furthermore, in 1994, the New Jersey Department of Commerce and Economic Development published a report that emphasized the importance of beach restoration projects and their positive impact on the State economy.

Shore protection efforts can be divided into two categories, structural and non-structural. The "structural" engineering solutions -- of which hundreds exist along New Jersey's ocean and bay shores -- include bulkheads, seawalls, groins, breakwaters and revetments. The so-called "non-structural" engineering solutions include beach nourishment and dune construction/maintenance.

In fact, some of the most notable coastal hazard mitigation initiatives in New Jersey have been "non-structural" dune creation and enhancement projects. In particular, a number of State funded and supervised dune projects implemented subsequent to the March 1984 coastal storm have been successful in establishing natural coastal protection in the form of vegetated dunes. The NJDEP has documented the damage reduction benefits of these

newly established/enhanced dunes and continues to provide technical support to municipalities in the area of dune creation, maintenance and enhancement.

It is vital that the State's beach replenishment project's long term goals and expectations be carefully defined. Long term replenishment programs should include an effective plan for monitoring the recreational beaches that support the design and management of the project. There is also the need to identify sources of funding and sand replenishment that are adequate to handle the impact of storms.

In the design of beach restoration projects, historical beach erosion rates are factored into the beach design. In addition, data regarding rising sea level are also considered in the final design. Once the beach has been constructed, the US Army Corps of Engineers/State monitor the project. The monitoring takes place twice a year using aerial photography and on-ground data collection. In the event of a major storm, providing there is funding, the reconstruction of a beach can be undertaken quickly through existing Federal (US Army) provisions and regulations.

Before implementation, the Army Corps performs a cost benefit analysis on all beach restoration projects. The benefits for these projects are justified on the basis of a reduction in damages to coastal facilities (public and private) through the construction of a beach area. Although not considered in the authorization of the project or in the Army Corps' cost benefit analysis, a secondary benefit of a beach restoration project is that it provides a recreational area for tourists and residents. As such, public access to the beachfront is an important factor that is taken into consideration before proceeding.

Currently, all Federally authorized beach restoration (construction) projects have sufficient sand to last the life of the project, which is 50 years. Although a small amount of the sand being used to replenish the beaches is mined from sand quarries, the vast majority is dredged from New Jersey waters (i.e., within 3 miles of the coast). All ongoing beach restoration studies are investigating potential sand borrow sites within the three mile limit. However, the pressure to mine from the ocean is expected to increase since sand and gravel are also being dredged for construction purposes in the New York metropolitan region and the transport of sand and gravel from distant quarries gets increasingly more expensive.

Contrary to popular belief, while there is believed to be sufficient sand to meet the needs of the present Army Corps/State projects, the area off the New Jersey coast is not a vast sand deposit. Many areas have only a veneer of sand over finely grained sediments or rock. Before any dredging begins, samples are taken and geophysical work performed to estimate the quality and volume of suitable sand available for beach replenishment.

Recognizing that eventually there will be a need to look for alternative sources of sand outside of New Jersey waters, the New Jersey Geological Survey (NJGS) obtained a grant from the US Department of the Interior Mineral Management Service (USMMS) to investigate the use of sand from Federal waters (greater than 3 miles from the coastline). A map has been produced showing where New Jersey's beaches are eroding and where they have actually gained sand (see **Figures 5a and 5b**). All available offshore sediment data has been collected and additional cores and geophysical surveys have been performed to find suitable sand deposits. Two promising areas have been discovered and one of them is being evaluated further. An economic and environmental study is being performed to compare the costs of dredging in Federal waters versus quarrying on land.

The USMMS and New Jersey are now exploring a larger scale study with Delaware and Maryland to find the best areas for sand dredging in Federal waters adjacent to those states. Because an Environmental Impact Statement (EIS), including an archaeological investigation, must be performed before any sand can be dredged from Federal waters, the USMMS is proposing a partnership with the states to identify suitable sand deposits and perform the EIS before they are needed. An EIS may take up to two years. Therefore, having an EIS completed prior to a storm event would be very advantageous to the states, since sand could be taken immediately after a storm without further investigation.

Since these borrow areas often contain commercially important surf clam resources, the NJDEP has expressed concern to various state and federal agencies over potential short and long term impacts. To assess the impact of such dredging projects, in the fall of 1995 the NJDEP initiated a three-year study to monitor a borrow area off Belmar, New Jersey that is included in an Army Corps of Engineers beach nourishment plan. This plan includes the removal of nearly four million cubic yards of sand from borrow sites located within three miles of Belmar to replenish beaches from Asbury Park to Manasquan. Generally, the areas that contain sand in quantities and grain size necessary for beaches are prime surf clam habitat. Results from this study can be used to determine impacts of sand removal on the surf clam population.

Changes in the shoreline due to the erosion and accretion have been accurately mapped for almost 160 years. These maps were completed by the National Oceanic and Atmospheric Administration (NOAA) (formerly the US Coast and Geodetic Survey), the Army Corps and the State of New Jersey. A comparison of these maps show an erratic history with the shore experiencing both erosion and accretion. However, the general trend has been towards erosion.

In 1986, as part of the Hazard Mitigation following the 1984 coastal storms, the State undertook an effort to establish a beach profile system along the entire Jersey shorefront. There are over 190 profile points along the coast and data is collected every

year at these locations. The most recently completed survey, done in 1995, indicated that there has been some long-term recovery following the 1984 storm generally through the entire shoreline and that the areas of the Raritan Bay and Delaware Bay are fairly stable due to the fact that they are not subject to the direct ocean wave action energy generated by northeast storms.

Throughout the years, the State has relied upon the Army Corps of Engineers for their engineering and design of shore protection structures. Historically over time, the State has completed five major shore protection projects (i.e., projects that have received federal funding) in Sea Bright, Monmouth Beach, Barnegat, Ocean City and Cape May City and is involved in three new projects: Long Branch, Asbury Park to Avon and Belmar to Manasquan, each of which will be started in early April/May 1997. In addition, there are nine major studies by the Army Corps which covers the balance of our shoreline. Many of these studies will develop into a construction project in Fiscal 1998 with construction extending through early 2002.

Since 1986, when the federal Water Resource Development Act was enacted into law, the State of New Jersey, in conjunction with the Army Corps, has aggressively pushed forward to implement various shore protection projects throughout the state. The first project, completed in 1991, was the new south jetty at Barnegat Inlet. It turned Barnegat Inlet, previously known from a navigation point of view as the worst inlet along the entire eastern seaboard, into a safe and navigable inlet. Because of this, the navigational channel is relatively stable and more commercial and private fishing boats are using this waterway.

The second project was from Cape May Inlet to Lower Township. This project re-established the beachfront area in Cape May City and in the adjacent Coast Guard Training Base. Erosion of the beachfront in this area was the direct result of the construction of the mile long jetties at Cape May Inlet that were built in 1910. This project has prevented serious flooding and damages to the coastal communities.

In 1992, the third project was undertaken that called for construction and beach restoration in the City of Ocean City. This project demonstrated the significance and importance of a well-established beach in reducing storm damages. In the January 1992 coastal storm, the City of Ocean City experienced $10 million in damages to public and private infrastructure. During the December 1992 storm, after the new beach had been put into place, the total damages in Ocean City for public and private infrastructure was zero. The beach did experience some erosion and this area was re-established in the spring of 1993 at a cost of approximately $2 million.

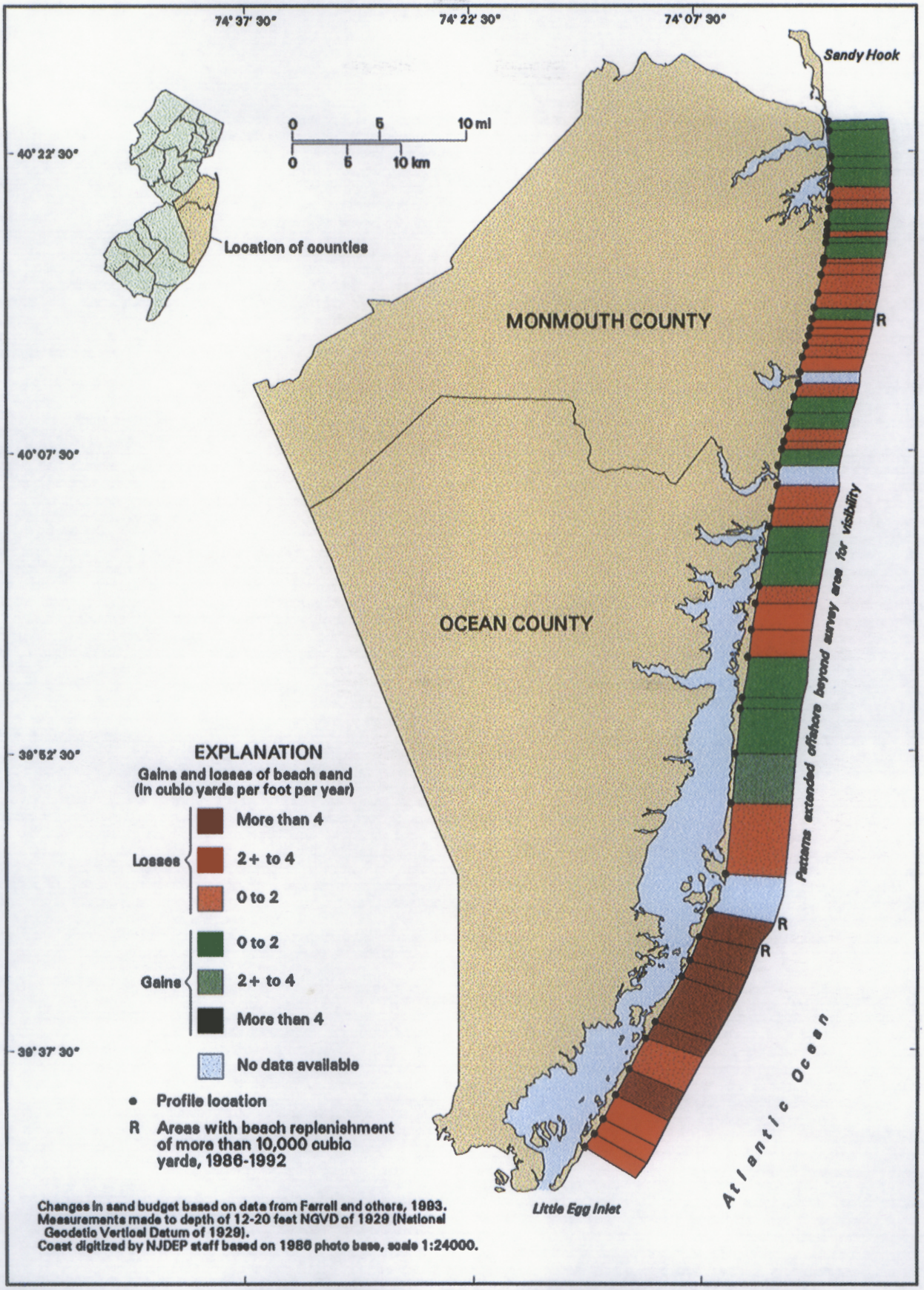
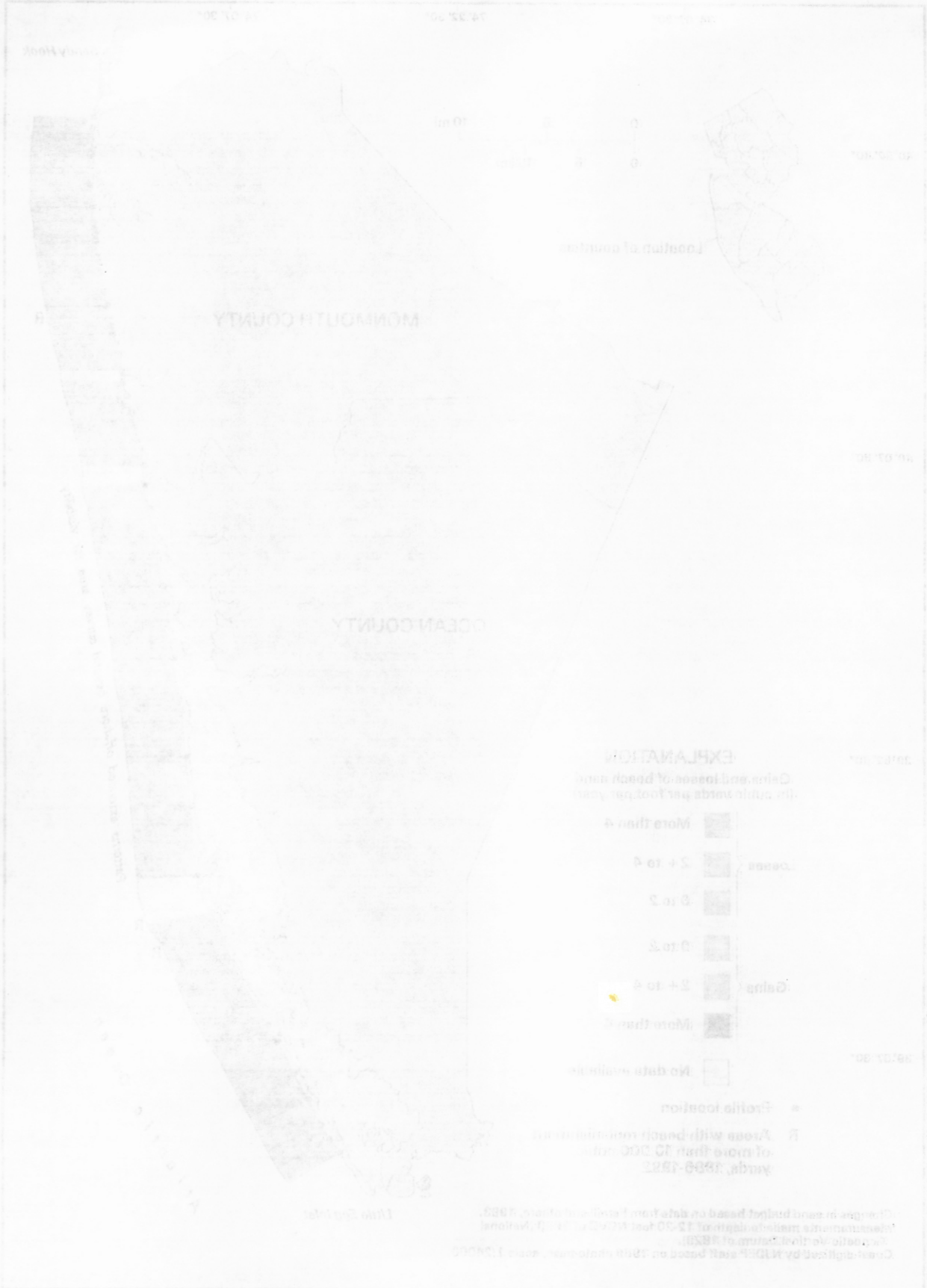


Figure 5a --Changes in volume of beach sediment and replenished (resupplied) sediment in the Northern Coastal Area (Monmouth and Ocean Counties), 1986-1992.



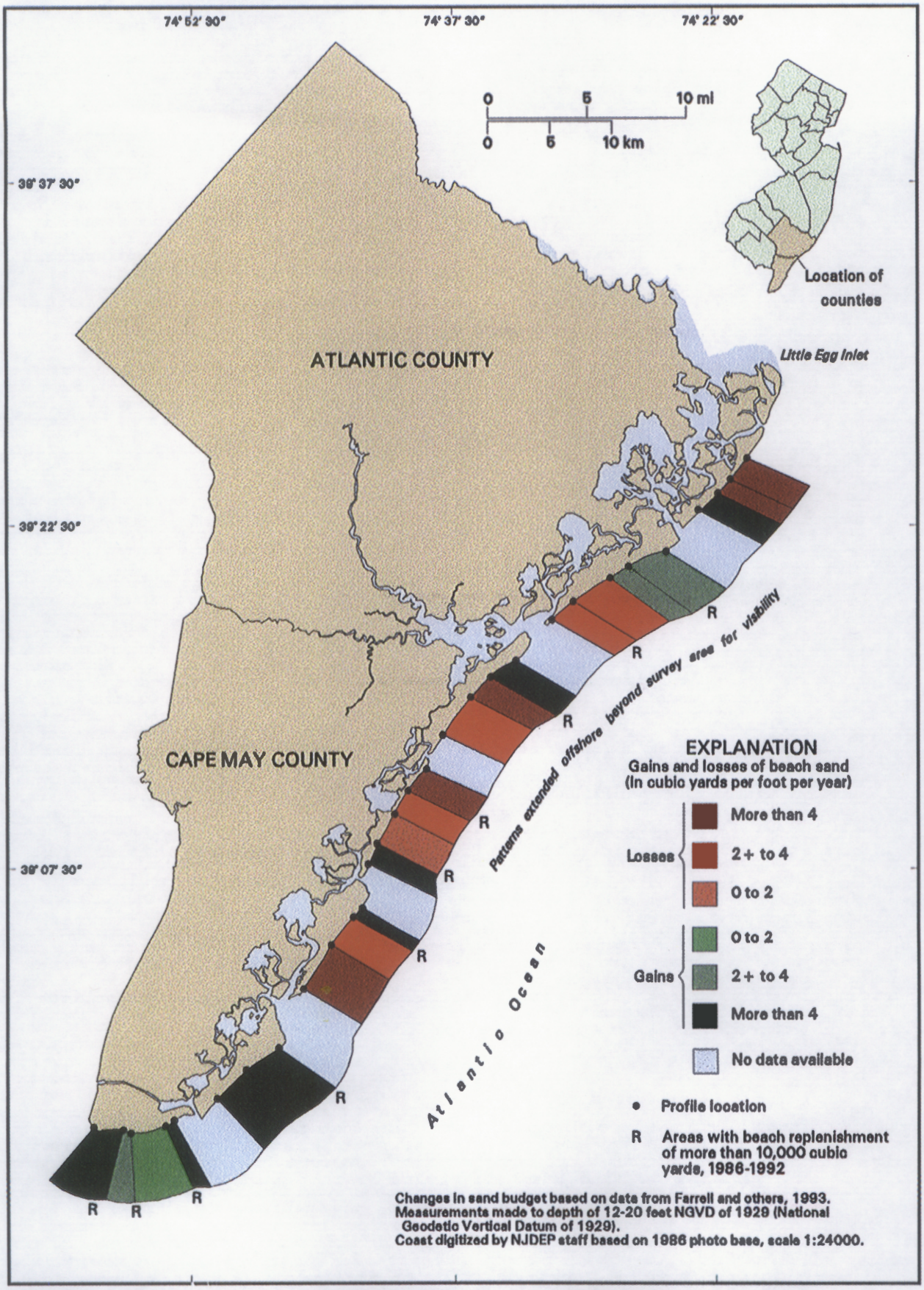


Figure 5b --Changes in volume of beach sediment and replenished (resupplied) sediment in the Southern Coastal Area (Atlantic and Cape May Counties), 1986-1992.



In 1994, the Army Corps of Engineers/State undertook the beachfill project in Monmouth Beach and the southern end of Sea Bright. This project placed approximately 7 million cubic yards of sand along the three and one half miles of shorefront and took two years to complete. Although there has been some erosion at the very southern end of the project in Monmouth Beach, the overall project has been successful. The cause of this erosion at the southern end can be attributed to two factors: the offshore wave infraction due to the Shrewsbury Rocks and the next segment of the project in the City of Long Branch has not been constructed and, therefore, the end of the project is vulnerable to heavy erosion.

In 1995, a project was initiated to re-establish the beaches in the north end of Sea Bright. This project also took two years and was completed in November 1996. It should be noted that the beaches in Monmouth Beach and Sea Bright have shown some minor erosion during various coastal storms as the beaches experienced an anticipated readjustment. This project has been the subject of much public discussion regarding the need for greater public access. As discussed in the Public Access section below, this is an issue that will need to be further evaluated not only for this beach but all along the shore.

In 1997, three projects for beach restoration will be undertaken. These projects are: 1) Long Branch from the Monmouth Beach borough line to Lake Takanassee, 2) Asbury Park North which will begin at Asbury Park and go south to Avon-by-the-Sea, and 3) Asbury Park South which goes from Belmar to Manasquan.

As stated previously, there are numerous shore protection studies underway in New Jersey with the Army Corps of Engineers. The following is a brief summary of the current status of these studies:

- Raritan Bay area - Four studies are underway. In the Keansburg/Old Bridge area, the Corps is revisiting previously authorized projects to determine potential Corps of Engineers cost share in the maintenance of these projects.

- Cliffwood Beach - Likewise, a current study is reviewing the construction of a previous State/municipal project to determine if the project could become an authorized Federal project for maintenance of the seawall and beach area.

- Port Monmouth area - Ongoing study between Pews Creek and Comptons Creek to determine what levels of protection could be economically provided to the Township of Middletown.

- Borough of Union Beach - A planned study of beach protection and other coastal structures that could reduce the damages of the local infrastructure due to severe coastal storms. This project was authorized by Congress in Fiscal Year 1997.

- The area between Sea Bright and Manasquan - Construction for the various phases related to this study are either completed or will be under construction by the summer of 1997.

- Manasquan Inlet to Barnegat Inlet - Authorized in the 1997 Federal Fiscal budget, the Feasibility Study for the area that was hit hard during December 1992 storm should be completed in approximately four years.

- Barnegat Inlet to Little Egg Harbor Inlet - The Feasibility Study for this area was started in Fiscal 1996 and covers almost 25 miles of oceanfront. This study should be completed in July 1999.

- Brigantine Inlet to Great Egg Harbor Inlet - This Feasibility Study has been broken down into two parts. The Absecon Island portion will restore the beaches in this area and create new sand dunes along the entire shorefront. Detailed plans and specifications call for construction in Fiscal Year 1998. The other area is Brigantine Island; this study is still ongoing and will be completed by November 1998.

- Great Egg Harbor Inlet to Townsends Inlet - This project actually covers the area between 34th Street in Ocean City to Townsends Inlet. The upper portion of Ocean City is part of a previously authorized and constructed beachfill project. The Feasibility Study for this area is ongoing and should be completed by approximately the year 2000.

- Townsends Inlet to Cape May Inlet - The Feasibility Study has been completed and Congressional authorization was provided to enter into the final detailed plans and specifications. Construction could start by late Fiscal Year 1998.

- Lower Cape May Meadows to Cape May Point - A Feasibility Study has been completed for this project to provide stabilization to the Lower Cape May Meadows, an extremely important wildlife flyway and bird sanctuary along the Atlantic Coastal Flyway. Construction of this project could begin in Fiscal Year 1999.

- Lastly, the State of New Jersey and State of Delaware are working closely with the Army Corps of Engineers in the Delaware Bay. Some of the areas in New Jersey that are being looked at are Cape May Villas, Oakwood Beach and Reeds Beach to Pierces Point.

Land Use Controls

Each municipality in New Jersey is required under the Municipal Land Use Law (N.J.S.A. 40:55D-1) to adopt master plans and zoning ordinances. These plans and ordinances can designate and regulate areas subject to flood and erosion hazards, and thus incorporate hazard mitigation measures into the local land use scheme. These measures include the establishment of preservation/ conservation zones, maximum development densities, transfer of development rights (TDRs) and waterfront setbacks.

In the Borough of Avalon, Cape May County, an expanse of oceanfront property, largely dunes, has been zoned as a conservation area which is off limits to development. This undeveloped oceanfront property, valued at almost 3 billion dollars, serves as storm and flood protection to the thousands of developed properties in the Borough. The Borough recognizes the value of the property as protective dunes, and has amended the municipal zoning ordinance to maintain this protection in the form of a conservation/preservation zone for the oceanfront dune areas.

Waterfront setbacks are another very effective hazard mitigation technique which has been incorporated into municipal zoning ordinances in a number of areas. The City of Ocean City, Cape May County, is just one municipality using this technique. Specifically, the ordinance requires all new oceanfront construction be set back a minimum of thirty feet from the oceanfront bulkheads to minimize the potential for damages caused by storm waves overtopping the bulkheads. This zoning change has mitigated a substantial amount of storm damage by providing a buffer between the developed oceanfront property and the high energy storm waves which break on and across the oceanfront bulkhead. It should be noted that this local setback requirement of thirty feet exceeds the NJDEP setback requirement of twenty-five feet, as established in the Rules on Coastal Zone Management (N.J.A.C. 7:7E).

Following the December 1992 storm, which resulted in a Federal Disaster Declaration for the four oceanfront counties in New Jersey, the Borough of Mantoloking, Ocean County, amended its municipal land use ordinance to require that all new construction or reconstruction of oceanfront homes be setback to an area landward of the projected 30-year erosion zone. Through a voluntary cooperative effort involving the Borough and the NJDEP, the Borough delineated and mapped the 1992 storm scarp line along the oceanfront dunes and provided the historical shoreline change data and corresponding erosion rate data which defined the projected 30-year erosion zone. This information was used to amend the municipal ordinance to include erosion hazard area setbacks. As a result of this ordinance amendment, several new homes have been reconstructed in areas considerably landward of their previous locations.

New Jersey State Library

Land Acquisition

Acquisition of land in high hazard areas for conservation, dune creation/ enhancement and public safety purposes is another storm hazard mitigation strategy. In addition, the public acquisition of lands increases public access to the shore and associated recreational opportunities. However, the cost of acquiring developed oceanfront property can be high. If the acquired property provides public access for recreation, any lost property tax revenue may be offset by increases in recreational income from beach fees or recreation related expenditures and the resulting tax revenue. Also, unlike other mitigation techniques, public acquisition is a permanent solution.

Along the New Jersey oceanfront, the most successful examples of public acquisition are the numerous public parks. Through the use of Green Acres funds and the recently approved Coastal Blue Acres funding, the opportunities for public acquisition of vulnerable coastal properties remain in place.

In some of the more developed oceanfront areas, there are other examples of public acquisition of hazard prone property. Subsequent to the 1926 coastal storm, which devastated the New Jersey shore, the City of Sea Isle City, Cape May County, implemented a land swap plan whereby privately owned properties located on the eroded beachfront were traded for municipally owned properties on the landward side of Ocean Drive. As a result, the City retained ownership of the high hazard properties which were then rezoned as conservation lots while new residential construction and reconstruction were redirected to locations less vulnerable to coastal storm damages.

Construction Standards

Requiring that structures be built to minimum hurricane and storm resistant building standards is another means of reducing storm damages. These building codes can take the form of performance standards or specifications. In New Jersey, the Basic Building Code of the Building Officials and Code Administrators International, Inc. (BOCA) has been adopted as a Uniform Construction Code (N.J.S.A. 52:27D-1 et seq.) and must be used by all municipalities. The floodproofing and elevation requirements of the Uniform Construction Code are, for the most part, performance standards. Post-storm damage surveys by the DEP have documented that, in general, new construction built in accordance with the requirements of the current code is less vulnerable to storm damages than pre-code construction.

While the floodproofing and elevation requirements of the BOCA Basic Building Code have strengthened the code, there are still several areas of concern. First, the Federal Flood Insurance Rate Maps do not recognize wave runup in delineating coastal high hazard

areas and, therefore, there are no specific construction standards for development in wave runup zones. There is the potential for substantial storm damages to structures located in these areas. Second, the standards are felt to be inadequate with regard to design wind speeds and anchoring the walls and roofs. Lastly, the performance standards are general, making the interpretation and enforcement difficult.

Municipalities in New Jersey are required to use the BOCA Basic Building Code as the construction standard and may not supplement this code with more stringent standards, either as a building code or under a zoning or special ordinance. Therefore, in order for adequate standards to be adopted in coastal communities, the standard must first be incorporated into the BOCA Building Code at the national level and then the amended code adopted by the state. Should the State wish to establish stronger flood proofing controls, legislation to that effect would need to be enacted.

Construction and Reconstruction of Infrastructure

Proximity to infrastructure is an important determinant of where development and redevelopment occurs because access to roads, sanitary sewer lines and potable water is essential. Thus, by limiting construction of infrastructure in hazard prone areas, development of these areas can be discouraged. This approach may be most feasible for less developed shorefront areas such as the Whale Beach section of Sea Isle City/Upper Township, and the Delaware Bay shore in Cape May County.

In summary, the above examples of hazard mitigation implementation serve as models for continued mitigation efforts throughout the coastal zone. Although not specifically identified above as a mitigation strategy, public education and awareness is a critical component of any overall mitigation strategy. There is a need to increase public awareness of natural hazards and to educate the public about the site-specific mitigation options which are available to address storm hazards.

Public Access and Recreation

For generations, the dream of spending time at the coast has made famous the image of "The Jersey Shore." Through its constitutional, statutory, regulatory and judicial authorities, New Jersey has consistently maintained that public access to the coastal waterfront is a public right. However, as fame of the Jersey Shore spread, the shorefront became a magnet resulting in the concentration of residential, resort and commercial investment and development. This growth in development has naturally produced an ongoing debate regarding the best mechanisms to ensure that the public has full access to the water while at the same time protecting private property interests. The issue of beach

ownership and access is a complex one. In general, however, it is clear that available, suitable, recreational shoreline areas will continue to decline if current erosion, development and recreational demands trends continue.

Although the State has over time conveyed riparian grants for about 40 percent of its ocean front tidelands, the courts have held that these lands remain impressed with a "public trust" and must be open and unrestricted to the public for the purpose of navigation, commerce, fishing (New Jersey Beach Access Commission, April 1977) and recreational use (New Jersey Supreme Court case *Borough of Neptune v. Borough of Avon-by-the- Sea* (61 NJ 296, 1976)). More recently in 1984, the court held in *Matthews v. Bay Head Improvement Association*, 95 N.J. 306 (1984) that, under the public trust doctrine, the rights of private owners must give way, to some extent, to the public's right to have "reasonable access to the sea." And, in 1987, while the United States Supreme Court in *Nollan v. California Coastal Commission* (107 S.Ct. 3141 (1987)) reiterated the standard rule that government cannot require private property owners to dedicate land for a public use unless the dedication will solve a problem created by the landowner, the decision did not invalidate the public's right to access tidal-flowed waters.

The State authority to promote public access through regulatory action is contained in the four fundamental coastal laws: CAFRA, the Wetlands Act, the Waterfront Development Law, and the Tideland Statutes. In keeping with this statutory authority, New Jersey's coastal rules reflect the mandate to provide as many points of public access as possible that will satisfy the diverse recreational needs of its citizens. Under these rules, new waterfront oriented developments are required to establish points of public access parallel to the waters edge with appropriate signage to that effect. In most cases, this requirement is incorporated as a deed restriction. In addition, there is a recognition for the need to preserve certain visual corridors that enable inner city areas to share in the scenic attributes of being a coastal city. This, in turn, fosters a better and more balanced citywide redevelopment.

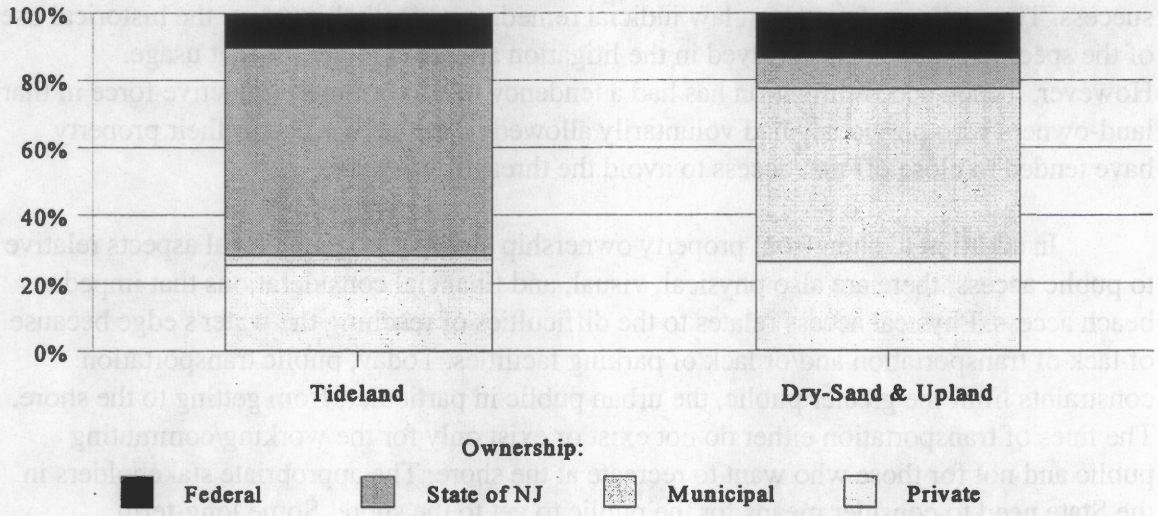
While the State has long maintained the legal right to enforce public access, the most effective -- and least confrontational -- mechanism utilized over the years has been to buy and preserve waterfront properties for general public use. Residents and tourists alike have consistently demanded that more and more of the coast be dedicated as a small but important network of public-oriented parks, promenades and overlooks to complement the already existing numerous municipal and privately held parcels of coastal land. Through its capital spending programs, the State and its municipalities have in the past utilized funds to maximize the public's access to the shorefront. This opportunity still exists. In particular, Green Acres Program funds may be spent for acquiring waterfront sites for public use, especially with the addition of the Blue Acres Program.

The 1981 Shore Protection Master Plan estimated that 95 percent of the publicly owned ocean beach frontage, and 55 percent of privately owned frontage is available for public use. This can be attributed to the fact that some private beach owners lease beach areas to municipalities. For example, Atlantic City leases its municipally oriented free beaches from the private individuals and corporations who own nearly all oceanfront, lots, the boardwalks, and riparian grants along the Atlantic City oceanfront.

A summary of the State's oceanfront tideland ownership status (in shorefront length) by reach, and by reach community, is provided in **Figure 6**. [1]

Figure 6

Oceanfront Ownership in New Jersey



As summarized in this Figure, of the total linear shorefront distance along the Atlantic coastline of New Jersey, a total of about 72 percent of the tideland (below mean high water line) is owned by the public sector (including Federal, State and municipal ownership). The remaining 28 percent is under the ownership of private individuals, corporations, and associations.

Along the Hudson River, Delaware River, and the other urban waterways in the state, much of the waterfront is in private ownership, belonging to industrial, commercial, or residential interests. Despite this, public access exists at many street ends along a 20 to 30 foot strip behind some bulkheads. In fact, the Hudson River Waterfront Walkway

[1]Adapted from New Jersey Beach Access Study Commission, 1977.

represents NJDEP's best effort in providing meaningful public access with over eight miles of Walkway completed in the most urban portion of the state.

Although the greatest barrier to public use of beaches is that of beachfront property ownership, it is not the only factor controlling public access to beaches. For example, public access to backbay beaches is problematic as most of these bays are fringed with wetlands and provide limited access opportunities.

Determining the appropriate level of public access involves balancing the public trust with the constitutional rights of private property owners. In general, the courts have tackled the beach access problem with traditional common law arguments and theories, primarily in case-by-case litigation over isolated tracts of land and with only limited success. The success of common law judicial remedies typically hinges on the historical use of the specific beach areas involved in the litigation and an evidence of that usage. However, beach access litigation has had a tendency to be a counterproductive force in that land-owners who previously had voluntarily allowed public access across their property have tended to close off that access to avoid the threat of litigation.

In addition to shorefront property ownership and its associated legal aspects relative to public access, there are also physical, visual, and financial considerations that impede beach access. Physical access relates to the difficulties of reaching the water's edge because of lack of transportation and/or lack of parking facilities. Today, public transportation constraints limit the greater public, the urban public in particular, from getting to the shore. The lines of transportation either do not exist or exist only for the working/commuting public and not for those who want to recreate at the shore. The appropriate stakeholders in the State need to consider means for the public to get to the shore. Some long-term transportation issues that could be addressed include identifying and developing an inventory of transportation options, developing provisions for park and ride facilities, enhancing bus routes to and along the shore during the summer, and implementing train service to shore area stations.

Physical access to the shoreline, beach and ocean has also been blocked by private construction precluding access to the water for fishing, walking, or simply viewing. Physical restrictions may also include natural features such as wetlands and dunes, and structures such as fences and seawalls. Transportation barriers may include inadequate or congested access roadways, or inadequate or non-existent public transportation means.

Visual access is impeded where construction blocks off views to the beach and water. The protection of views can enhance the character of a place and contribute to protecting its natural features and property values. Views overlooking water also offer intangible social benefits to the public at large.

Another measure that has influenced public access to beach areas are beach fees. Under Federal and State definition, the term "public use" means recreational use by all on equal terms, regardless of origin or home area. This definition, which was reinforced by the New Jersey Supreme Court (Neptune vs. Avon 61 NJ 296) ruling that the imposition of differential beach fees between residents and non-residents is unconstitutional, allows a reasonable beach entrance fee, uniformly applied to all, for use in payment of local maintenance costs. Normal charges made by concessionaires and municipalities for use of facilities such as bridges, parking areas, bath houses and umbrellas, are not usually construed as a charge for the use of a beach as long as they are commensurate with the value of the service they provide and return only a reasonable profit. Most municipalities have imposed fees along the entire shorefront for maintenance and services, including lifeguards, cleanup, and provisions for sanitary facilities. Notable exceptions include Atlantic City (which levies an 8 percent luxury tax in its hotels), Upper Township, North Wildwood, Wildwood Crest, and Lower Township.

For a comparative discussion of common law doctrines, litigation, and other related legal concepts and mechanisms regarding public rights to use and acquisition of access to beach areas, the reader is referred to *Putting The Public Trust Doctrine to Work, The Application of the Public Trust Doctrine to the Management of Lands, Waters, and Living Resources of the Coastal States*, Coastal States Organization, November, 1990.

Sea Level Rise and Global Warming

"Sea level rise" refers to an increase in the relative level of the sea as compared to the elevation of the adjacent shore. There is broad scientific consensus that sea levels are rising as a result of natural and man-induced activities affecting the global climate. During the last century, the sea levels along the Atlantic coast have risen by 30 centimeters (12 inches) and the average worldwide sea level by as much as 15 centimeters. [1] The level of the sea is projected to rise at an even more rapid pace in the next century.

It follows that sea level rise may result in significant long-term environmental and economic impacts to States with extensive shore communities and investment in coastal development. Shorelines are subjected to increased rates of erosion and property built close to the ocean becomes increasingly vulnerable to damage from storms. A diminished and/or damaged shore area decreases recreational opportunities as well as property values. Potential consequences also include greater costs for shore protection, greater frequency and

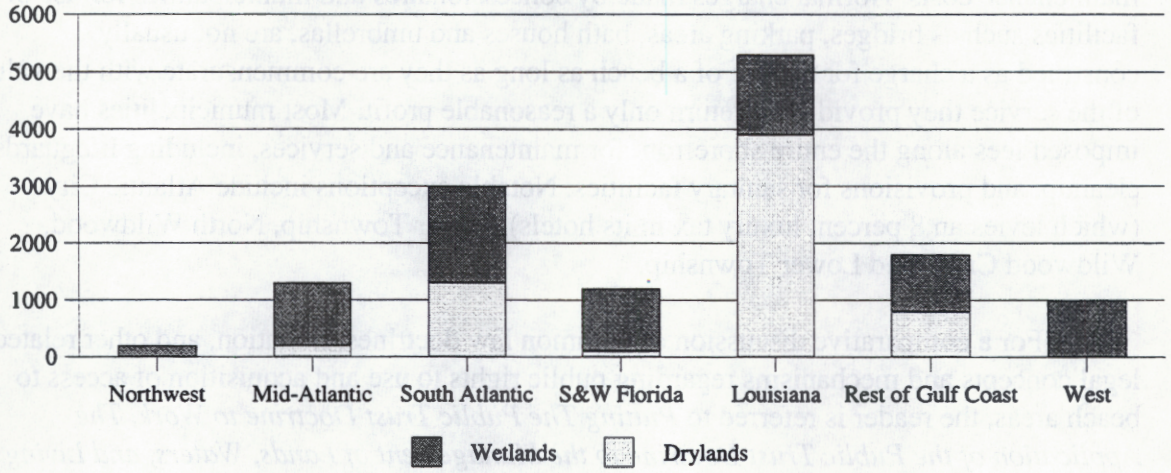
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[1] United States Department of Environmental Protection, Report 230-R-95- 008, J. Titus and V. Narayanan, 1995

magnitude of storm damage and intrusion of salt water into ground water. **Figure 7**[1] shows the potential risk to United States coastal resources from a 1 meter sea level rise. The issue of sea level rise has significant economic implications to all shore communities, including those in New Jersey.

Figure 7

Coastal Resources: U.S. Coastal Lands at Risk from a 1 Meter Sea Level Rise



Some of the factors influencing the global climate sea level rise are natural processes over which man has little control. From the time of the last ice age (over 18,000 years ago when glaciers covered much of the surface of the earth, including parts of New Jersey), the average temperature of the earth has increased by about 5 degrees Centigrade (2 degrees Fahrenheit), making the level of the sea about 100 meters (300 feet) higher today than it was then. The melting of the glaciers has resulted in both an increase in the volume of water in the oceans and an overall warming of the seas which has caused the volume of water to expand. While most of the glaciers have receded and melted, several, most notably those in Greenland and Antarctica, still contain enough water to raise global sea levels by more than 70 meters.

Natural processes are also at work on land in many coastal areas, especially older continental margins like the Eastern coast of the United States, namely in the form of subsidence (sinking). Some of the subsidence is caused by removal of groundwater for human drinking and other purposes but much is attributable to natural processes as recent deposits of sediments along the barrier islands are compacted. This all serves to further increase the level of the sea relative to New Jersey's coastal areas.

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[1] United States Department of Environmental Protection, Titus et al. (1991)

While some of the processes influencing global climate are naturally occurring, sea level rise is also influenced by human activity. Greenhouse gases are among the most significant anthropogenic (man-made) contributors to this problem. These gases are chemical compounds that absorb infrared radiation in the form of heat, preventing the venting of this energy into space. A certain level of greenhouse gases in the atmosphere is positive because the earth's temperature is maintained at a level that can support life. However, as the concentration of greenhouse gases in the atmosphere increases, more heat is trapped and the overall global temperature rises. Scientists agree that the primary cause of change in global climate during the last century is the anthropogenic input of greenhouse gases to the atmosphere. The most significant man-made greenhouse gases contributors are:

- carbon dioxide (CO_2): a product of fossil-fuel combustion
- methane (CH_4): a product of animal activity and landfills

CO_2 emissions account for approximately half of the warming that has been experienced to date as well as half of all projected future global warming. Before the industrial age began, global levels of CO_2 were about 270 parts per million (ppm). The present level is estimated at about 350 ppm (about a 30% increase), and is increasing at a rate of about 0.4% (1.5 ppm) per year.[1] The atmospheric input of methane is estimated to be increasing at a rate of 1% per year. Inputs of CFCs should be greatly reduced due to laws and international agreements restricting their production and application. Greenhouse gases remain in the atmosphere from 100 to as much as 1000 years. These trends are shown in **Figure 8**.[2]

These increased levels of atmospheric greenhouse gases levels are closely correlated with changes in global temperature. **Figure 9**[3] presents the temperature trend -- an increase of 0.4 degrees Centigrade -- over the last 130 years. The relationship of the amount of CO_2 introduced into the environment and temperature is illustrated in **Figure 10**.[4] As the concentrations of greenhouse gases in the atmosphere increase, so does the increase in the temperature of the earth. This, in turn, causes the sea to expand and its water levels to rise (and the melting of glaciers can aggravate this process).

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[1] National Academy of Sciences: CO_2 and Climate: A Scientific Assessment, National Academy Press, 1979.

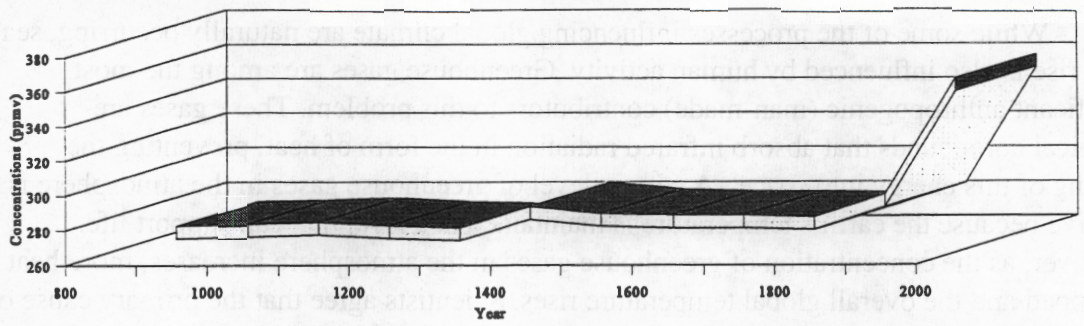
[2] Primer on Greenhouse Gases, D.J. Wuebbles and J. Edmonds, Lewis Publishers, Inc., 1991.

[3] International Panel on Climate Change (IPCC), 1990.

[4] Ibid.

Figure 8

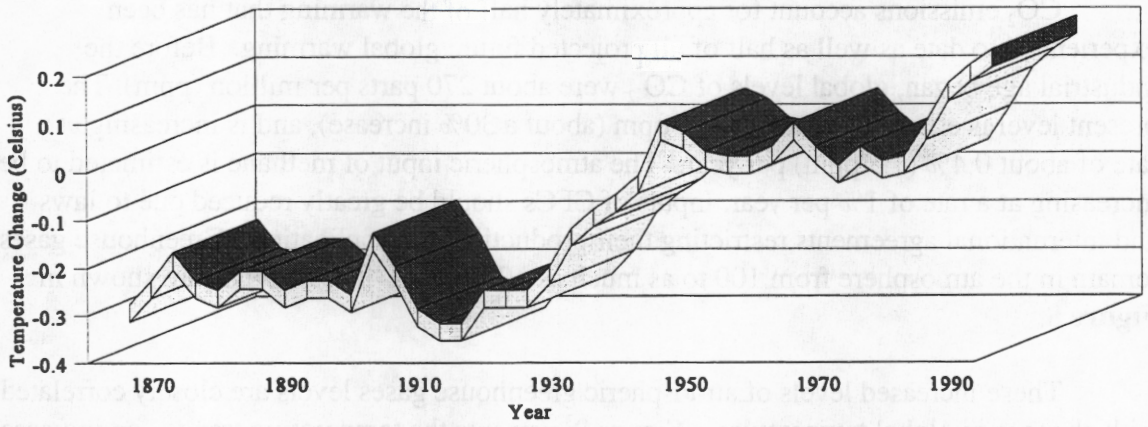
Carbon Dioxide Concentrations Over the Past 1000 Years*



* Derived from ice-core measurements (Siple and South Pole) and direct observations (Mauna Loa, Hawaii)

Figure 9

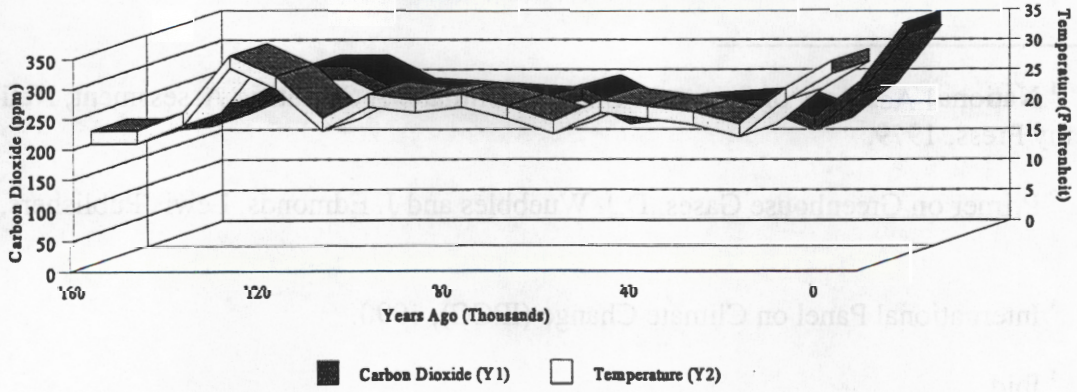
Global Mean Surface Air Temperature, 1861-1989**



** Temperatures expressed relative to 1951-1980 average.

Figure 10

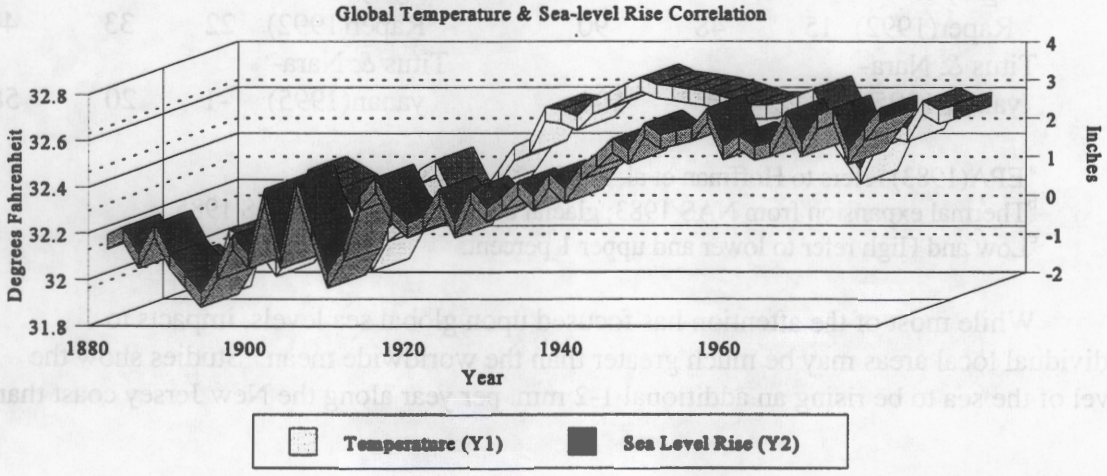
Atmospheric Temperature & Carbon Dioxide Correlation



Various scientific conferences (Villach, Austria in 1985, *The Role of CO_2 and Other Greenhouse Gases in Climate Variations and Associated Impacts*; and Toronto, Canada in 1988, *The Changing Atmosphere: Implications for Global Security*) have concluded that (1) greenhouse gases do contribute to global warming, and (2) the problem is getting worse. There is general agreement that the input of greenhouse gases will contribute to an increase in the mean global temperature and cause the level of the sea to increase at a rate exceeding that which can be attributed solely to natural causes.

These findings have been confirmed by subsequent scientific studies by organizations such as the Intergovernmental Panel on Climate Change (IPCC), United States Environmental Protection Agency (USEPA), National Academy of Sciences (NAS) and many national and international scientists. The IPCC has compiled a set of internationally accepted reports on how to conduct emission inventories of gases that may affect the atmospheric heat balances. In its 1996 report[1], the IPCC states "the balance of evidence suggests a discernable human influence on global climate", that "warming since 1860 is a statistically rare event that is unlikely to be highly natural in origin" and "patterns of temperature change ... are consistent with the combined effects of greenhouse gases and aerosols". **Figure 11**[2] compares historic trends in sea level and global mean temperature, showing a direct correlation.

Figure 11



[1] International Panel on Climate Change (IPCC), 1996

[2] N. Psuty, A White Paper on the Measurements of Sea Level Rise in New Jersey and a Perspective on the Implications for Management, Rutgers University, 1996.

Figures 12[1] and **13**[2] summarize the results of some recent studies by national and international organizations on the impacts of greenhouse gases on the rise in global climate and sea level. As these projections also show, there is no agreement among scientists on exactly how much the sea will rise, and when. The different estimates of how much sea level will rise is due in part from varying assumptions on the quantities of greenhouse gases that will be introduced over time. However, whatever projection may prove to be the most accurate, there is widespread consensus in the scientific community that the level of the sea will rise at increasingly rapid amounts over the next century, and greenhouse gases are the major reason for this increased rate of rise.

Figure 12
Total Greenhouse Contributions to Sea Level By the Year 2100 (in cm)

	Low	Medium	High
EPA(1983)[a]	56	175	345
NAS(1985/83[b])	50	100	200
NRC(1987)	50	100	150
IPCC(1990)	30	65	110
Wigley & Raper(1992)	15	48	90
Titus & Narayanan(1995)	-1	34	104

Figure 13
Contribution to Thermal Expansion by the Year 2100 (in cm)

	Low	Medium	High
EPA(1983)[a]	28	72	115
NAS(1983)[b]	24	30	36
NRC(1987)	---	---	---
IPCC(1990)	26	39	58
Wigley & Raper(1992)	22	33	44
Titus & Narayanan(1995)	-1	20	58

[a] EPA(1983) refers to Hoffman et al. 1983.
[b] Thermal expansion from NAS 1983; glacial contributions from NAS 1985.
[c] Low and High refer to lower and upper 1 percent.

While most of the attention has focused upon global sea levels, impacts to individual local areas may be much greater than the worldwide mean. Studies show the level of the sea to be rising an additional 1-2 mm. per year along the New Jersey coast than

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[1] The Probability of Sea Level Rise, USEPA Publication EPA 230-R-95-008, J.Titus and V. Narayanan, 1995.

[2] Ibid.

in other areas.[1] Tidal gauge measurements compiled by Rutgers University dating back to 1860 show the annual sea level rise in New Jersey and surrounding coastal areas to range from 3-4 mm. per year in sites including Atlantic City and Sandy Hook.[2] Other studies have substantiated that New Jersey's rate of rise will be greater than the global average.

The end result is that, because of the rise in sea level, New Jersey can anticipate that there will be increased shoreline displacement, loss of wetlands and potentially the inundation of barrier islands. For example, the undeveloped Rainbow Islands in Great Egg Harbor have lost about 5% of their total area; one island has completely disappeared.[3] These issues have a significant impact upon state and local coastal policy and shore development.

Most climate modelers and atmospheric scientists also predict that global warming will affect worldwide patterns of precipitation. The amount of rain and snow that falls each year depends upon many factors, including global heat and water cycles that are impacted by the concentration of greenhouse gases in the atmosphere. A recent analysis of precipitation data from more than 5000 sampling sites worldwide from 1800 to the late 1980s reveals increased variability in precipitation events over time.[4] This means that episodes of heavy rain and snow, as well as periods of drought, are becoming more frequent.

More frequent severe storms and higher level of the sea increase the vulnerability of the shore to damage (see **Figure 14**).[5] As sea levels continue to rise, storms will become increasingly damaging. Based upon Psuty's data, by 2050 higher sea levels will turn a storm from an event that might presently occur only once every 20 years into an event that

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[1] US Department of Commerce, NOS, Yearly Sea Level and Monthly Tidal Summary Reports for Atlantic City, NJ, Battery, NY, Lewes, De., Philadelphia, Pa. and Sandy Hook, NJ, 1994.

[2] N. Psuty, A White Paper on the Measurements of Sea Level Rise in New Jersey and a Perspective on the Implications for Management, Rutgers University, 1996.

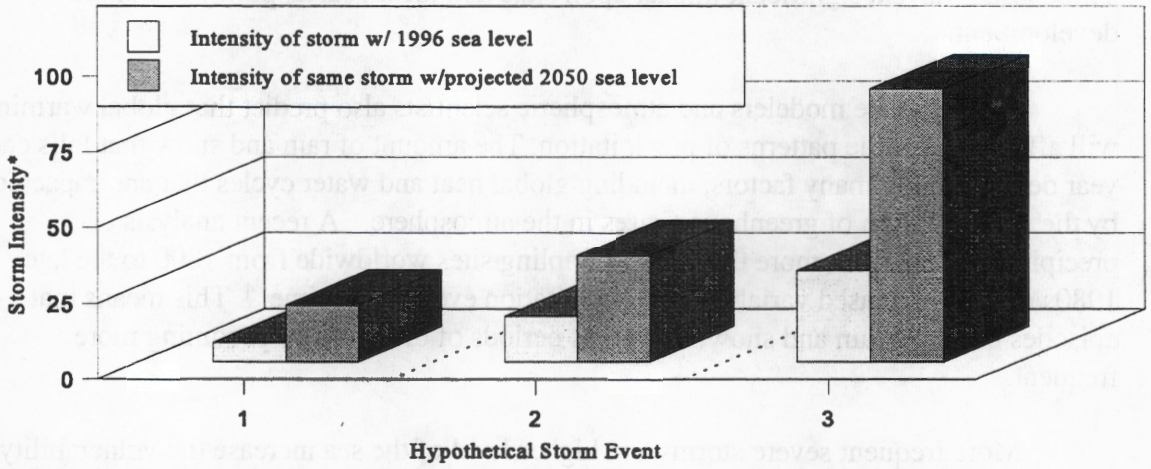
[3] N. Psuty et al., Sediments and Sedimentation in the Proposed ICWW Channels: Great Egg Harbor Bay, NJ, Rutgers University, 1993.

[4] A. Tonis, Nature, 382,700 (1996).

[5] N. Psuty, A White Paper on the Measurements of Sea Level Rise in New Jersey and a Perspective on the Implications for Management, Rutgers University, 1996.

would occur once every 5 years, meaning damaging events may occur more often. Similarly, a storm that presently occurs only once in a 100-year period would become as common as one that would occur every 20 years. The amount of greenhouse gases in the atmosphere contribute to the frequency and the severity of the problem. Those communities most prone to erosion and flooding will see the effects first. Inland areas not previously affected will begin to experience damage.

Figure 14
Magnification of NJ Coastal Storm



* Indicates historical frequency of storm this size.

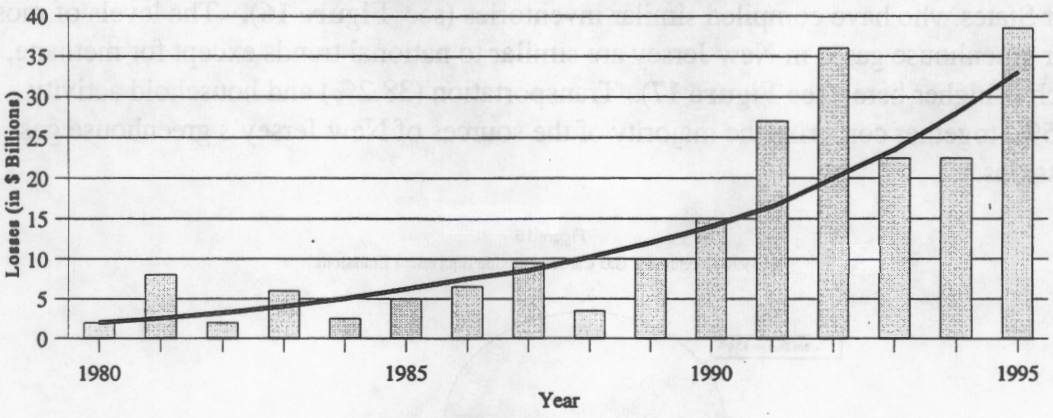
Insurance companies, who pay for much of the damage caused by improbable events such as 100 year storms several times in a decade, have realized their vulnerability to climate change. Worldwide levels of weather-related financial loss reached a new high of $38 billion in 1995. Severe storms such as Hurricane Opal, where $3 billion in claims were paid, have resulted in many insurance companies reducing their exposure in coastal and island real estate, most notably in Florida and the Caribbean. At the 1996 Conference of the Parties to the Convention on Climate Change in Geneva Switzerland, more than 60 insurance companies signed a statement asking governments to substantially reduce their emissions of greenhouse gases. **Figure 15** summarizes some of the economic consequences of weather-related disasters.[1] While many issues could contribute to these trends, the increasing frequency and intensity of coastal storms at a time when commercial

[1] C. Flavin, "Climate Change and Storm Damage: The Insurance Costs Keep Rising", WorldWatch Magazine, Jan./Feb. 1997.

and residential shore development is increasing puts billions of dollars in infrastructure and personal property in New Jersey at some risk.

Figure 15

Economic Losses from Weather-Related Natural Disasters Worldwide, 1980-1995*



* Represents cumulative insured and uninsured losses.

Since increases in greenhouse gas emissions have been shown to be a major contributing factor causing global sea level rise, cost-effective strategies to reduce emissions worldwide is an important part of the solution. Several recent international conferences have begun to define these strategies. The 1992 International Framework Convention on Climate Change in Rio de Janeiro, Brazil produced a protocol urging countries to reduce their greenhouse gas emissions. Since then, the United States and over 160 other countries have ratified an International Framework on Climate Change which establishes a goal for developed countries to reduce greenhouse gas emissions to 1990 levels by the year 2000. The same nations will meet this year in Kyoto, Japan to develop specific actions to reduce greenhouse gas atmospheric concentrations by 2010-2015. Since the goal set for 2000 will not be achieved, President Clinton has committed the United States to develop a policy position at the Kyoto meeting supporting real, verifiable and achievable reductions in greenhouse gases in a flexible, cost-effective manner. To date, 117 electric power generators and 281 business facilities around the country have begun to voluntarily reduce CO_2 emissions.

New Jersey is one of many States developing their own strategies to address the issues of greenhouse gas emissions and sea level rise. We are one of 30 States to have completed work on greenhouse gas emission inventories; 20 states, including New Jersey, have also begun work on action plans for their amelioration. Data from New Jersey's

Inventory of Greenhouse Gas Emissions [1] show that the Garden State produces approximately 2.2% of the United States greenhouse gas emissions, a low value considering we represent 3.1% of the U.S. population. The amount of greenhouse gases emitted in New Jersey has remained relatively constant over the past several years. Over 80% of New Jersey's greenhouse gases are from CO_2, which is consistent with distribution reported by other States who have compiled similar inventories (see **Figure 16).** The levels of most other greenhouse gases in New Jersey are similar to national trends except for methane, which is higher here (see **Figure 17**). Transportation (38.2%) and household activity (23.5%) together comprise the majority of the sources of New Jersey's greenhouse gas emissions.[2]

Figure 16
NJ 1990 Greenhouse Gas Carbon Dioxide Equivalent Emissions

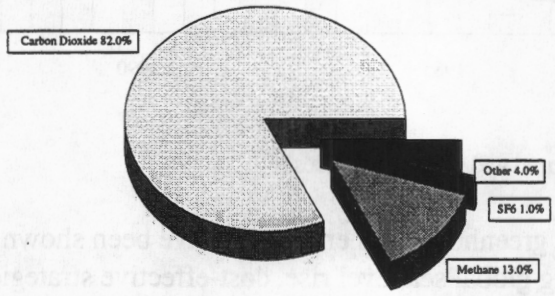
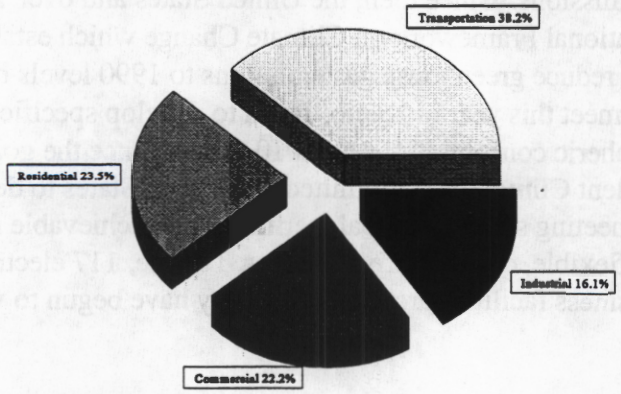


Figure 17
NJ 1990 Carbon Dioxide Emissions from Fuel Consumption by Use Type



[1] New Jersey Inventory of Greenhouse Gas Emissions, 1990, Prepared by the NJDEP and NJBPU, 1996.

[2] Ibid.

While there are options to address the problem of sea level rise other than reducing levels of greenhouse gases -- including modifying the extent of coastal development, shore replenishment, buy-outs and abandonment of most vulnerable structures or through infrastructure improvements such as seawall construction -- efforts to reduce greenhouse gases will in the long run will be most effective. It will be a case of addressing the cause, rather then the symptoms. Greenhouse gas reduction will also neatly dovetail with efforts that are mandated by federal and state law to reduce emissions of other contaminants to the air. Namely, the contaminants in question create ground level ozone, which is known to cause respiratory and other public health problems.

There are similarities between greenhouse gases, namely CO_2, and other air pollutants like ozone. The primary sources of both CO_2 and ozone are electric utilities and other power generators, manufacturing facilities, automobiles and trucks. Also, both ozone and CO_2 are chemically active in the atmosphere. However, it should also be noted that there are differences as well. CO_2 can last more than 100 years and remains close to its point of generation, while ozone can form and break apart very easily and can readily be transported over long distances. Greenhouse gases should be included in any state or regional plan to reduce the concentrations of atmospheric pollutants.

Several States with greenhouse gas reduction programs have combined this effort with other policies that generate positive economic as well as environmental improvements. California and Pennsylvania are two States where greenhouse gas reduction policies are linked to new regulatory initiatives such as utility least-cost planning, building standards, fuel choices and renewable energy development. These programs are linked to a long-term collaboration with the private sector, resulting in both energy and cost savings. [1]

The University of Maryland and the United States Fish and Wildlife Service have collaborated on a report, "Vanishing Lands" [2] that examines the effects of global warming and sea level rise on the Chesapeake Bay. The range and extent of potential damage are similar to what we face in New Jersey. Recommended options for addressing the problem of sea level rise in the bay included site-specific infrastructure development and coastal defenses that are built to withstand a potential 2 to 3 foot rise in sea level over the next century. Management plans to protect and restore coastal habitats are also proposed. These strategies for addressing the effects of sea level rise were developed in conjunction

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[1] D. Feldman and C. Wilt, J. Env. Devel., 5, 46 (1996).

[2] Vanishing Lands: Sea Level Society and Chesapeake Bay, University of Maryland and United States Fish and Wildlife Service, 1995.

with important stakeholder groups and with substantial involvement from interested citizens.

New Jersey has been aware of the issue of greenhouse gas emissions and their impact on the environment for several years. In a 1989 report titled "New Jersey Global Climate Change Initiative"[1], Governor Kean acknowledged the problems caused by greenhouse gas emissions and their effects upon New Jersey. The NJDEP has been active in this issue though collaborative efforts with other government organizations, industry and public interest groups. These NJ leadership activities include:

- Governor Whitman has recommended appropriations in her proposed 1998 budget for a NJ Transit Alternatively Fueled Bus Program that will significantly improve NJ's air quality and reduce CO_2 emissions. The program includes building a state-of-the-art terminal facility dedicated to compressed natural gas (CNG) bus operations and the purchase of 50 CNG buses; it will be phased in as NJ Transit replaces aging diesel buses with ultra-clean burning compressed natural gas and fuel cell powered buses. This NJ Transit program complements NJDEP's Clean Fleets Program, which encourages public and private fleet operators in New Jersey to utilize clean burning alternative fuels whenever possible. By the year 2005, the State Fleet is projected to have over 2,000 propane or CNG fueled vehicles under this program.

- NJDEP Commissioner Robert C. Shinn is Chairman of the Global Climate Change Committee of the Environmental Council of States (ECOS), which places New Jersey at the forefront of discussions on national and international collaborative efforts to address issues surrounding reduction of greenhouse gases. In March 1997, ECOS passed a resolution supporting continued efforts to reduce CO_2 and other greenhouse gases and for continued federal funding for state and local efforts to plan for and mitigate impacts from global climate change.

- Voluntary reductions and reporting of CO_2 emissions by New Jersey companies that recognize the environmental importance of this issue include Public Service Electric and Gas, Atlantic Electric Co., General Public Utilities, Johnson & Johnson, Bristol-Myers Squibb Co., Lucent Technologies, Schering Plough Corp., Roche Vitamins & Fine Chemicals, Homasote Co., Cosmair, Inc., Pathmark Stores, St. Barnabas Medical Center

[1] New Jersey Global Climate Change Initiative, NJDEP, 1989.

and Holy Name Hospital. CO_2 emission reductions are routinely achieved by utilizing more energy efficient/pollution prevention strategies in business operations.

- Design, and implementation on a long-term basis, of a banking system to quantify and credit voluntary greenhouse gas emission reductions from New Jersey business and industry. NJDEP is working collaboratively with the US EPA and the Center for Clean Air Policy, a Washington D.C. based environmental organization, to design a greenhouse gas bank to enable New Jersey companies to conduct emission trades with other states as well as with countries around the world. New Jersey is the first state to propose doing this. As it is developed, this banking system will involve other states, New Jersey business and industry, environmental organizations and other interested stakeholders. Once the system is designed, other states can choose to adopt it and a national system can develop resulting from New Jersey leadership.

- NJDEP and the New Jersey Center for Advanced Technology (NJCAT) are working cooperatively to promote development and export of clean technologies to developing countries, whose contributions to CO_2 emissions are expected to rise significantly over the coming years. An example is Hydrocarbon Technologies, Inc. (HTI), an employee-owned Research & Development company/process licensor in Lawrenceville, NJ. This company will work with the Chinese government and the Chinese Central Coal Mining Research Institute over the next 6 years to commercialize a coal liquefaction plant in China using HTI's coal liquefaction technology. China is one of the largest contributors to world-wide CO_2 emissions and their contribution is expected to double by 2010.

- The U.S. Department of Defense (DOD) has chosen the U.S. Army's Picatinny Arsenal in New Jersey to administer a $14 million grant program to assist fuel cell buyers as part of a broader government effort to reduce greenhouse gas emissions. This Climate Change Fuel Cell Program promotes commercialization of stationary fuel cells by stimulating use by electric utilities and DOD power generators, thereby stimulating production volume by U.S. fuel cell manufacturers. Funding can cover as many as 60 projects nation-side. Proposals are due May 1.

- NJDEP, NJ Board of Public Utilities, and the NJ Department of Transportation will work with state business and industry, local government representatives, environmental organizations, and other interested parties to

develop in-state strategies to further reduce greenhouse gas emissions and mitigate the impacts of global climate change.

- NJDEP is preparing regulations to control greenhouse gas emissions from 19 landfills in New Jersey. Methane from New Jersey's landfills account for 9.2% of the state's total greenhouse gas inventory. USEPA has also developed a Landfill Methane Outreach Program (LMOP) to require landfill operators to asses landfill gas emissions and the potential for cost-effective recovery to use the energy from the gas, which New Jersey will implement. This rulemaking will also reduce volatile organic compounds (VOCs) which contribute to the formation of ozone and hazardous air pollutants.

Managing the Waters

Water Quality Protection

As noted in the Introduction & Overview, residents and visitors of the New Jersey shore often ask the following questions in regards to the coastal waters:

Can I swim in the waters?
Can I eat the fish and shellfish?
How healthy are the waters and the biological community?

Over the past 20 years, the answers to these questions have increasingly been in the affirmative. All ocean waters are acceptable for recreational bathing with health-related closings now being infrequent; they are localized and brief when they do occur. For the most part, the fish and shellfish in the bays and off the coast of New Jersey are indeed safe for consumption with the number of shellfish beds open for harvesting increasing dramatically since 1975. A positive response can be provided for the final question as well in that, using the population of fisheries resources as a good measure of the health of marine waters, over the past decade such species as striped bass, Atlantic mackerel and Atlantic herring have recovered from very low levels to fully restored status. Other species such as summer flounder (fluke), weakfish, king mackerel and Spanish mackerel are showing increased stock size.

A large part of this success has been due to the effort New Jersey has put forward to significantly improve water quality through upgrading sewage treatment in coastal communities. Increased awareness of coastal water quality has been shown through the efforts of many municipalities and their citizens. Residents of the Barnegat Bay have worked together to develop a management plan for the Bay. Utilizing the Sewage

Infrastructure Improvement Act (SIIA), most coastal municipalities worked to identify and map potential sources of water pollution. Some municipalities have adopted stormwater management ordinances. Significant efforts have also been made to reduce or eliminate floatables and beach litter.

While we are continuing to improve, maintain and protect coastal water quality, however, there is a recognition that additional work is needed. As coastal municipalities become more densely populated, stormwater management, nonpoint source pollution control and continued vigilance in controlling discharges from point sources will all be essential to protect coastal water quality into the future. The Statewide Watershed Framework and the National Estuary Programs in the New York/New Jersey Harbor, Barnegat Bay and Delaware Estuary are a few of the mechanisms that will be used to give structure to the State's plans to meet this objective.

To enable the State to answer the critical questions of whether we will in the future continue to swim in or eat fish and shellfish from coastal waters, it is necessary to understand the nature of the water quality-related problems that continue to challenge the coastal area. Furthermore, it is essential to outline and evaluate the present actions and initiatives, including data collection and assessment programs, that are being pursued in this area, with a focus on alterations or retooling that may be needed or any additional efforts that should be undertaken in the future.

In order to properly address the issue of water quality improvement in this document, the first section will contain descriptions of the problems that affect coastal water quality and the mechanisms that are in place to monitor the extent of the specific problems . Toxic and bacterial contamination, eutrophication and low oxygen levels are examples. The next phase of the discussion will focus on the prime culprits for causing these problems. They include stormwater, nonpoint pollution source and point source discharges. Lastly, the discussion will focus on the efforts -- both active and planned -- that are designed to reduce the problems, with special attention on areas where these initiatives may need strengthening or where new efforts may be helpful.

The Issues & Problems

Bacterial Contamination

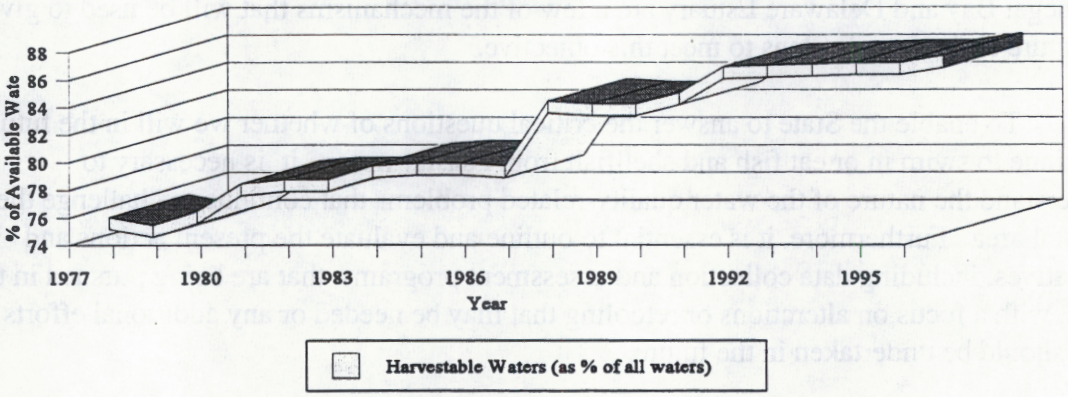
The State maintains an extensive sampling network to monitor bacterial contamination in saline waters, habitat for clams, oysters, and mussels. Water quality information is combined with land use and pollutant source information to classify saline waters for shellfish harvesting. The water is reappraised at least once every three years for harvesting suitability and shellfish safety.

New Jersey has opened additional water for shellfish harvesting each year since 1988. Over the past 20 years, the overall availability of saline waters for shellfish harvesting has increased from 75% to 86%, as shown in **Figure 18** . **Figure 19** compares the bacterial water quality in saline waters in 1975 with that in 1996. Two trends are obvious:

- Water quality has significantly improved in the backbays, particularly south of Great Bay; and
- Water quality has significantly improved in the immediate offshore areas.

Figure 18

NJ Shellfish Harvestable Waters Trend



These trends correlate with construction of regional facilities, which eliminated wastewater discharges to the backbays and nearshore, and improvement and upgrading of additional wastewater treatment plants. **Figure 20** shows those treatment facilities which have been eliminated in the coastal areas. The wastewater formerly treated by these facilities now receives a higher level of treatment and is discharged approximately one mile offshore in deeper, well-mixed water, resulting in greatly improved water quality in the backbays and nearshore areas.

Microbial indicators of fecal contamination are internationally used for regulatory purposes related to drinking water, shellfish harvesting, and recreational bathing. The microbial indicators, such as total and fecal coliform, have satisfactorily reflected disease-related public health concerns under most conditions. However, the effectiveness of microbial indicators can be affected by those conditions, such as the chlorination of wastewater, that differentially affect the survivability of microbial and viral disease-causing agents. Where disease-causing viruses survive longer than microbial indicators, alternate

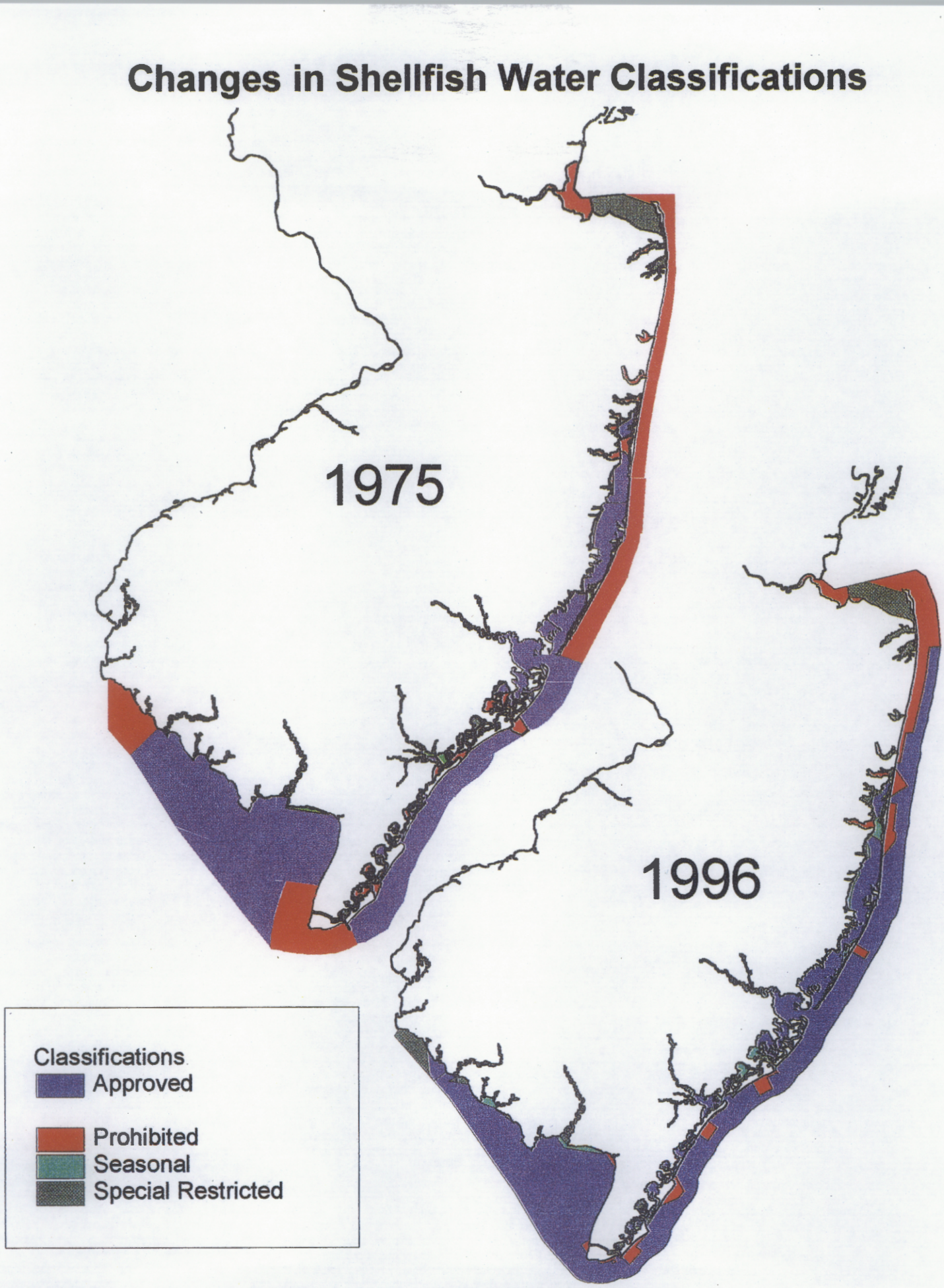


Figure 19. Changes in Shellfish Water Classification, 1975-1996



Coastal Discharges to Surface Water

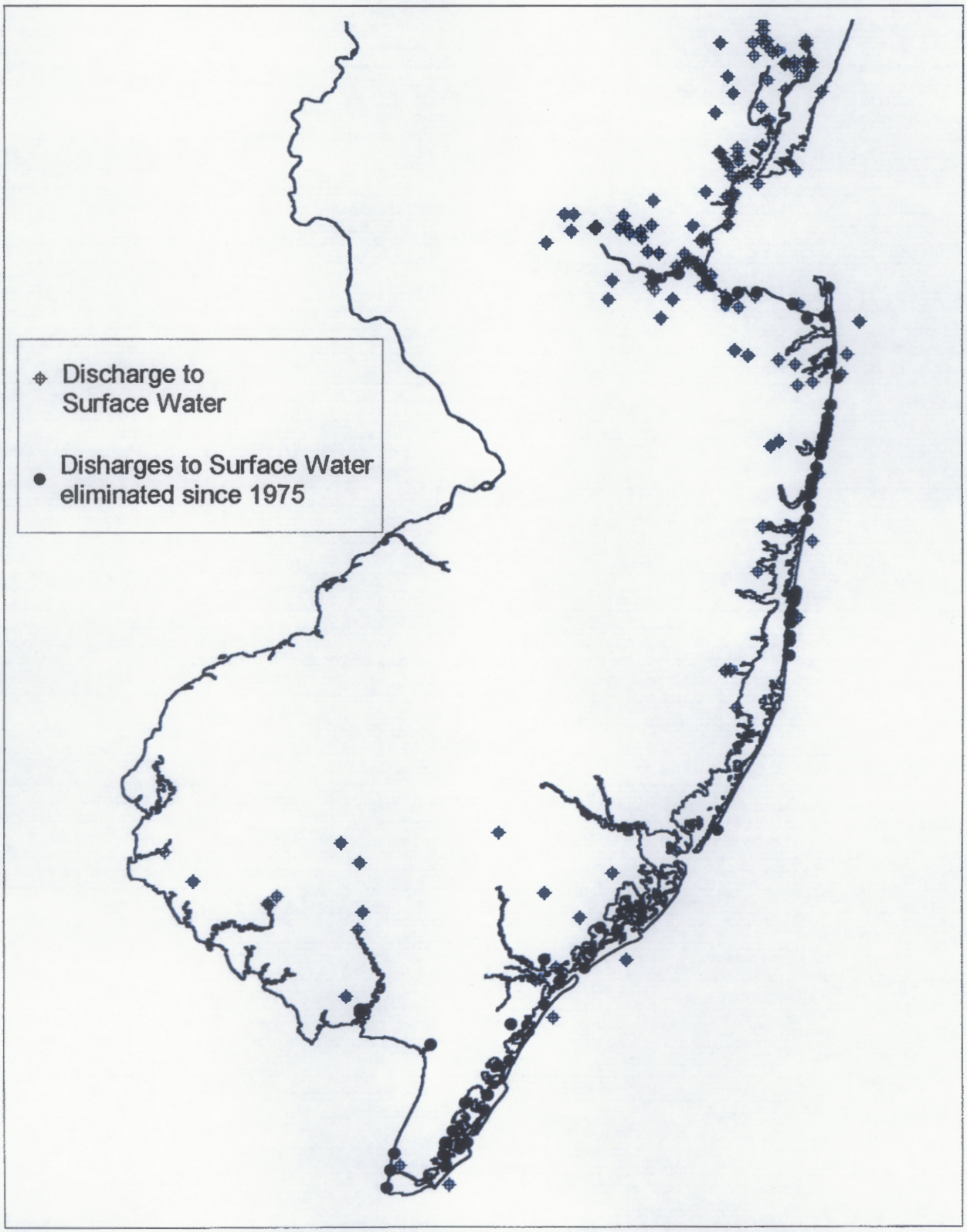


Figure 20. Coastal discharges to surface water, present & eliminated since 1975.



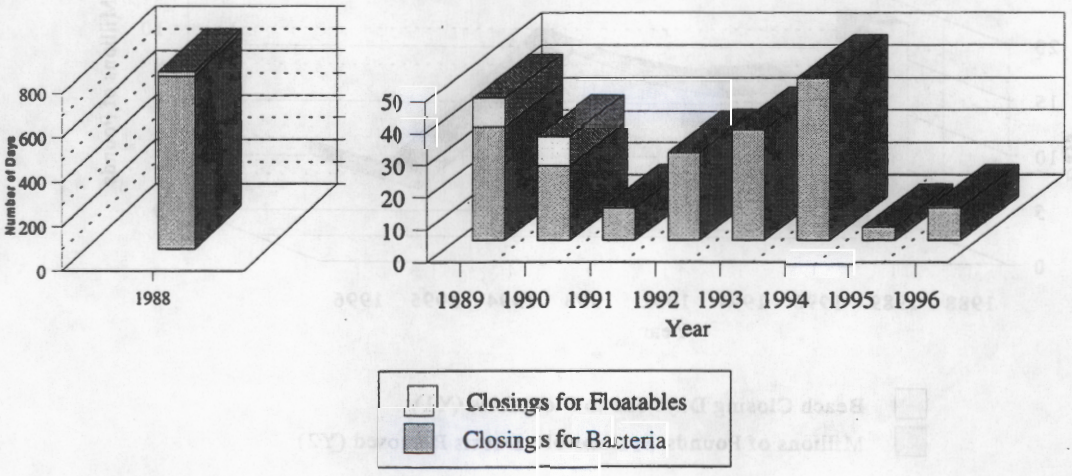
indicators may be better used to reflect public health risk. The NJDEP, with funding from the New York/New Jersey Harbor Estuary Program, has performed research with a virus, the F+RNA coliphage, that may be an alternate indicator to supplement existing microbial indicators in water quality evaluations. In fact, the NJDEP has used this viral indicator in water pollution investigations. A key feature of this virus is its ability to be used to distinguish between animal and human sources of fecal contamination. DEP continues to refine the analytical methods for this viral indicator and experiment with its use in field situations.

Recreational Bathing Water Quality

New Jersey and its local health departments have for some time administered the most rigorous ocean water testing and monitoring program of any state in the nation. It is one of the few states where detecting floatable debris and high bacteria concentrations can trigger an automatic requirement that health agencies close bathing areas of recreational beaches to protect public health and safety. In the past, this program has been a mixed blessing. New Jersey is therefore protecting public health by stringently monitoring and, if necessary, closing down beaches based on the results of this monitoring. However, the closings can incorrectly skew the public's perception of New Jersey's ocean water quality, especially when compared to States who do not monitor in the first place or, if they do, monitor far less frequently than does New Jersey.

Even with this stringent monitoring program, however, there were only 4 pollution-related ocean beach closings in 1995, dramatically down from a record high of 803 closings in 1988 (see **Figure 21**). The reduced number of closings after 1988 indicate that causes of large scale closings, such as sewage treatment facility malfunctions, have been controlled.

Figure 21
Ocean Beach Closings in Days



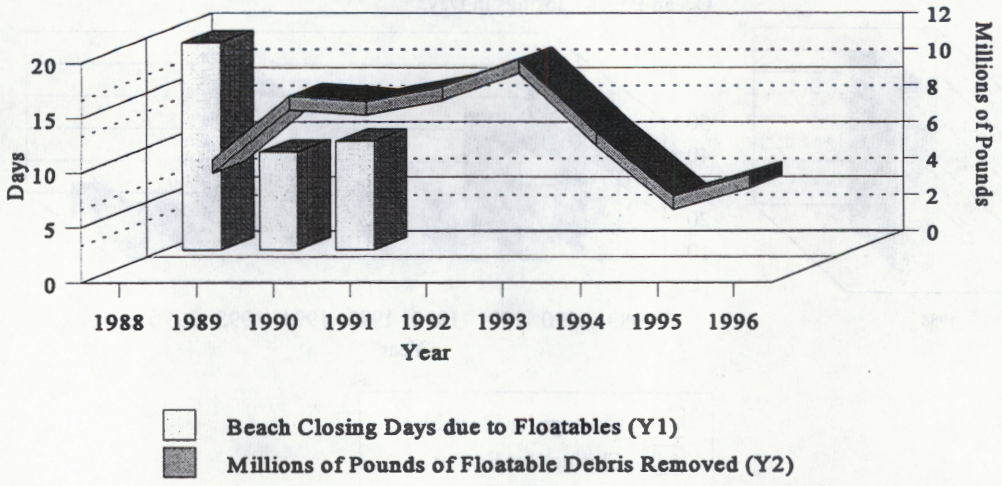
The fluctuations in the numbers are caused by very localized, discreet sources, such as specific stormwater pipes, that continue to negatively impact individual beaches. Bay recreational waters tend to be more susceptible to nonpoint source pollution due to less effective dispersal of larger volumes of stormwater in the confined bay areas. Most of the closings, in the ocean and bays, are now associated with stormwater. No closings from 1991 through 1996 were due to floatables wash-ups.

The Cooperative Coastal Monitoring Program (CCMP), in which NJDEP, NJ Department of Health, and local health agencies participate, assesses the water quality conditions in the nearshore ocean and estuarine waters used for recreation. These agencies use 180 ocean and 132 bay monitoring stations weekly during the summer to determine if fecal coliform concentrations are within the health-related standard and if other conditions (e.g., the presence of floatables or algae) are of concern to public health. The agencies use the routine monitoring to initiate pollution source investigations that result in corrections to sewage and stormwater collection systems. Municipalities implementing the Sewage Infrastructure Improvement Act are mapping their sewage and stormwater systems, assessing the physical integrity of the systems, and remediating interconnections of the two systems (see **Figure 22**).

Complementing the CCMP is the Clean Shores Program in which the NJDEP uses State inmates to remove floatable debris from shorelines of the Hudson, Raritan and Delaware estuaries and barrier island bays. Non-recreational shorelines that have been left unattended serve as reservoirs of debris that can be picked up at high tide or during storm events and redeposited on recreational beaches or become floating hazards to navigation or impact marine life. Since its 1989 inception, the Clean Shores Program has removed more than 65 million pounds of floatable debris from the State's estuary shores (see **Figure 23**).

Figure 23

Clean Shores Program & Beach Closing Reductions



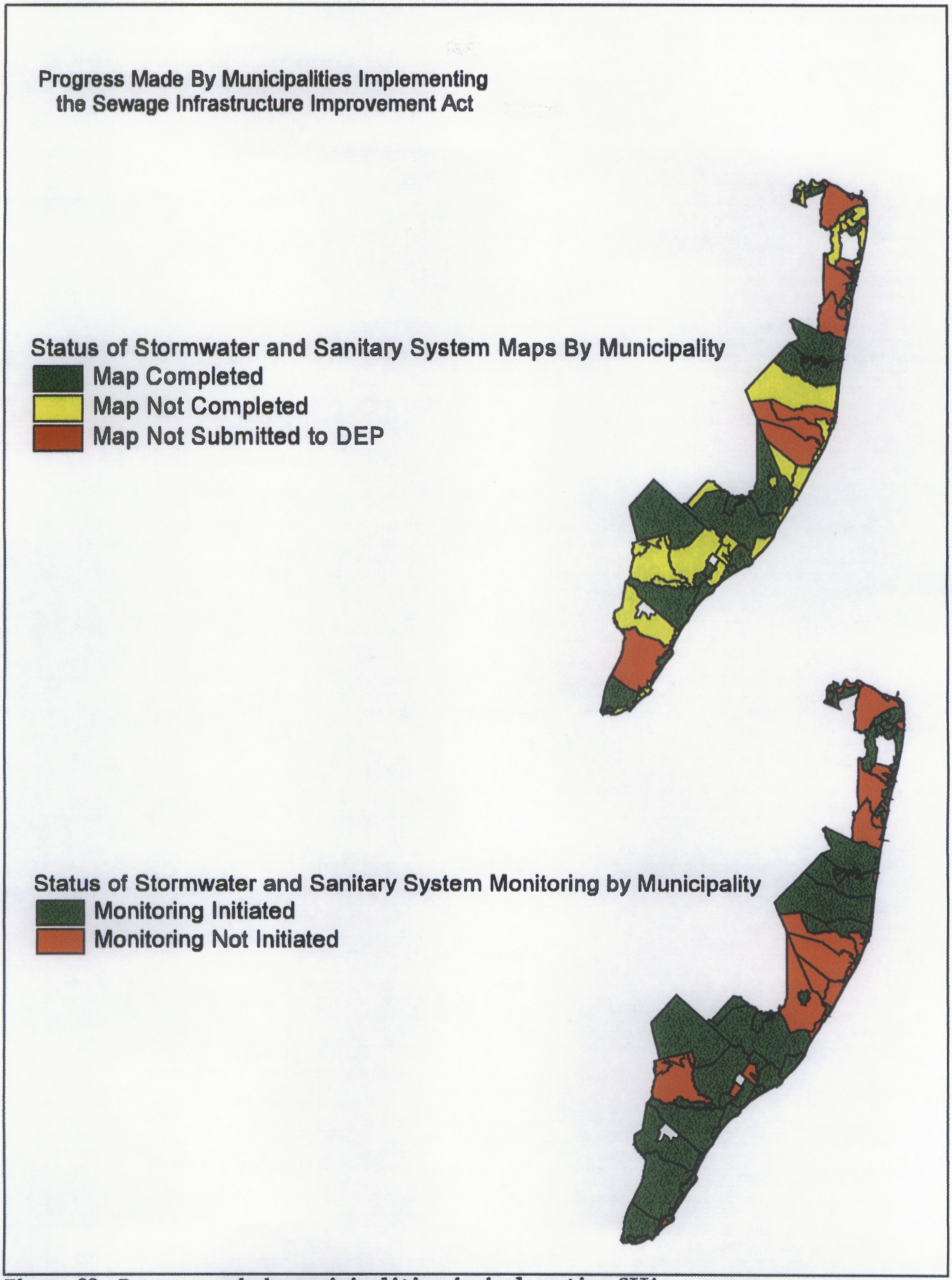


Figure 22. Progress made by municipalities in implementing SIIA

Toxics in Marine Water, Sediment, and Biota

The toxic contamination of the State's marine waters is mainly a concern in estuarine waters adjacent to heavily urbanized and industrial areas, the most impacted of which is the New York/New Jersey Harbor estuary. Current releases of toxic compounds to the environment are suspected to occur from nonpoint source pollution, air deposition, accidental spills and possibly unpermitted point sources. Efforts are being directed toward detection of these compounds in ambient water at sites throughout the Harbor and at discharge points. The Delaware Estuary is considered less impacted, though the Delaware River and Basin Commission (DRBC) have generated data demonstrating exceedances of surface water quality criteria for lead and copper in the lower estuary.

Toxic contamination of sediments in the State's marine waters are distributed on a regional basis, with the greatest contaminant concentrations occurring in estuaries adjacent to heavily urbanized areas. The NY/NJ Harbor Estuary Comprehensive Conservation Management Plan, 1996 includes information on sediments which contain high concentrations of a broad range of contaminates, including polychlorinated biphenyls (PCBs), pesticides, polyaromatic hydrocarbons (PAHs), dioxins/furans, and other metals. Sampling has indicated that the Delaware estuary sediments are considerably less impacted by these contaminants.

Bioaccumulation of toxics in biota can cause direct adverse impacts to the living resource and, in turn, indirectly to human health through biota consumption. Elevated concentrations of dioxin and PCBs detected in finfish and blue claw crab in New Jersey and many other coastal state marine waters have resulted in the issuance of recreational fishing advisories by the State. Recommendations for limited or no consumption are in effect in certain water bodies for striped bass, blue fish over 6 lbs., American eel, white perch, white and channel catfish, and blue claw crab. New Jersey's marine waters that have, at one time or another, been affected by consumption advisories include the NY/NJ Harbor, the Raritan Bay complex, northern coastal waters, and the Delaware estuary.

Eutrophication and Low Oxygen Levels

Eutrophication is the excessive enrichment of a water body by nutrients (primarily nitrogen and phosphorus) and organic materials. Nutrients may stimulate algal blooms resulting in noxious odors, the lowering of dissolved oxygen in bottom waters and the death of finfish and shellfish (see **Figure 24).** The sources of the nutrients may be natural but, in many estuaries, most of the nutrients come from human sources. Discharge from point sources, such as wastewater treatment plants, and nonpoint sources, such as runoff from fertilized lawns, gardens, and agriculture, directly affects water quality, indirectly affects commercial fisheries, and may affect human health either through drinking, food

contamination or direct contact. The Department routinely monitors coastal water quality to provide basic data to understand the extent and causes of eutrophication.

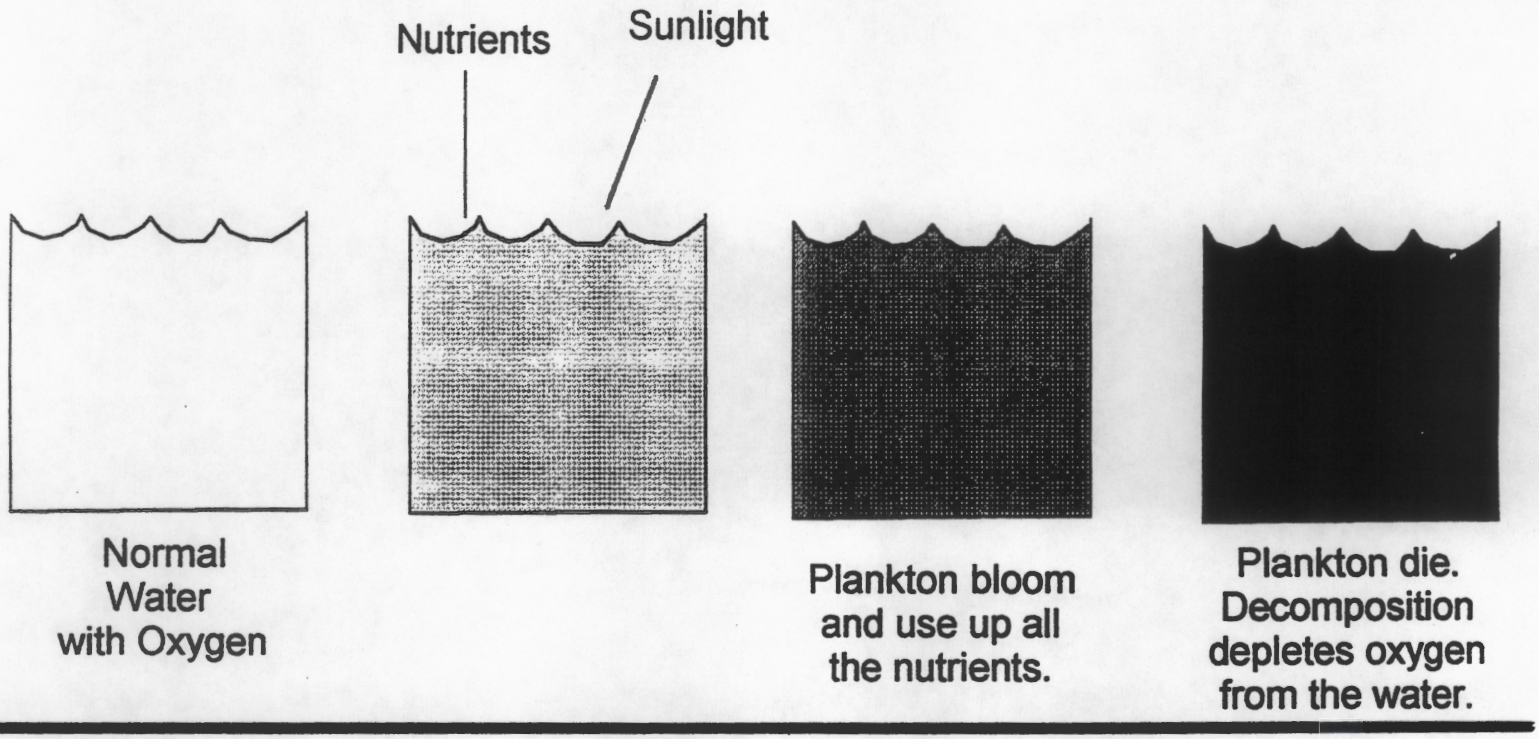
The severity of the eutrophication problem is difficult to assess accurately, and cause/effect relationships are difficult to establish. **Figure 25** shows estimated amounts of nitrogen (by county) applied as fertilizer in 1989. These estimates were published by the U.S. Geological Survey. The colored dots represent the average nitrate concentration measured in New Jersey's coastal waters from 1989 - 1993. Some of the highest average nitrate levels occur in the upper portions of Delaware Bay. These waters are downstream of the highest estimated fertilizer application. While there are other major sources of nitrogen (such as wastewater discharges and agriculture in Pennsylvania and Delaware), the estimated fertilizer application rates in Gloucester and Salem counties in New Jersey were some of the highest in the Delaware Estuary watershed.

While nitrogen (and phosphorus) inputs to the Delaware Estuary are among the highest for estuaries worldwide, **Figure 25** illustrates the complexity involved with eutrophication processes. Despite high loads, the Delaware Bay generally does not show evidence of low oxygen. However, **Figure 25** shows intense phytoplankton growth in the bay waters adjacent to Cape May County. Researchers believe that high turbidity in the upper portions of the estuary will not allow light to penetrate into the water. Lack of light limits the growth of phytoplankton. Nutrients from Delaware Bay may also be helping to support growth of phytoplankton in the ocean along the southern New Jersey coast. In turn, this could result in algae blooms and low dissolved oxygen.

Low dissolved oxygen may cause the loss of suitable habitat and, therefore, a decline in the population of bottom-dwelling living organisms. Loss of habitat, including loss of underwater vegetation and food organisms, can affect fish food chains and therefore commercial fisheries. In addition, excess nutrients may cause changes in the numbers and types of plankton and increases of nuisance or toxic algal blooms. Low dissolved oxygen and toxic algal blooms have probably contributed to fish kills in this estuary during the past decade.

Areas of the ocean adjacent to New Jersey routinely experience extremely low oxygen levels during the summer as shown in **Figure 26**. A particularly severe and widespread event occurred in the summer of 1976 where a massive bloom of the dinoflagellate Ceratium tripos resulted in a complete lack of oxygen over an 8,600 km sq. area and the resultant death of significant numbers of shellfish.

Recent reports indicate that summer bottom oxygen levels in the New York Bight, the ocean area extending approximately 100 miles from the New York/New Jersey Harbor to the outer limits of the Continental Shelf, were generally good. On the limited occasions



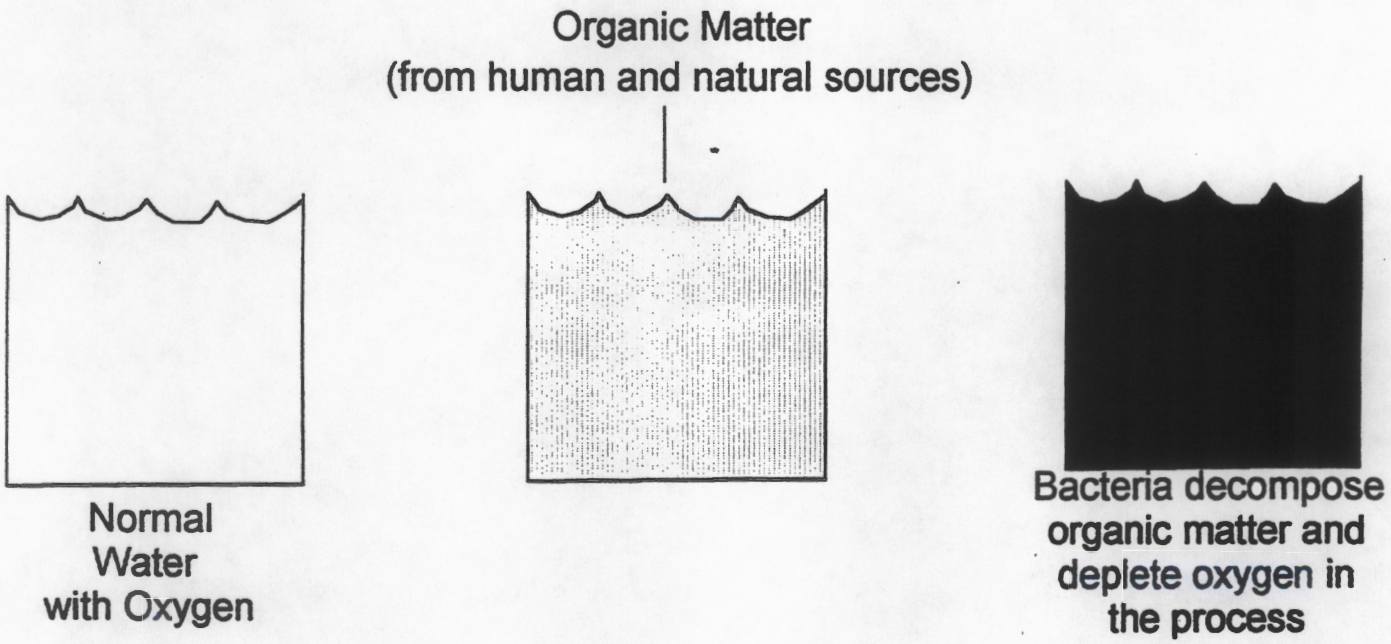


Figure 24. The eutrophication process

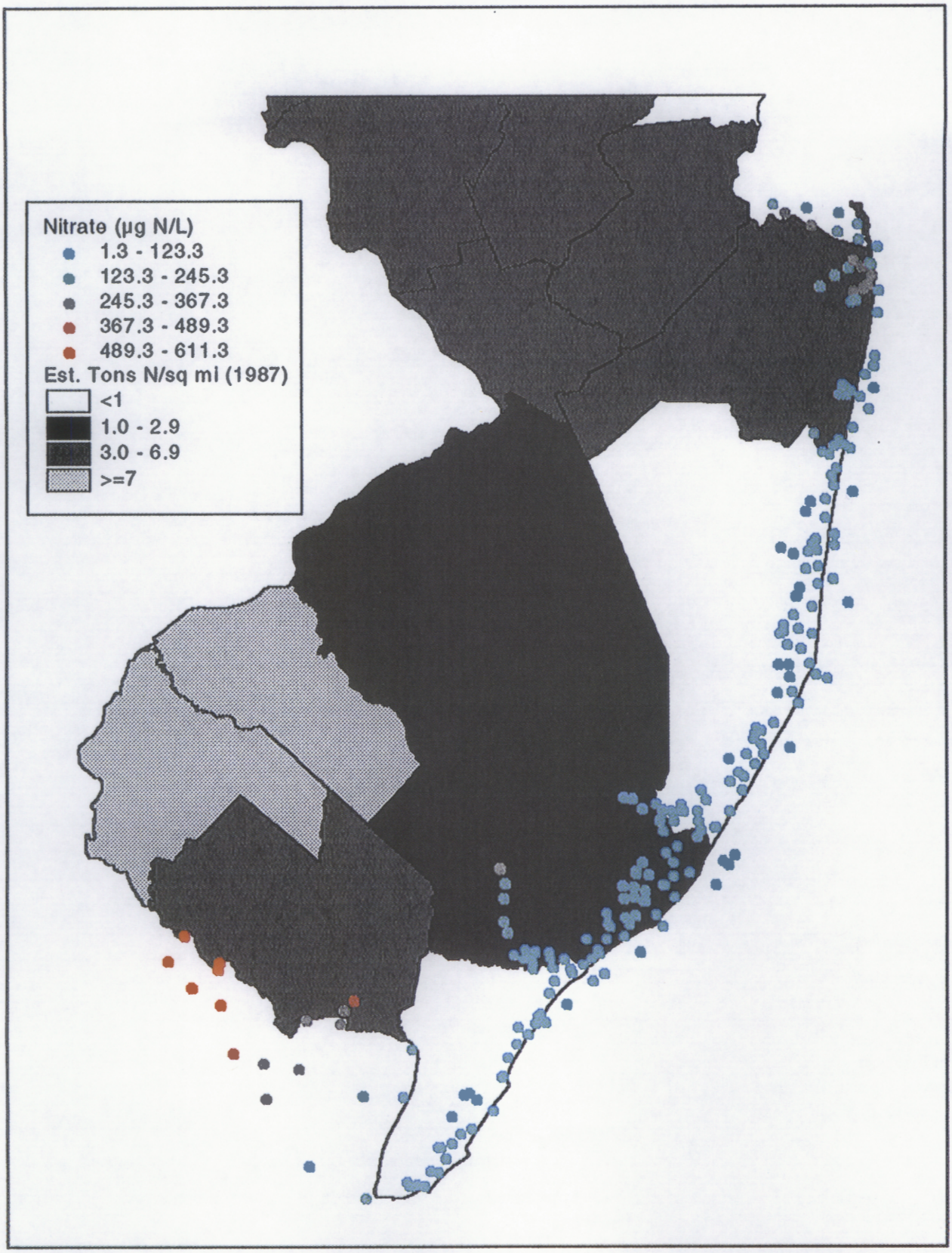
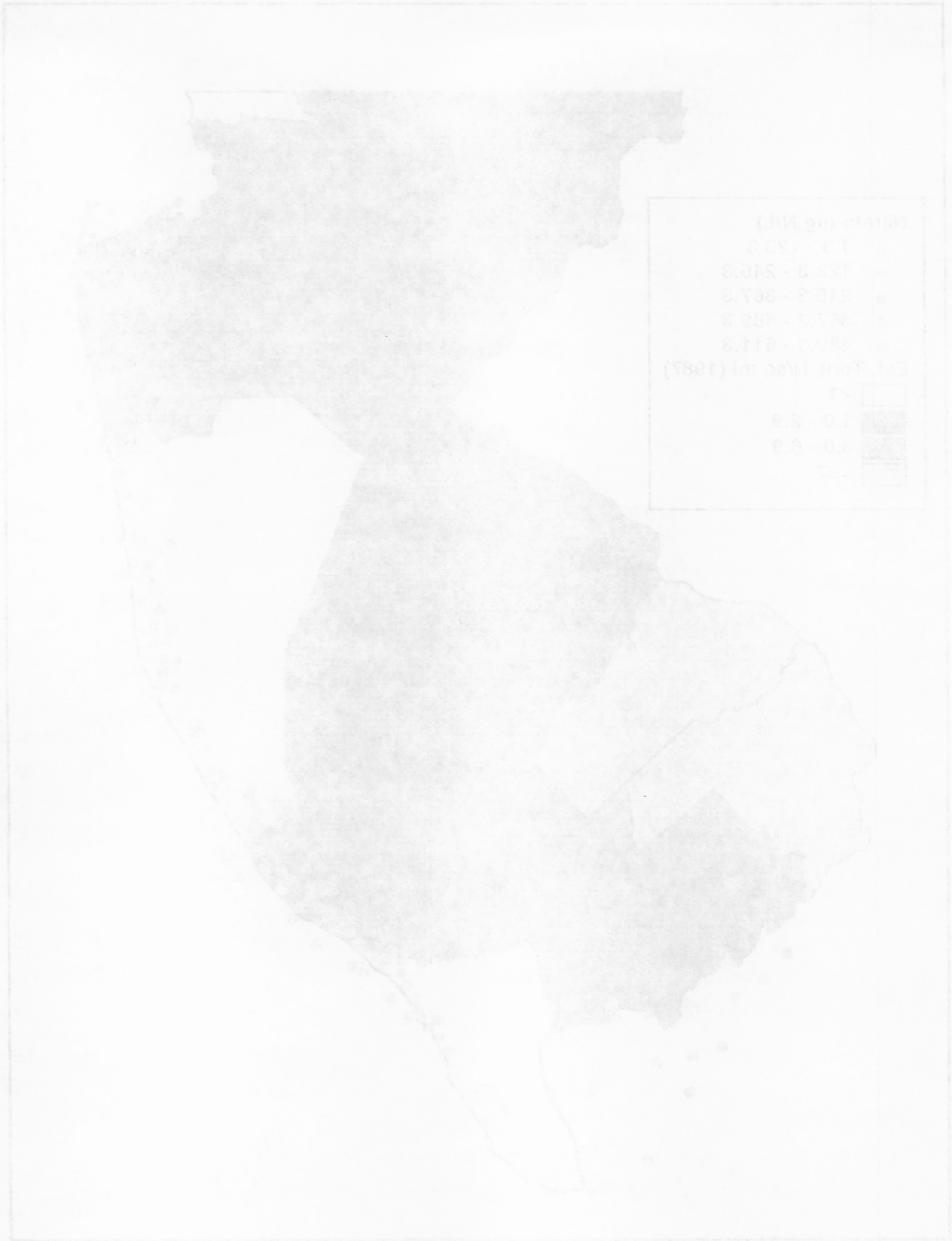


Figure 25. Average nitrate concentrations in NJ coastal waters, 1989-1993; and estimated amounts of nitrogen applied by county in 1989.



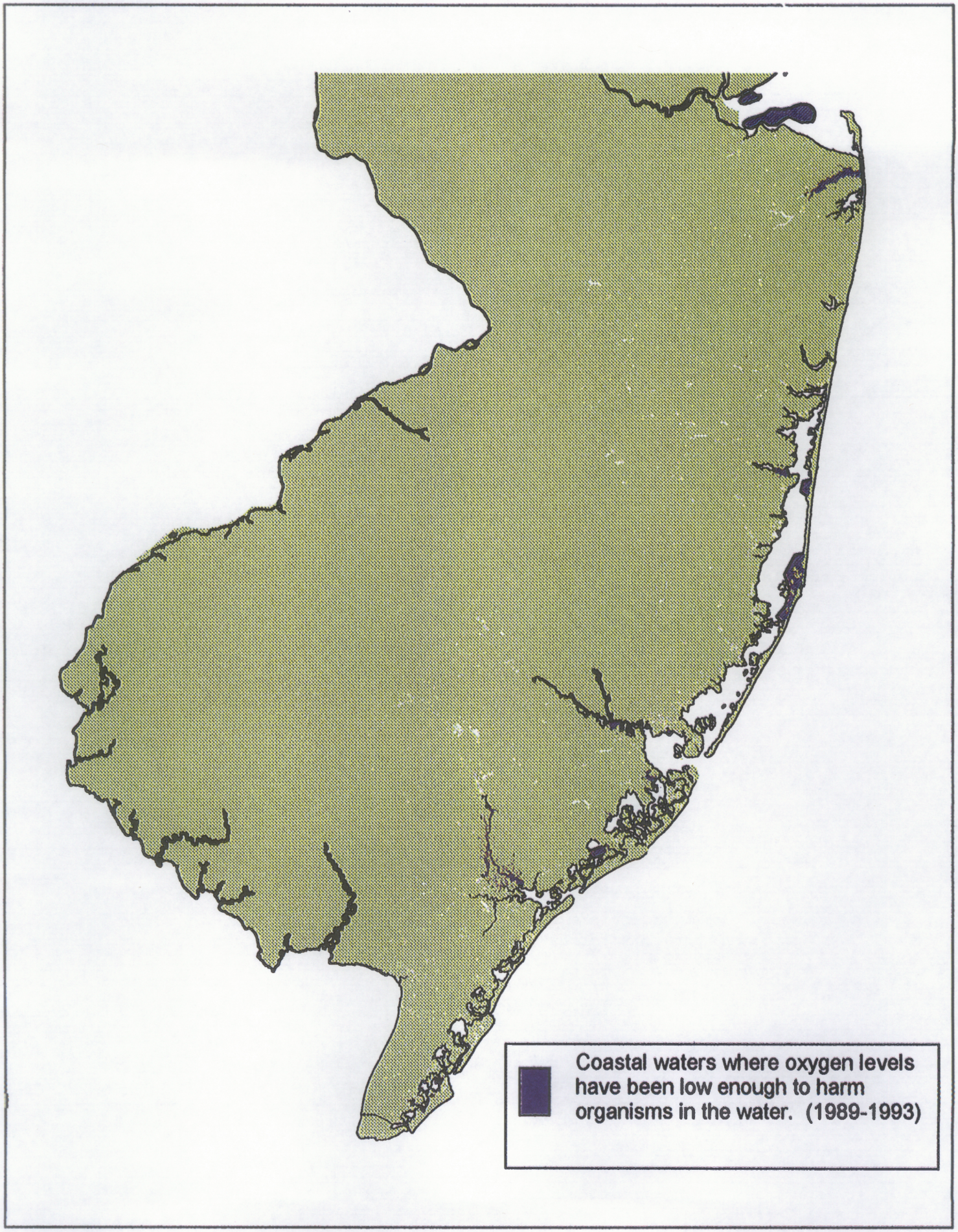

Coastal waters where oxygen levels have been low enough to harm organisms in the water. (1989-1993)

Figure 26.

when low levels were recorded, they persisted for only a short time. It was not that long ago though, that these levels were consistently poor. In 1985, approximately 1,600 sq. mi of ocean bottom experienced low oxygen levels. The summer of 1990 was also a period of relatively poor water quality, although low oxygen was not as widespread or persistent as during the summer of 1985. The variation in water quality from year to year is partially due to storm activity which mixes the water column and promotes aeration of bottom waters.

Figure 27 shows the results of many years of routine monitoring of phytoplankton along New Jersey's coast. Plankton blooms are frequent and intense in Raritan Bay and Sandy Hook Bay. In general, blooms in the northern ocean waters have been less intense than those in the Raritan Bay and not as severe as the 1976 bloom described above. Chronic, summer-long blooms have occurred in Barnegat Bay, Manahawkin Bay, Little Egg Harbor and portions of Great Bay. **Figure 27** also shows the location of several "green tide" blooms which occurred in the mid-1980's along New Jersey coast. These blooms resulted in strong odors and reports by swimmers of skin irritations.

Nonpoint Sources of Pollution

While New Jersey has made considerable progress in removing point sources of pollution (wastewater discharges) from its estuarine waters, it has become clear that water quality is still being degraded by non-point sources of pollution. **Figure 28** shows the results of the past 10 years of coastal water quality monitoring. Areas shaded red represent waters where bacteria levels are higher following storm events. Note that many of these areas coincide with areas where there are restrictions to shellfish harvesting.

There are a number of possible sources of the pollutants that are carried in storm water. These potential sources include failing or illegal septic systems, air deposition, failing sewage collection systems, runoff from livestock and high density wildlife areas and from street runoff. The relationship between human activity and estuarine water quality can be seen in Barnegat Bay. **Figure 29** shows the rainfall impacted waters in the northern portion of the bay in relation to land use and the presence of storm water outfalls. In general, rainfall impacted waters are next to developed land and/or areas with many storm water outfalls.

Atmospheric deposition, one contributor to nonpoint source pollution, occurs when air pollutants are released from point or mobile sources, transported away from the source, and eventually deposited to a water body or a land area that drains into a water body. Air pollutants can be released from either local or distant sources such as industrial smokestacks, power plants, residential woodburning, pesticide applications on agricultural fields, and vehicle exhaust. Data collected elsewhere indicate that, for certain parameters, air deposition may have a substantial impact on water quality.

USEPA's Office of Air and Radiation has issued a draft report entitled, "Nitrous Oxides Impacts on Public Health and the Environment" (November 1996). According to this report, "Atmospheric deposition direct to surface waters and deposition to watersheds and subsequent transport to tidal waters has been documented to contribute from 12 to 44 percent of the total nitrogen loadings to U.S. coastal waterbodies." This report also found that " ... [nitrogen] emissions contribute directly to the widespread accelerated eutrophication of U.S. coastal waters and estuaries." NJDEP is in the process of assessing the national and regional air transport models and other air deposition data and determine the range of impact of air deposition on New Jersey's watersheds.

In order to more clearly define the effect of land use and non-point source pollution on coastal water quality, the NJDEP, in conjunction with the U.S. Geological Survey (USGS), is in the midst of a five-year study of stormwater in the Toms River basin. The study began in May of 1994. Four sites have been selected in the basin. Sites were selected to provide a range of land use conditions so that relationships between water quality and land use could be evaluated. Sampling of streams is performed during eight storm events per year. Samples are collected during the entire storm with the use of automated samplers. Samples are collected for bacteria, nutrients and basic water quality (oxygen and pH). Continuous measurements are made of the changing amount of water flowing through the stream during the storm. This allows scientists to measure the total amount of pollutants being carried into the bay by the storm water.

The first 18 months of the data have been analyzed by USGS and a report on that data should be available from USGS in the very near future. Although an official report has not yet been released, preliminary presentations on the data by USGS show distinct differences between pollutant loads at the 4 sites monitored. One unexpected result so far is that, at the moderate density residential location (Southampton Road), nitrate loads under base flow conditions were equal to or greater than the loads under storm conditions. This was not the case, however, at the high density/commercial location.

Many of the various sources of nonpoint source pollution need to be addressed at the local level. To control these sources, an effective forum should be established to increase local participation in the development and implementation of goals and action plans. Watershed planning and National Estuary Program implementation should facilitate this dialogue. Though the Department has earmarked significant resources for the implementation of watershed management, these efforts will require the collective resources of state, regional agencies, county, and local governments, as well as private citizens, to meet the goal of improving, protecting and maintaining coastal water quality.

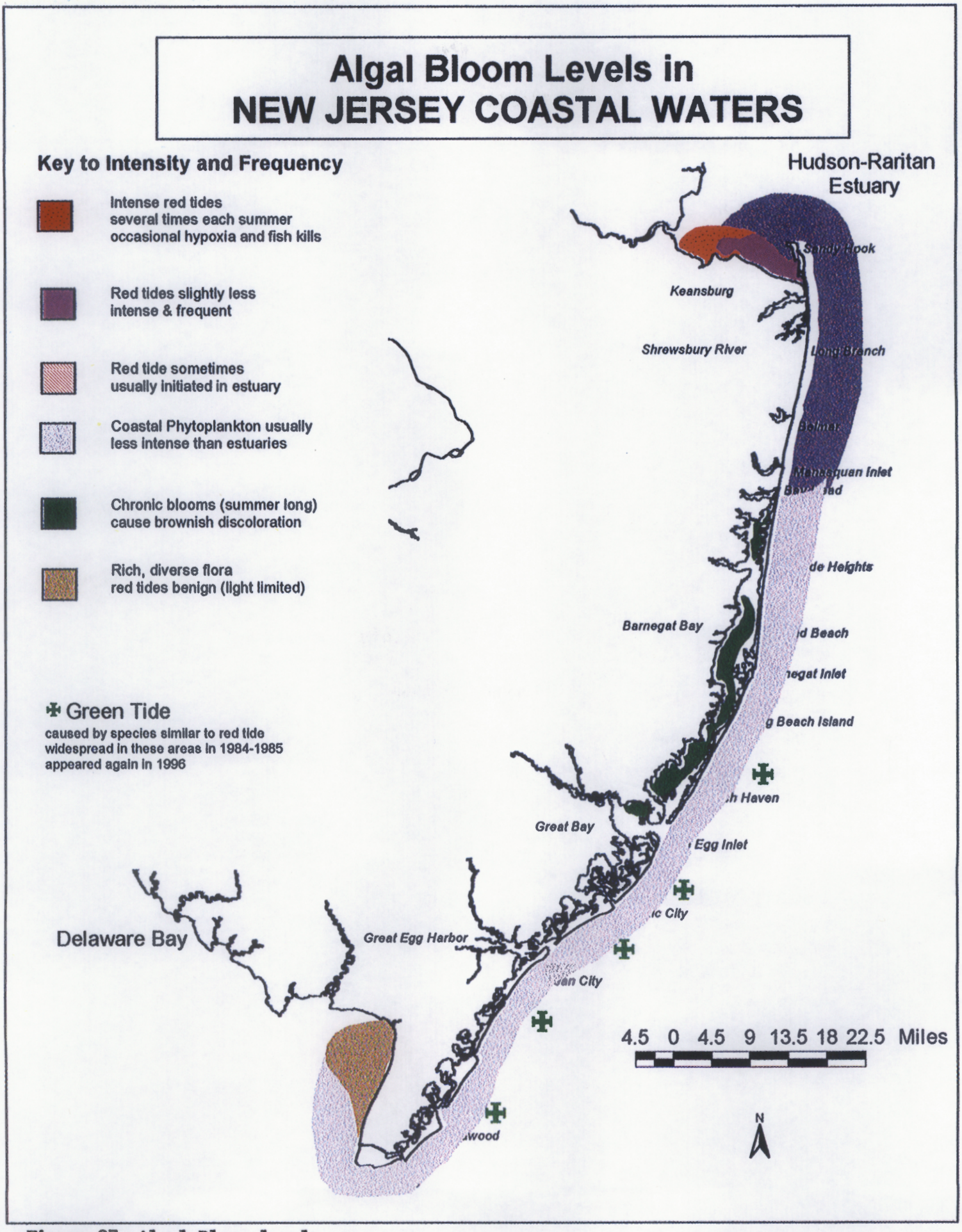
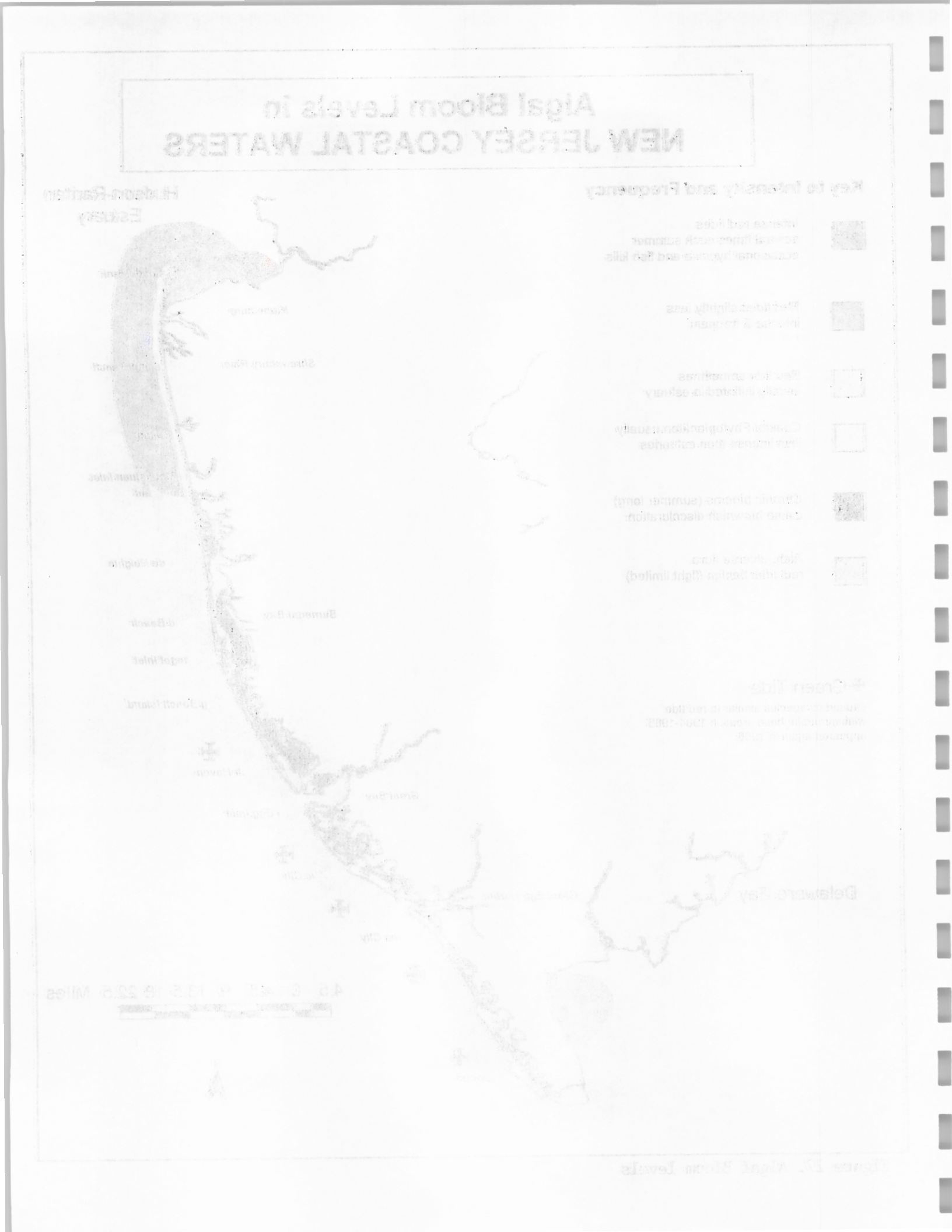


Figure 27. Algal Bloom levels



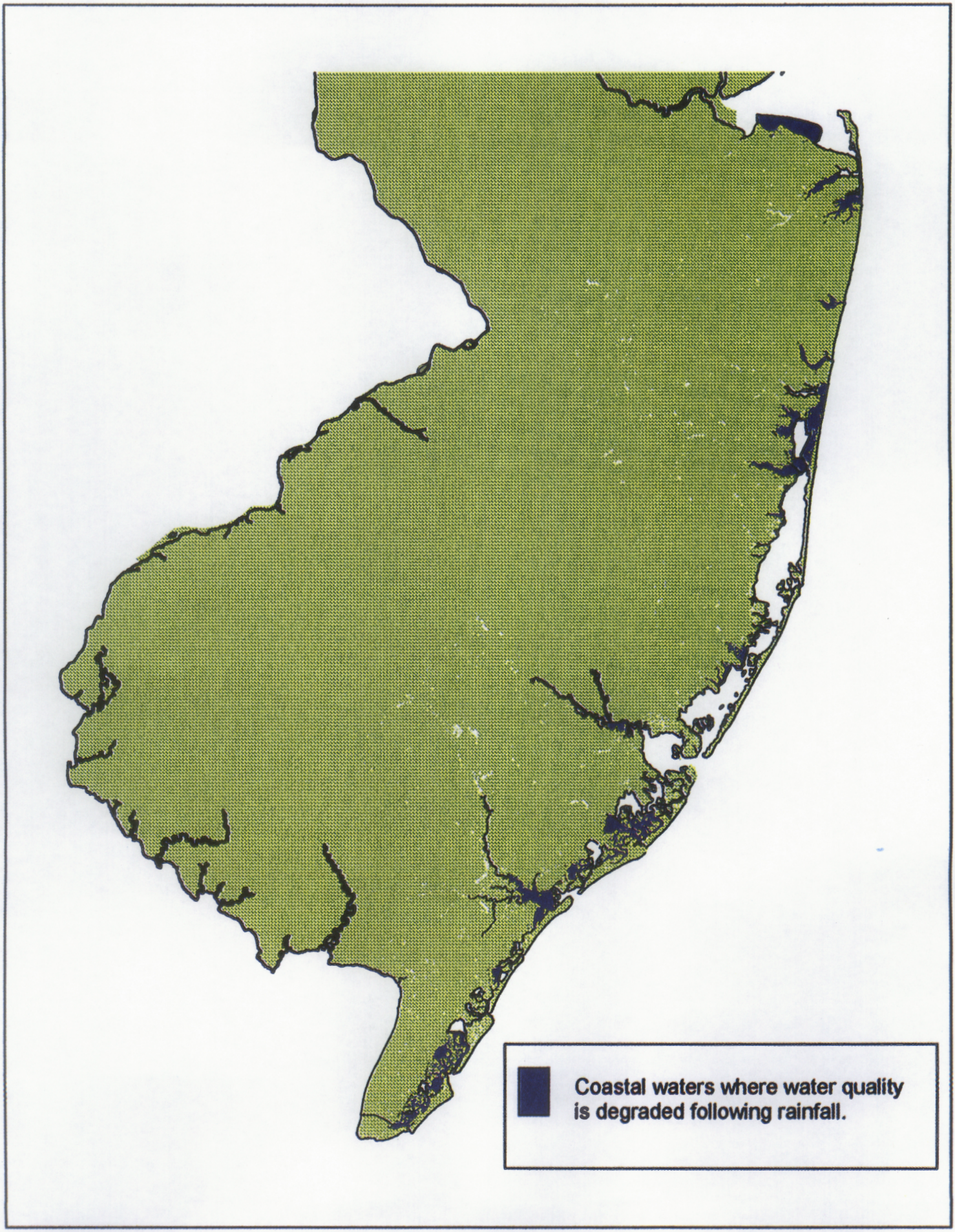
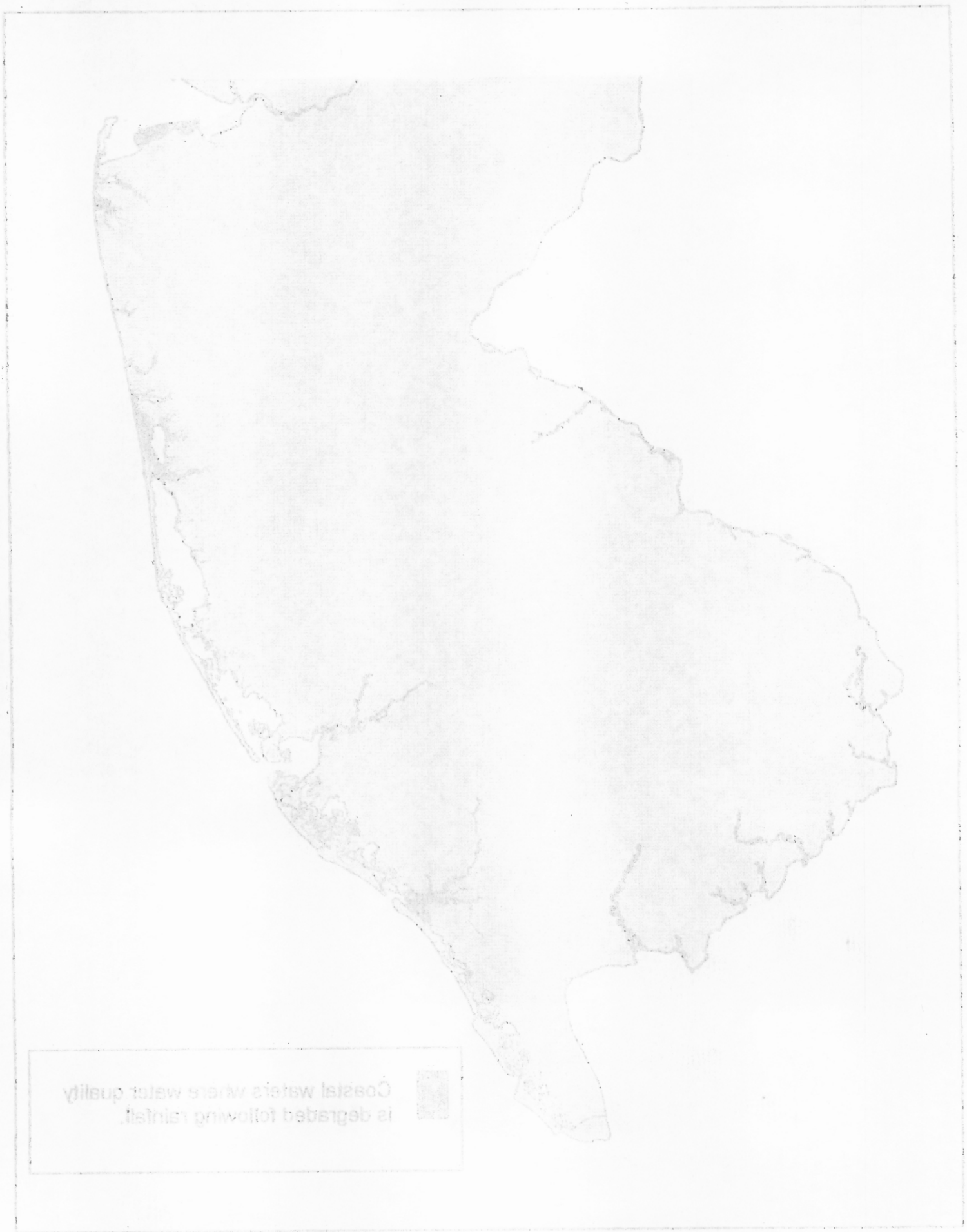

Coastal waters where water quality is degraded following rainfall.

Figure 28.



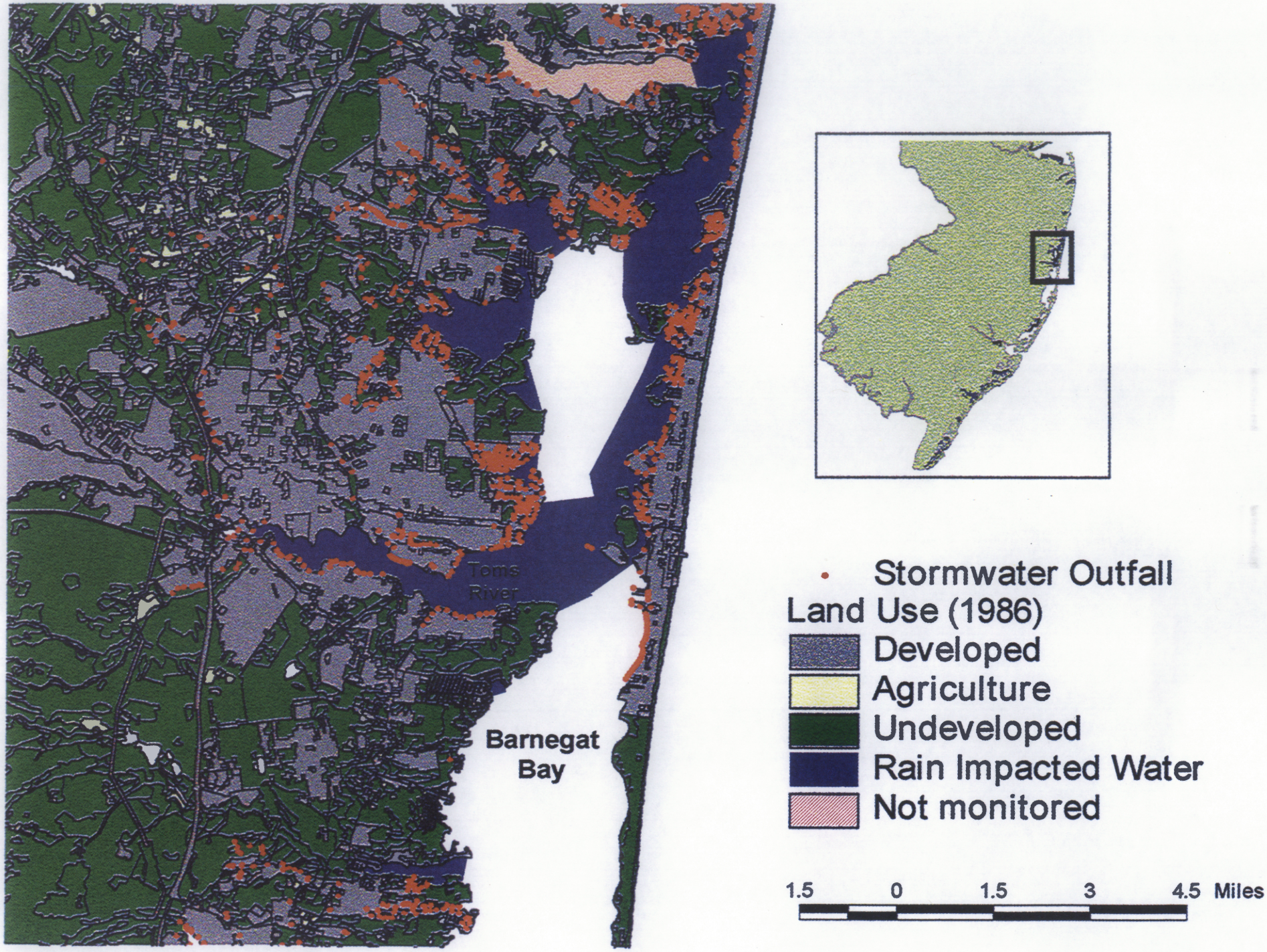

Toms River
Barnegat Bay
Stormwater Outfall
Land Use (1986)
Developed
Agriculture
Undeveloped
Rain Impacted Water
Not monitored
1.5 0 1.5 3 4.5 Miles

Figure 29.

Stormwater Outfall
Land Use (1998)
Developed
Agriculture
Undeveloped
Rain Impacted Water
Not monitored
0
1.5
3
4.5 Miles

Effects of Spills and Flooding

In addition to the long-term concerns of point and nonpoint source pollution, the DEP, county and local governments must deal with short term spills such as overboard discharges related to shipping, sewage collection system failures and discharges from overturned tank trucks. Depending on the substance discharges, the impact can be long-term or short-term. Even when the impact is short-term, it can cause economic problems for those persons making a living from the coastal waters.

In order to ensure that seafood harvested in New Jersey is safe to eat, the NJDEP and the Department of Health close shellfish waters and issue fish advisories in areas affected by spills. This can cause a loss of income for the baymen and fishermen who make a living from these marine resources. **Figure 30** shows the extent of waters affected by a 100,000 gallon sewage spill in Great Sound, Cape May County. The result of this spill was that all of Great Sound and some of the adjacent waters were closed to shellfishing for almost two weeks.

Therefore, an interconnected federal, state and local emergency response network, as well as the most comprehensive ocean water monitoring program in the nation, has been developed to detect environmental emergencies as they emerge and then to implement a coordinated and rapid response to mitigate their potential impacts. The May 10, 1996 Motor Tanker *Anitra* spill of approximately 40,000 gallons of crude oil off the coast of the Cape May peninsula provided a perfect example of this network in action. The cooperation and assistance from the NJDEP, various federal agencies, local and county governments and local business, motel and restaurant owners were the key to a successful process of cleaning 90 miles of shoreline in less than two months after the first observed fouled shoreline from Higbee Beach to just south of Sunset Beach, Cape May County. Over 500 clean-up personnel, 50 boats, oil skimmers, helicopters and all terrain vehicles were mobilized as federal, state, county and local agencies worked together 20 hours a day to satisfactorily clean the beaches.

With the *Anitra* spill, it became acutely obvious that there is enormous potential for extensive damage to the coastal natural resources from accidental and other discharges. Specifically, the vast wetlands behind New Jersey's barrier islands would be especially vulnerable to the effects of these spills. The back bays of coastal New Jersey have been identified as an Environmentally Sensitive Area which provide safe harbors for the nesting of vast numbers of migrating and wintering waterfowl. In addition to waterfowl, there are tremendous amounts of shellfish and sport and commercial fisheries. These areas also provide a prime location for recreation and tourism by the public.

Since accidental -- and even intentional -- spills are going to happen from time to time, the only way to ensure that the wetlands, bays and estuaries are adequately protected is to establish the capability to respond immediately to stop oil from entering the inlets. The primary strategy to achieve this goal is through the deployment of booms that act as barriers between the oil spill and the inlets. Since it is impossible to predict when and where spills may occur, it is crucial for there to be a booming plan in place with all parties in agreement as to the respective responsibilities in implementing the plan should an emergency occur.

At present, only preliminary booming plans have been formulated for the coastal inlets. Unlike the Delaware Bay, where the Delaware Bay and River Cooperative have set plans for every river, ditch and gut from Cape May Canal north to Trenton, there has been no formal plan for the protection of the back bays. In the Philadelphia Contingency Plan, strategies only recommend booming the inlets so that oil would either stay off shore or hit the beaches where environmental damage would be limited. There are no definitive plans or data on these inlets.

To fill in these gaps, an inlet booming task force has been established. The task force is comprised of representatives from the NJDEP, United States Coast Guard, National Oceanic and Atmospheric Administration (NOAA), U.S. Army Corps of Engineers, Department of Interior and major oil spill response companies. The need for local and county input and involvement with this task force is very important. This task force will:

- Develop protective strategies for the eleven New Jersey inlets;
- Determine areas to protect, deflect and collect oil;
- Identify sensitive areas;
- Identify staging areas for waste and equipment;
- Determine the best type of boom to be used; and
- Determine the resources that are at risk.

It is the goal of the task force to develop strategic plans for the inlets by June 1997. To meet this goal, Research Planning, Inc. has been retained under contract to assist the task force to configure these protection strategies. Its task will be to gather data regarding the inlets themselves, the potential oil collection areas and the best booming technologies. Research Planning, Inc. will then prepare a report in manual and digital form for use along the coasts.

While rapid emergency response is crucial, it must be complemented by a diligent program to prevent environmental emergencies from occurring in the first place. The fact that the New Jersey Shore is bounded by two of the busiest ports in the nation -- Philadelphia is the leading crude oil transport port and New York/Newark is the busiest commercial traffic port -- makes constant diligence even more critical. In addition, the NJDEP and other federal and state agencies are in the process of evaluating the ways to

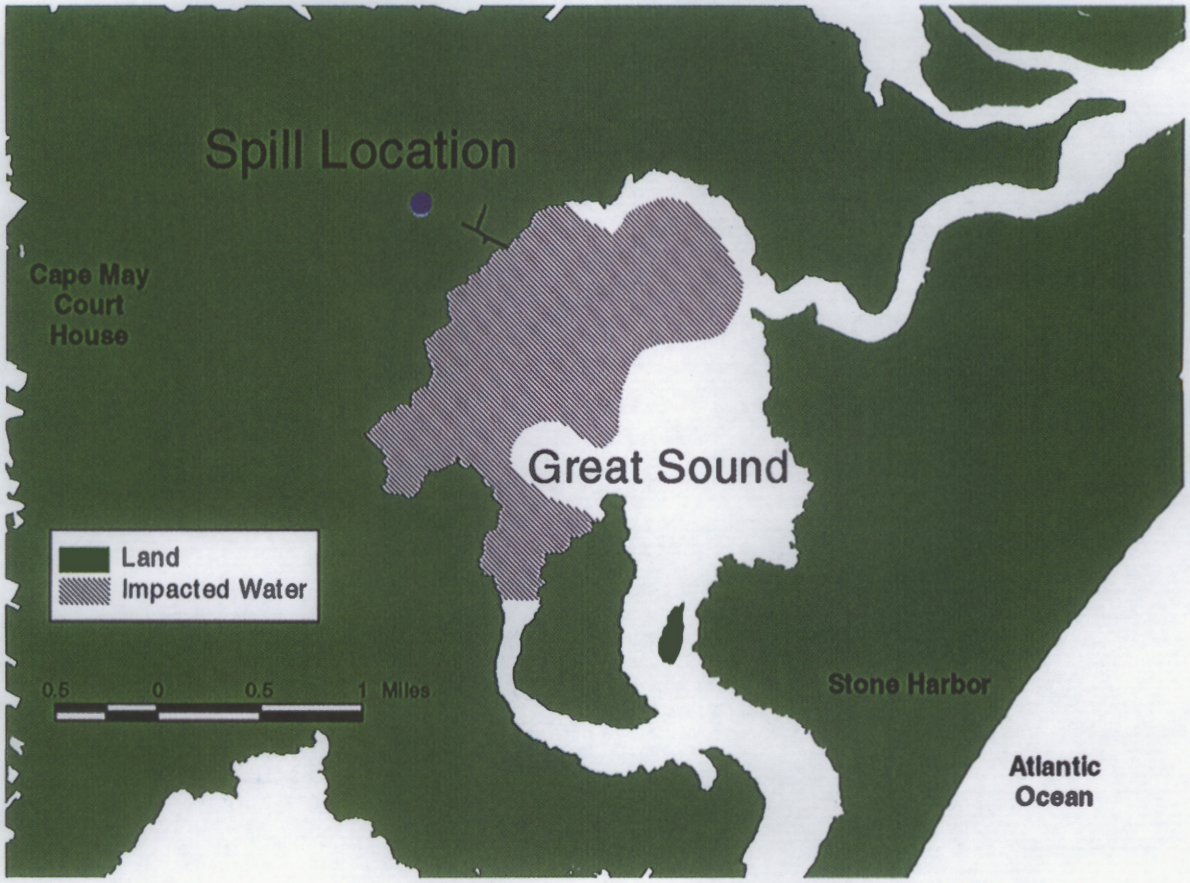


Figure 30. Extent of waters impacted by 100,000 gallon spill in Great Sound, Cape May County

ensure that risks to the environment from the lightering process (where petroleum is transferred from large vessels to smaller shallower draft vessels) are reduced to the greatest extent possible.

To protect the shoreline, the inlets and wetlands, a response net has been developed which ties together the U.S. Coast Guard, the U.S. Environmental Protection Agency, the N.J. Department of Environmental Protection, the national and regional spill response organizations, the State Police Office of Emergency Management and county coordinators in a unified and focused organization which fosters prevention while preparing for response. While New Jersey's pollution response policy emphasizes physical recovery of spilled oil, it is also a leader in pre-approved agreements to employ dispersants and in the use of in situ burning, should a catastrophic spill occur off of the New Jersey coast.

Federal law (the Oil Pollution Act of 1990) assigned oil spill jurisdiction to Federal On Scene Coordinators (FOSCs), the Port Captains of New York and Philadelphia and the USEPA Regional Spill Response Director; however, all FOSCs use the unified command system which assures New Jersey a loud and clear voice when State resources are at risk.

Pollution of coastal waters also occurs when storms cause exceptionally high tides that flood low-lying areas of the coast. The high waters flush areas with septic systems and areas where high densities of wildlife exist, washing wastes into the bays. High tides can also cause failures in the sewage collection systems of coastal towns. These failures often result in the discharge of sewage into the bays. **Figure 31** shows the effect that tidal flooding had on coastal water quality after the storm of late October 1991. One day after the storm, bacterial levels measured by the DEP were high throughout the Atlantic coastal waters from Barnegat Bay south. All of these waters were closed to shellfish harvesting until bacteria in the waters returned to safe levels. The chart on the right in **Figure 31** shows that five days after the storm, bacterial levels were returning to normal.

Current Initiatives

Watershed Management Framework

Over the past 20 years, efforts to address pollution problems caused by human activities have focused primarily on reducing the flow of pollutants to waters from discrete point sources. It has become clear that this traditional "end-of-the-pipe" approach is not the total answer to ensure the long term protection or improvement of coastal and fresh water quality. This is particularly true in New Jersey coastal waters where pollutants from nonpoint sources account for a large portion of the total pollutant equation. In addition, water quality problems experienced in coastal areas generally reflect the combined impacts of multiple land and water uses, which continue to require attention despite the gains

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experienced in the control of point sources of pollution. This is further complicated by a recognition that the extent of water quality problems experienced in marine waters depends in part on the natural dynamics and uses of watershed lands which drain into coastal waterbodies.

In 1981 a project was initiated by the Department, in cooperation with private institutions and federal, county, and local government agencies, to reduce pollution entering the Navesink estuary. The primary sources of pollution included runoff from horse breeding farms, increased residential development, and human waste from marinas and boats. A comprehensive management plan was implemented in 1986 to reduce the input to the river through better management, including animal waste disposal and pump-out facilities at marinas. As a result, water quality in the estuary has improved and for the first time in over 25 years, a portion of the estuary has been opened for shellfish harvesting.

Using the Navesink River Estuary project as a case study of effective watershed management in the coastal region and with other successful watershed pilots elsewhere in New Jersey, the NJDEP is planning to implement water resource management on a watershed basis throughout the state. This will help to more comprehensively address the complex factors affecting marine and fresh water quality.

In January 1997, the NJDEP released its draft *Statewide Watershed Management Framework Document for the State of New Jersey*. This document defines the watershed planning and management process the Department is proposing to implement in the state's 20 watershed management areas and five water regions. **Figure 32** shows New Jersey watersheds, watershed management areas, and water regions.

Watershed management will be accomplished through close collaboration between the Department and regional stakeholders in a sequential planning process detailed below:

A. Perform preliminary organizational and data gathering activities within a given watershed
   - Initial planning/Stakeholder involvement
   - Monitoring and data collection

B. Conduct & develop preliminary watershed characterization, technical work plan, screening/targeted monitoring, modeling and analysis
   - Watershed characterization and assessment

C. Perform detailed watershed characterization and assessment, environmental indicators, problem identification and prioritization
   - Goal setting

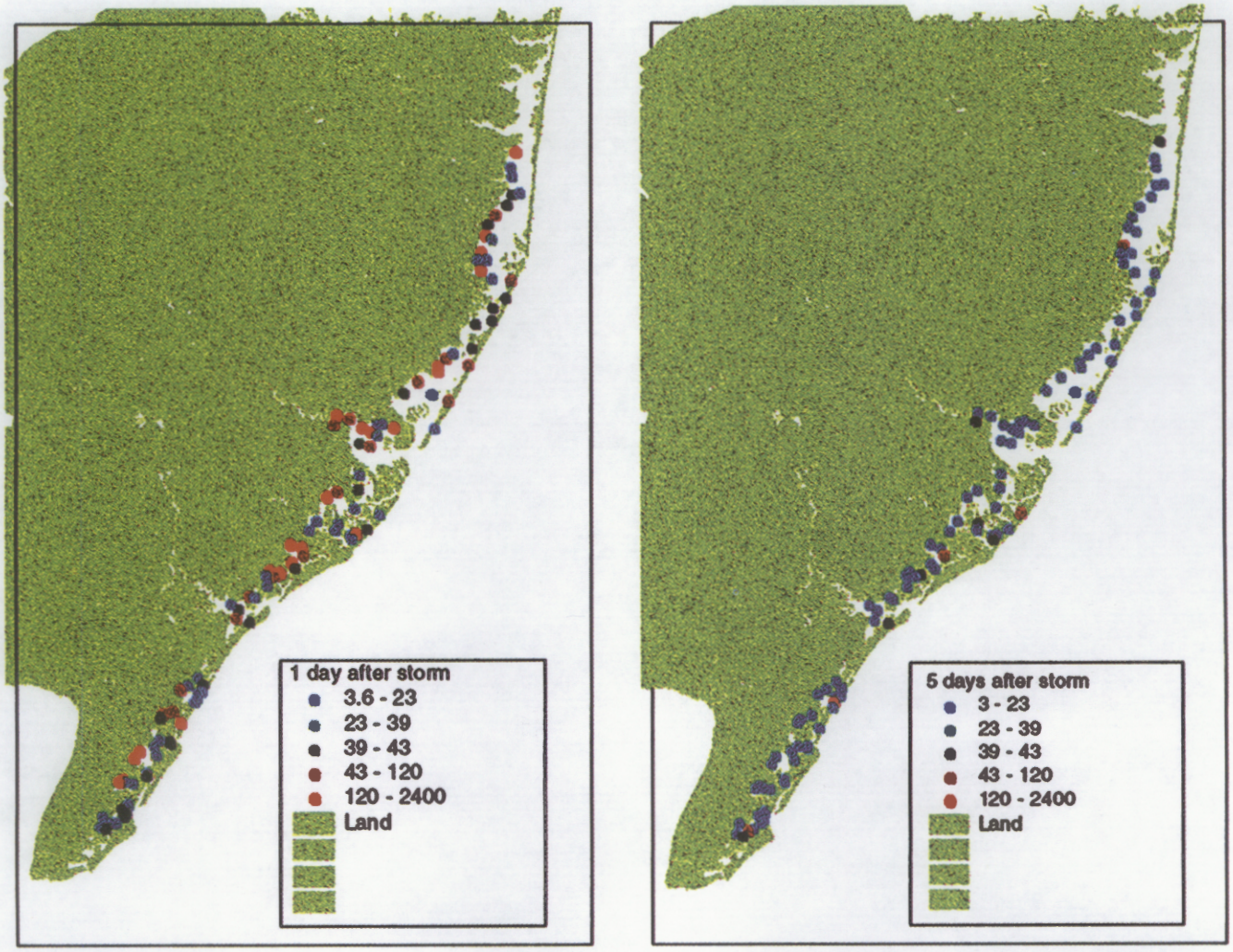


Figure 31. Effects of tidal flooding on coastal water quality, comparing one day after a storm and five days after that storm in October 1991.

D. Develop environmental objectives and evaluative criteria & TMDLs
   - Management strategy development

E. Perform simulations/forecasting, alternatives analysis, BMP options & cost-benefit analyses
   - Watershed management plan development
   - Watershed management plan implementation

F. Adopt watershed management plan, permit issuance, nonregulatory measures, financial incentives & compliance measures
   - Evaluation and refinement

G. Perform ongoing monitoring, evaluation, plan refinement & enforcement
   - Evaluation and refinement

As part of the draft *Statewide Watershed Management Framework Document for the State of New Jersey*, a statewide watershed management implementation schedule has been proposed by the Department. This schedule recognizes that the coastal region contains areas which should be addressed under watershed management on a priority basis. On-going initiatives including the following areas will be expanded as initial watershed management activities begin: the New York/ New Jersey Harbor Estuary, the Barnegat Bay Estuary and the Delaware Bay Estuary.

Stormwater and Nonpoint Source Pollution Control

Further coastal water quality improvements will be achieved when specific nonpoint sources of pollution are identified and addressed. Nonpoint sources of pollution degrading coastal waters include municipal stormwater, overland runoff, air deposition, inputs from rivers, and shipping and boating.

In 1990, Congress recognized through enactment of the Coastal Zone Act Reauthorization Amendments (CZARA) that nonpoint source pollution is a key factor in the continuing degradation of many coastal waters and it established a new program to address this pollution. Congress further recognized that the solution to nonpoint source pollution lies in state and local action. Thus, in enacting CZARA, Congress called upon states to implement specific management measures to manage coastal nonpoint source pollution. The NJDEP completed a plan in July 1995 to satisfy the Federal requirements of CZARA. New Jersey's plans for protecting coastal water quality recognizes that many of the required management measures are already required by current programs in New Jersey.

Currently, there are 150 municipal stormwater discharges to the ocean and 7,000 to back bays. Most of the remaining restrictions on shellfish harvest areas and bathing beach closures are due to nonpoint source pollution. The Department has an number of initiatives underway to control nonpoint sources of pollution.

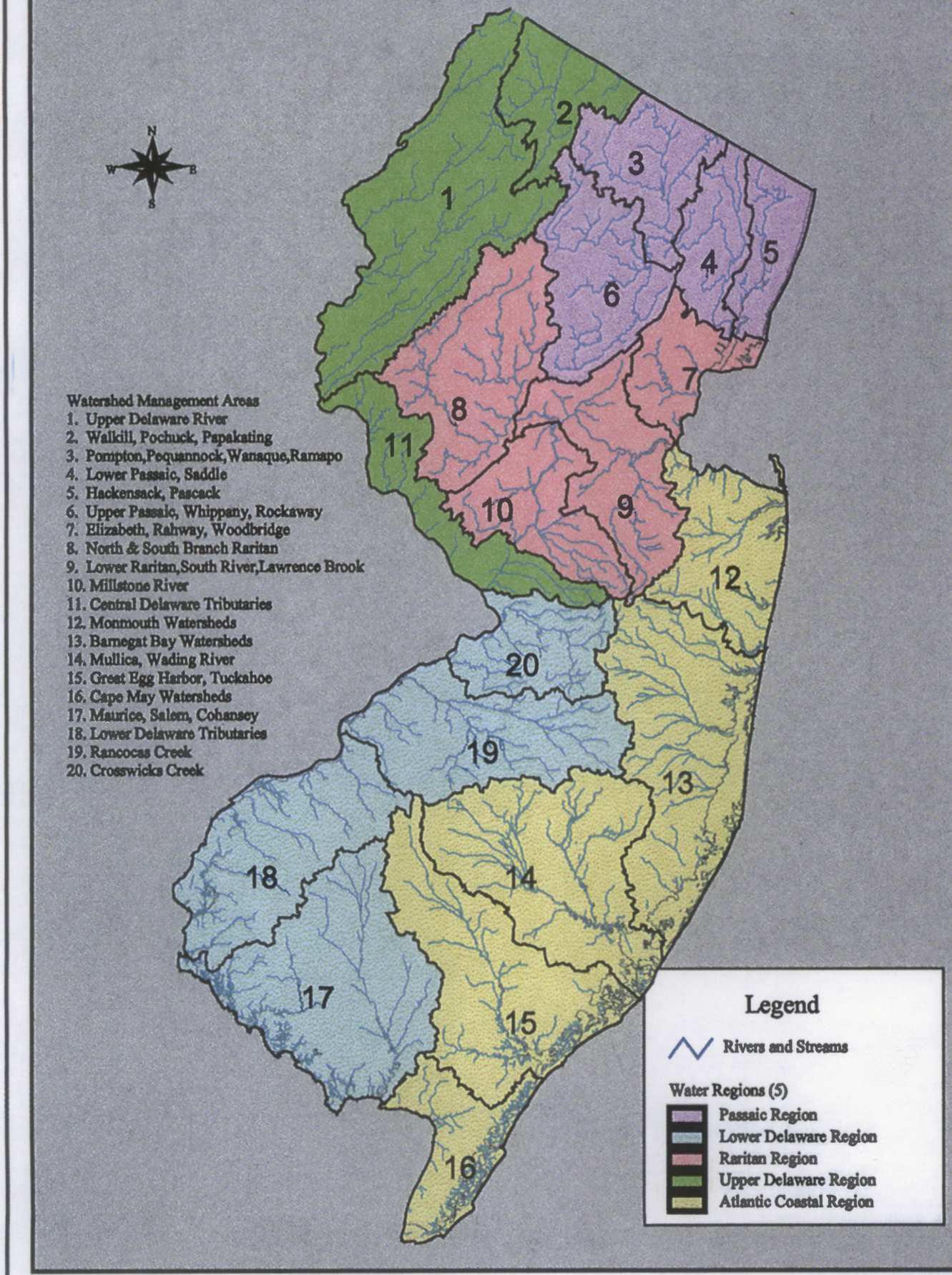
The NJDEP seeks to protect surface water from stormwater-borne contaminants through the permitting of industrial facilities under the NJPDES Permit program. This program emphasizes pollution prevention techniques and source control rather than "end-of-pipe" treatment. The NJDEP utilizes general and individual permits to regulate facilities. Since the program's initiation in 1993, the NJDEP has issued over 2,000 permits for conventional industrial discharges, and over 2,750 permits for construction related discharges. Of the 2,000 conventional permits, approximately 350 permits cover facilities in the five counties of the coast. Of the 2,750 construction related permits, approximately 549 were issued in the coastal area (see **Figure 33**).

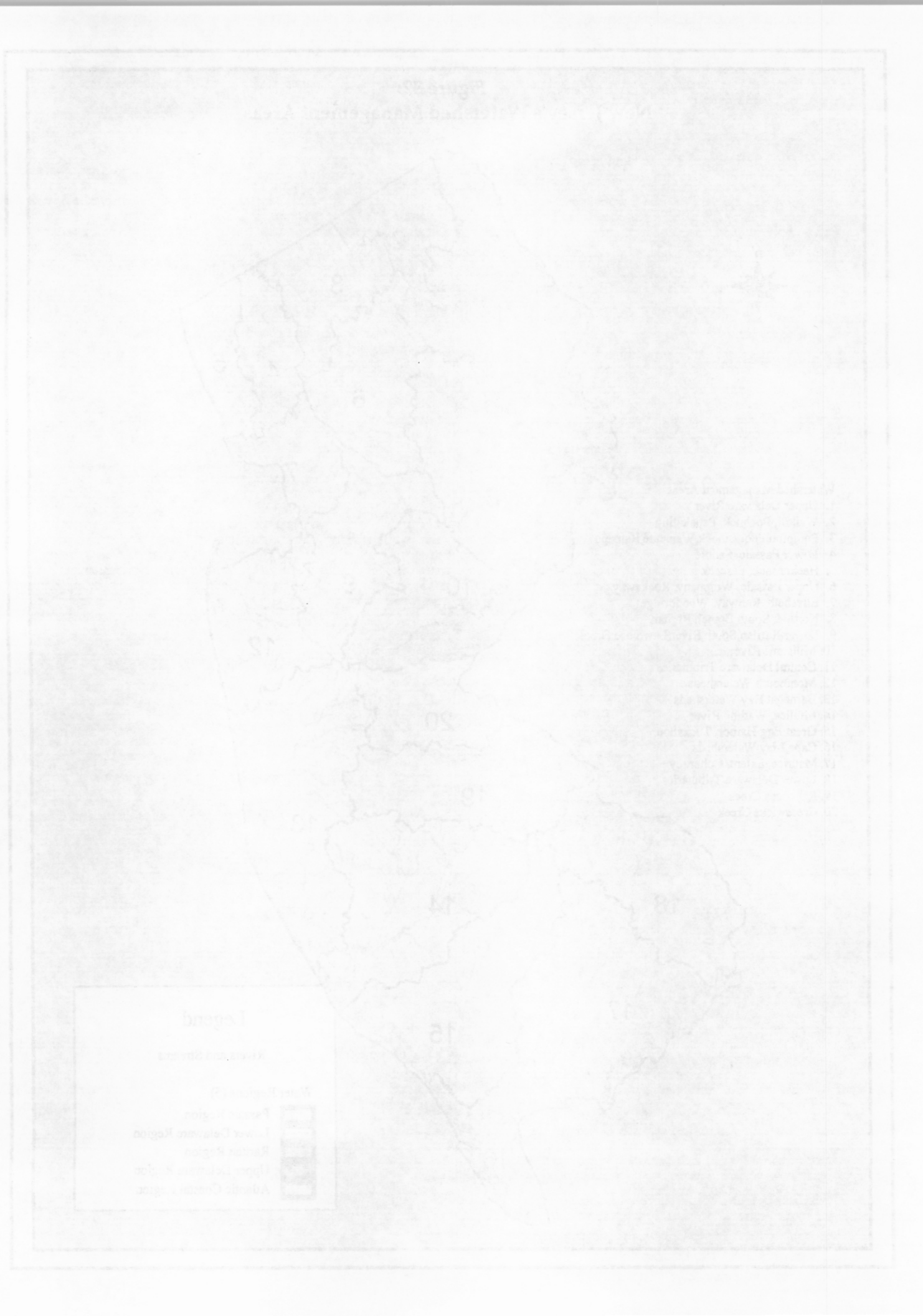
The stormwater permitting program requires industrial facilities to prepare and implement Stormwater Pollution Prevention Plans. These Plans identify areas where the facility can apply pollution prevention best management practices. It is anticipated that these efforts will reduce or eliminate significant amounts of stormwater/nonpoint source pollution entering the streams, rivers and the ocean. At this time the Program is limited to industrial sites; however, the USEPA intends to expand the program to municipal stormwater discharges by the year 2000.

Recognizing that no single technical practice or institutional framework for managing stormwater runoff is the answer for every watershed, the Department will soon propose amendments to the Municipal Stormwater Management Rules which establish criteria for the development and adoption of watershed based stormwater management plans. The proposed amendments will enhance technical standards and improve regulatory efficiency. The overall purpose of watershed stormwater management plans is to establish a program of effective and implementable actions that could *prevent new* and *abate existing* flooding and point and nonpoint sources of pollution related to stormwater runoff. It is essential that watershed based stormwater management plans be developed by, or in coordination with, local and regional agencies. The incorporation of watershed management principles into the DEP stormwater management program is an important element of NJDEP's *Watershed Management Framework.*

It is understood that funding is needed for both the formulation and the operation of stormwater management programs. It is intended that both a portion of the Stormwater and Combined Sewer Overflow Bond Act of 1989 ($50 million) and a portion of the New Jersey Corporate Business Tax (CBT) be made available to local and regional agencies to fund watershed based stormwater planning and construction activities. Once plans are developed, funds will likely be needed for implementation of preventive and retrofit projects. The Department has expanded the scope of the Wastewater Financing Program to include construction costs for stormwater projects due to the increasing water quality concerns from stormwater runoff.

Figure 32:
New Jersey's Watershed Management Areas





Toms River Basin Nonpoint Source Monitoring

DEP continually assesses its water quality monitoring methods as well as new approaches to monitoring and analyses to achieve better data. New automated methods such as those utilized in the Toms River Stormwater Project provide more consistent and timely data than traditional manual methods, while at the same time minimizing costs. NJDEP has used self-contained monitoring systems called sondes to measure coastal water quality that provide continuous temperature, salinity, oxygen, and pH measurements. These unattended systems are able to provide further insights into tidal dynamics and coastal water quality.

The Department maintains five sites in the Toms River basin for monitoring stormwater quality. These sites are monitored during eight storm events each year as well as four times a year during base flow conditions. Discharges are measured concurrently with water quality, allowing for the calculation of pollutant loads. Sampling sites were chosen to reflect different land use conditions. This project is providing accurate, current data on the relationship between land use and pollutant loads resulting from stormwater. This data will be used for the development of environmental indicators of nonpoint source pollution impacts.

Sewage Infrastructure Improvement Program

As previously mentioned, the Sewage Infrastructure Improvement Act (SIIA) established requirements for 94 coastal communities to control bacterial discharges through stormwater systems within their jurisdiction. The SIIA included two principal components: (1) stormwater and sewage collection system mapping and nonpoint source control and (2) combined sewer overflow abatement. The 94 municipalities were required to map stormwater collection systems, monitor stormwater quality and identify and remediate inter- and cross-connections of stormwater and sewer systems. The remediation of these connections is intended to reduce the impacts of sewage-contaminated stormwater discharges on coastal water quality.

The Act also authorized a grant program to financially assist with the mapping activities. Grants have been awarded to the majority of the 94 affected municipalities, with pending grant awards to all remaining eligible municipalities.

Coastal municipalities have contributed to improvements in coastal water quality and reductions in beach closings by performing mapping, investigations and remedial activities required by the Sewage Infrastructure Improvement Act. However, the near shore coastal waters and the barrier island bays, in particular, remain susceptible to the bacterial contamination that stormwater often conveys.

Clean Vessel Act

The Federal Clean Vessel Act of 1992 provides grants to states for the purpose of addressing concerns related to vessel-generated sewage, which is considered to be a nonpoint pollution source. In New Jersey, 60-70% of boating occurs in coastal counties and is a particular concern in coastal embayments where marinas and other boating facilities are located. The success of the program can be measured as follows: 12 marinas have been approved for pump-out facilities with 30 more marinas pending. The number of marinas with these facilities should double by the end of 1997. A No Discharge Zone application has been filed with EPA for the Manasquan River. The Department is planning to designate no discharge zones along the entire coast starting with the Navesink and moving southward.

Point Source Pollution Control

In addition to stormwater (which can be considered both a point and a nonpoint source of pollution), the NJDEP actively regulates municipal and industrial discharges into the ocean, waterways of the coast, and estuaries through the New Jersey Pollution Discharge Elimination System (NJPDES). The purpose of this regulation is to improve water quality for drinking, swimming and natural resource protection. The NJDEP also provides financial assistance to municipalities to enable them to plan and construct waste and stormwater facilities.

There are now no direct industrial discharges to ocean waters. However, seventeen municipal sewage treatment plants, which treat municipal sewage and industrial waste, discharge treated wastewater to the ocean. Municipal and industrial treatment plants also discharge treated waste to tidal waters. Regionalization and upgrades of sewage treatment facilities since 1970 have significantly improved the quality of the estuarine waters.

Through the combined efforts of planning, permitting, enforcement and financing programs in NJDEP, all existing domestic wastewater treatment facilities in the State, including those discharging into the marine environment, were upgraded to secondary treatment by 1988. Regionalization of the domestic wastewater treatment facilities discharging into the marine environment has resulted in the elimination of six (6) sewage treatment facilities and the removal of all associated backbay point source discharges. It should be noted that, based on review of discharge monitoring report data (1994-95) for the 17 permitted treatment facilities which discharge into the ocean through 14 outfalls, the average effluent quality is significantly better than the permitted levels. As a result, significant progress has been achieved in improving the quality of the State's marine and estuarine waters.

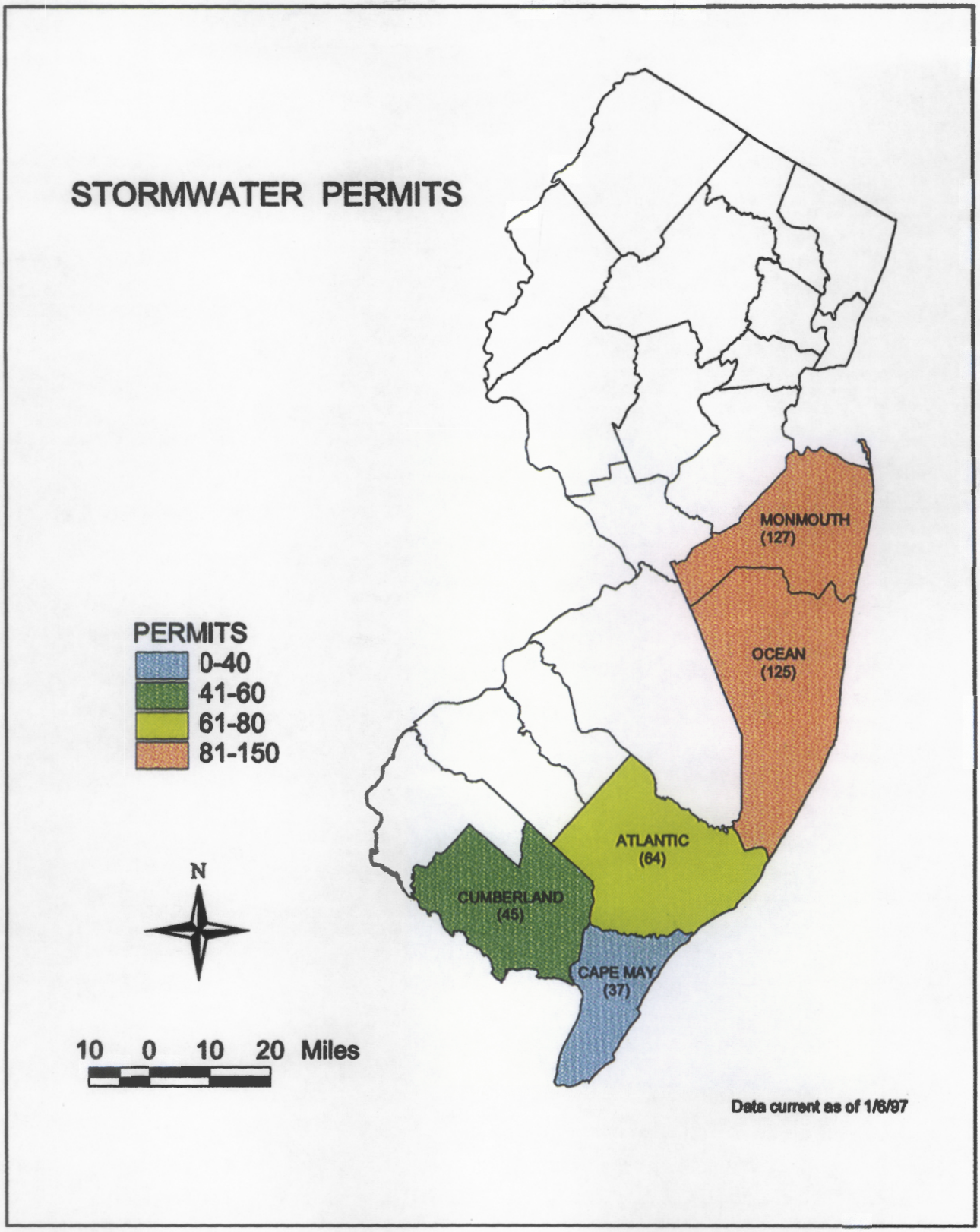

STORMWATER PERMITS
PERMITS
0-40
41-60
61-80
81-150
MONMOUTH
(127)
OCEAN
(125)
ATLANTIC
(64)
CUMBERLAND
(45)
CAPE MAY
(37)
N
10 0 10 20 Miles
Data current as of 1/6/97

Figure 33.

STORMWATER PERMITS
PERMITS
0-40
41-60
61-80
81-159
10 0 10 20 Miles

Figure 33.

The NJDEP also regulates industrial, municipal and private systems discharges to ground water. Recent studies show that ground water contamination can result in increased levels of surface water pollution, as the contaminants find their way from the ground water into the base flows of surface waterways. The NJDEP has permitted 785 facilities statewide. Of these, 266 permitted facilities are located in the coastal region.

Cessation of Ocean Dumping of Sludge

Until 1989, over half of the sewage sludge being generated in New Jersey was disposed in the Atlantic Ocean. Under Federal and State Judicial Consent Decrees (JCDs), six treatment facilities agreed to implement plans for their residuals to be reused as beneficial products. The elimination of ocean sludge dumping by New Jersey in 1991 as a result of state law and by New York's following suit shortly thereafter resulted in immediate water quality improvements at the dump site and renewed public confidence in coastal water quality in general.

Combined Sewer Overflows

Combined sewers collect and transport stormwater and sewage to sewage treatment plants through a single collection system. In wet weather, the collection systems often become overloaded with stormwater. Stormwater and untreated sewage are then discharged via combined sewer overflow pipes. In total, approximately 300 CSO discharge points have been identified, located mainly in the older, urbanized areas of the State. Of these, approximately 240 CSO points exist north of Sandy Hook.

The combined sewer systems in the State, associated with 30 municipalities and other public utilities, are primarily concentrated in three specific areas of the State: 1) throughout the New York/New Jersey Harbor Complex; 2) in the tidal portion of the Raritan River from the City of New Brunswick; and 3) in the tidal portion of the Delaware River from Camden, Gloucester and Trenton Cities. There are no direct CSO discharges into the Atlantic Ocean. The frequency, magnitude and duration of wet weather discharges from CSO points varies greatly and has not been well quantified.

Under the NJDEP's combined sewer overflow strategy, which was granted final approval by the USEPA on July 9, 1996, the NJDEP requires the elimination of dry weather overflows, and has established a requirement that solids no greater than one half inch in diameter be allowed in CSO discharges. The half inch standard substantially reduces the solids and floatable materials discharged into the State's waterways, and assures capture of needles or other dangerous medical wastes prior to discharge. However, due to the presence of untreated sewage and associated pathogens during wet weather discharges, CSOs remain a human health concern.

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As of February 20, 1997, 19 local government entities which own and/or operate any portion of a combined sewer system in the New York/New Jersey Harbor Complex have received authorization under a general permit. These authorizations effectively regulate 244 of the 280 known CSO points discharging into this harbor. The remaining CSO points are regulated under individual or "system-wide" permits and, when applicable, corresponding Administrative Consent Orders. In June of 1996, the NJDEP furthered its compliance with the USEPA's Combined Sewer Overflow National Policy by modifying the New Jersey Pollution Discharge Elimination System (NJPDES) permits issued to wastewater treatment facilities in New Jersey discharging into the New York/New Jersey Harbor Complex. These permit modifications incorporated provisions requiring the implementation of the wastewater treatment facility specific elements of the National Policy's Nine Minimum Controls. Specifically, these modifications included language which called for the maximization of the conveyance of wastewater to the wastewater treatment plant for treatment and minimization of non-domestic user discharges during wet weather periods.

In addition, as of February 20, 1997, of the 280 known CSO points in the New York/New Jersey Harbor Complex, only 41 do not have NJDEP-approved long-term solids/floatables control plans. Of the 41 remaining CSO points, 12 have plans under review, leaving only 29 for which plans have not yet been submitted. Most New Jersey CSO dischargers are in the design phase in which plans and specifications are being prepared. The NJDEP has found that the planning, design and construction of CSO control measures is a time consuming task and a site specific undertaking.

Wastewater Financial Assistance

The NJDEP issues loans to municipalities for planning, design and construction of wastewater treatment facilities, as well as for stormwater/nonpoint source management facilities. This financial assistance enables municipalities to construct wastewater and stormwater facilities that will correct or eliminate surface water pollution. The three financial assistance programs are: 1) the federal State Revolving Loan Program, 2) the Wastewater Treatment Financing Program, and 3) the Sewage Infrastructure Improvement Act (SIIA). The SIIA authorized the availability of grant funding for mapping of stormwater and wastewater conveyance systems; planning and/or design of stormwater/nonpoint source management facilities in Atlantic, Cape May, Ocean and Monmouth counties; and planning and design of CSO facilities on a statewide basis. The NJDEP utilizes a priority system to rank facilities for assistance. The NJDEP has provided $140 million to the five counties of the coastal region for construction of projects under the loan program.

National Estuary Programs

In 1987, Congress established the National Estuary Program (NEP) as part of the Clean Water Act (Section 320). Congress also mandated that a restoration plan be developed for the New York Bight. The mission of the NEP is to protect and restore the water quality, biota and habitat of estuaries that are threatened by pollution, overuse, and development. The USEPA administers the program and designated three estuaries in New Jersey as nationally significant. They are (1) the New York/New Jersey Harbor Estuary Program/New York Bight Restoration Plan (HEP, 1988), (2) the Delaware Estuary Program (DELEP, 1989), and (3) the Barnegat Bay National Estuary Program (1995).

These programs build watershed management partnerships to fulfill environmental quality objectives and develop environmental quality indicators for New Jersey's estuaries. For the HEP and DELEP programs, scientists and environmental managers from the States of New Jersey, New York, Delaware and Pennsylvania are working cooperatively to develop regional monitoring programs and identify environmental indicators that can judge the success of the Comprehensive Conservation and Management Plan (CCMP) actions to address sources of toxic and pathogenic contamination, nutrient enrichment and loss of habitat and living resources. In the NY/NJ Harbor Estuary, the NJ Harbor Discharger Group (comprised of 11 major sewerage authorities in New Jersey) and New York City dischargers are working with the HEP to develop pilot projects to reduce toxic contamination from municipal discharges throughout the Harbor. Both the HEP and DELEP have successful mini-grant programs that have distributed over $300,000 in funds to over 100 organizations and local governments to conduct outreach and educational projects throughout the Harbor and Delaware regions.

Governor Whitman sent a letter of approval for the HEP CCMP on January 21, 1997 and the NJDEP has been advised that USEPA Administrator Browner has concurred and approved the HEP CCMP. The HEP CCMP contains over 300 actions to address priority issues of toxic and pathogen contamination, habitat loss, dredged material management, floatable debris, nutrient enrichment and point/nonpoint sources of pollution, public involvement, and environmental indicators.

The DELEP CCMP has not yet been approved. The CCMP contains over 75 actions that address land management, water use management, habitat and living resources, toxics, education and public involvement, monitoring and data management.

Designated by the USEPA in 1995, the Barnegat Bay Estuary Program has established a Management Conference and is conducting scientific characterization studies building on previous efforts (e.g., Watershed Management Plan for the Barnegat

Bay, 1993). Nonpoint source control and multiple user impacts are the issues receiving the main focus.

Water Supply Planning

Aquifer Recharge in Cape May Peninsula[1]

Cape May's desirability as a location to live and vacation places a significant strain on the peninsula's water resources. Projections of the future point to a steady increase in the year round population (perhaps increasing by more than 60% in the next 50 years) which will be drawing on the peninsula's already stressed watershed. In addition, Cape May experiences a seasonal influx that more than triples Cape May's population during the summer. This steadily increasing rate of withdrawal, combined with the fact that the peninsula has saltwater to the west, south and east and further compounded by little potential for surface water supplies to augment groundwater sources, has made the Cape May Coastal watershed especially vulnerable to saltwater intrusion, particularly in southern Cape May County and along the barrier islands.

Studies have shown that the yield of the shallow aquifer system has been exceeded in the southern Cape area, allowing saltwater to replace formerly freshwater supplies. The Cape May County Water Supply Study by the U.S. Geological Survey resulted in several reports including "Ground-water Hydrology & Simulation of Saltwater Encroachment, Shallow Aquifer System of Southern Cape May County"; Saltwater Intrusion into Fresh Ground-water Supplies in Southern Cape May County, 1890-1991"; "Analysis of Saltwater Intrusion in the Atlantic City 800-Foot Sand Toward Public Supply Wells in Cape May County"; and "Environmental Limitations to Water-Resource Availability in Cape May County".

Cape May water managers face significant challenges as they confront these facts and pursue regional water supply planning options or attempt to locate alternative future sites for aquifer withdrawals. Courses of action that may help to mitigate or prevent these problems include: (1) developing a county-wide water conservation program; (2) improving supply and demand management of water use from aquifers and protecting existing supplies; (3) making capital investments to relocate or to create new well fields or build a desalinization plant; and (4) install reverse osmosis water purification systems on existing wells.

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[1]Adapted from "The Vital Resource: New Jersey Statewide Water Supply Plan, NJDEP, August, 1996.

In 1995, the County Board of Chosen Freeholders received a water conservation grant to (1) identify water uses that characteristically demonstrate potential for water savings; (2) identify the most cost-effective and practical water conservation techniques for those uses; (3) implement these techniques; (4) monitor the water savings effectiveness and progress subsequent to implementation of these measures; and (5) develop a manual that can be used by other counties to reduce water use. The proposed target goal is to reduce county-wide water use by 15 percent, with special emphasis on southern Cape May County and along the barrier islands.

The southern Cape May County area has already commenced with their own water conservation measures as put forth in the "First Annual Status Report on Water Conservation Programs in the Southern Cape May Region," prepared in August of 1993 by the Southern Cape Regional Water Advisory Commission. Through water conservation via supply and demand management Cape May City Water Utility has reduced its water use by 30%. Programs include retrofitting all municipal buildings with low flow toilets and showers and a new conservation-oriented water rate structure.

Other management-related techniques which are being considered in this region to promote aquifer recharge and protection of the resource include requiring the use of septic systems rather than sewering as appropriate. This enables municipalities to recycle shallow aquifer water, if septic system densities are sufficiently low and the systems are properly managed to protect ground water quality. Additionally, implementation of wellhead protection and aquifer recharge initiatives are important to protect the quality of the water supply. Ground water quality and recharge protection minimizes the loss of existing supplies.

The challenge of maintaining adequate water supplies in light of saltwater intrusion and steadily increasing peak demands may also be accomplished in part through capital projects. The three main capital initiatives that are being considered by local water supply managers are to (1) institute a network of observation wells; (2) initiate indirect reuse of wastewater for the Cape May Coastal Planning area; and (3) develop alternative supplies.

The USGS has identified a need for a network of observation wells to monitor salt water intrusion in affected aquifers in the county. A saltwater monitoring network will allow analysis to correlate groundwater withdrawals with saltwater intrusion. If impairment to an aquifer does occur, the network will allow for an adjustment of withdrawals to control the problem.

A second capital initiative would involve the upgrade of wastewater treatment systems to be able to recycle wastewater effluent. This effluent, which would receive

tertiary treatment, would be land applied to local golf courses and farms thereby both recharging the underlying aquifer and decreasing the withdrawals necessary for these purposes. The Lower Township MUA has already begun investigating upgrading their sewage treatment plant for this purpose.

Lastly, alternative water supplies may need to be developed. Interconnections between systems, a desalinization facility, relocating wells and developing a new well field in the Atlantic City 800-foot sand aquifer are all being considered by local water supply managers. Implementing such capital management initiatives will allow the planning area to grow appropriately while maintaining an adequate water supply.

The City of Cape May has identified desalinization as its preferred water supply alternative to mitigate the saltwater intrusion threat. The NJDEP has indicated support for this project provided that an evaluation concludes that it is a cost-effective alternative, that it will not prohibit water supply options critical to neighboring municipalities and it has demonstrated that the project serves to reduce the rate of saltwater intrusion in southern Cape May County. If it meets these criteria, this project would be included in the NJ Statewide Water Supply Plan and would therefore be eligible for Water Supply Bond Fund monies and potentially other state or federal sources as they become available.

Delaware River Salt Intrusion

The impact on water supplies of salt water intrusion in the Delaware River has been of concern for many water users in the Basin. New Jersey supports the efforts of the Delaware River Basin Commission's (DRBC's) Flow Management Technical Advisory Committee to identify all of the requirements for maintenance of flows in the Delaware River and make recommendations to the full DRBC.

Dredging Navigational Channels Outside the Port of New York & New Jersey

As authorized under State law (N.J.S.A. 12:5, 12:6, and 12:6A, et seq.), the NJDEP is responsible for marking and maintaining over 400 miles of navigational channels throughout the state. Ninety percent of these channels are located in the Counties of Cape May, Atlantic and Ocean and are small channels that lead to or connect with the Intracoastal Waterway.

The New Jersey Intracoastal Waterway was built by the State in the early 1920s. Its purpose was to promote development of the Jersey Shore by encouraging recreational and commercial boating for fishing, shipping and other purposes. In 1942, the state constructed the Cape May Canal to provide safety to boaters and to connect New Jersey with the Intracoastal Waterway in the southern states. In 1950, the state turned complete operation, maintenance and control of the Intracoastal Waterway over to the Army Corps of Engineers.

In addition to the navigational channels that connect with the Intracoastal Waterway, there are other navigational channels along the Delaware River, Delaware Bay, Shark River, Shrewsbury and Navesink Rivers and the Raritan Bay.

In order to keep these navigational channels open and useful, periodic maintenance dredging must be performed. It costs approximately $400,000 to dredge one mile of navigational channels. From 1970 to 1997, $27.3 million in State funding has been appropriated for maintenance dredging of these navigational channels, an annual average of approximately $975,000, with the appropriation peaking at $3 million per year in the late 1980s. However, there have also been years (the mid 1970s and the mid 1990s) when no funds were appropriated.

Almost all of the material dredged from the small navigational channels consists of very fine sand, silts and organic material. The only locations where medium or large grain sand is found is on the Delaware Bay and at the state controlled navigational inlets.

In general, the material dredged from these small channels is clean and tests have indicated that they do not contain polychlorinated biphenyls (PCBs), dioxins or other highly toxic chemicals. Occasionally, a hot spot is found which contains hydrocarbons and metals. These hot spots are generally located near very large commercial marinas or in the vicinity of large stormwater drains.

For many years, the dredge material obtained from the small navigational channels was deposited in upland locations. Many of the locations are in prime wetland areas or in areas inaccessible by vehicle equipment. Many of these disposal sites have reverted back to freshwater wetlands and some sites are used as nesting areas for various species of birds. The State owns very few of the disposal areas. Access to current disposal areas are through short term leases with no cost to the state. Most of the disposal areas are now filled beyond capacity with no maintenance or remediation being implemented.

With the November 1996 voter approval of the "Port of New Jersey Revitalization, Dredging, Environmental Cleanup, Lake Restoration and Delaware Bay Area Economic Development Bond Act of 1996," the NJDEP has the opportunity to begin to allocate funding that will reemphasize the dredging of these small channels. Under the provisions of the bond act, $20 million is to be used for the dredging of the small navigational channels that are located outside the New Jersey/New York Port Region. The NJDEP is in the process of developing a budget for dredging projects and for the acquisition of permanent dredge disposal areas that would be owned, operated and maintained by the State or other entity. The NJDEP is also currently prioritizing the dredging needs of various navigational channels. This prioritization is to be based on commercial fishing needs, recreational boating intensity and availability of dredge disposal sites.

As mentioned above, dredge disposal areas are a critical part of the dredging program. Current thinking would be that the state would acquire large parcels of land that could be developed into a regional disposal site. These sites would be used not only for dredging of navigational channels, but could also be utilized by marina operators. It is important that the marina operators also have a place to dispose of their material because if they cannot find suitable disposal sites, they cannot dredge their marinas and provide accommodations for the boaters.

One of the possibilities would be for the dredge disposal site to be 100 acres or more in size and would contain several cells or compartments. As a compartment is filled, it could be left to dry while other cells or compartments are utilized. The dredge material by itself has little or no value. However, when the dredge material is mixed with other soils, the final product now becomes a valuable commodity. This mixed material could be used as a cover in landfill operations or could be used as a top soil dressing along state, county and municipal roadways. Dredge material could also be used to create additional wetlands or to improve upland habitat areas along the coastal waterways. With proper management of these disposal areas, New Jersey could restore its navigational channels and use the dredge material as an economic resource.

Managing the Living Resources

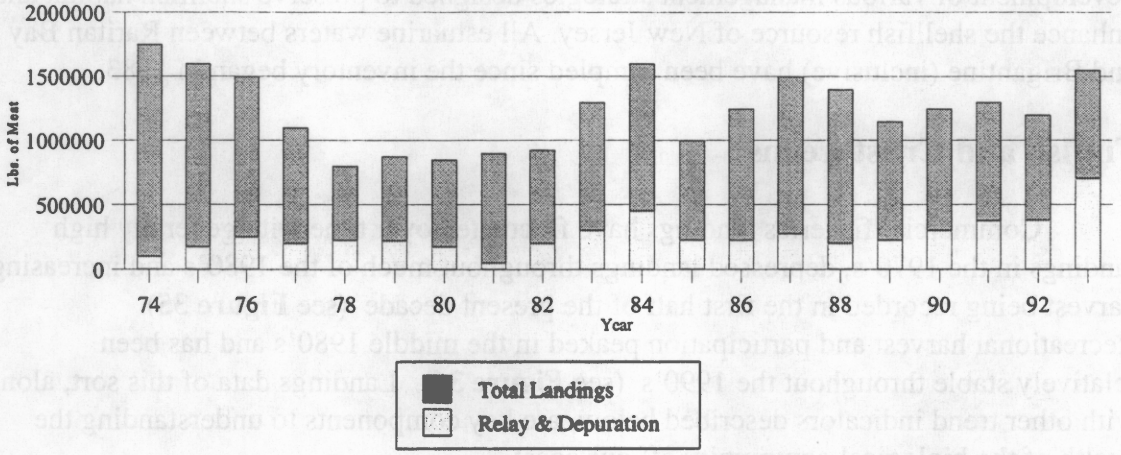
Shellfish

There are now approximately 583,000 acres available to the public for the recreational and commercial harvesting of shellfish. The relay and depuration programs allow hard clams from moderately polluted waters to be utilized. Clams from such waters are then transplanted to clean bay waters or processed in a state-approved

depuration plant for purification. Harvest for the relay and depuration programs occurs in the waters of Raritan and Sandy Hook bays, and the Navesink and Shrewsbury Rivers. Limited hard clam relays are also periodically conducted in the waters of Atlantic and Cape May counties.

These resource recovery programs have become increasingly important since their inception in 1970 (relay) and 1983 (depuration), contributing a significant portion of the total commercial hard clam landing in New Jersey (see **Figure 34**). In 1996, relay and depuration harvest account for over 50% of the total statewide commercial hard clam landings as reported by the National Marine Fisheries Service.

Figure 34
New Jersey Hard Clam Landings



The hard clam resource of northern Monmouth County supporting these programs shows no sign of stock decline as total harvest and catch per effort (i.e. clams/man/day) data have remained stable or increased since harvest commenced in this area in 1983. In 1996 over 31 million clams were harvested via these programs, providing economic benefits to program participants and the economy of New Jersey. The fact that the catch per unit of effort has also been increasing bodes well for the future of these programs.

The surf clam (Spisula solidissima) is one of New Jersey's most valuable fisheries, accounting for 45% by weight of the State's total molluscan commercial landings in 1995. Preliminary figures show that 86% of the total Mid-Atlantic and New England area catch of surf clams in calendar year 1995 was landed in New Jersey and had an ex-vessel value of over $27.0 million. In order to provide for the optimal use of the State's surf clam resources, an annual inventory is conducted in New Jersey territorial waters. The inventory program provides current information on the status of the resource including stock abundance and distribution, population structure, and recruitment.

Favorable environmental conditions, reproductive success and sound management practices have resulted in annual increases in standing stock over the last ten years, doubling the size of the population. The surf clam standing stock for New Jersey territorial waters was estimated to be 13,265,208 industry bushels (20,100,000 US bushels).

The primary objective of the Shellfish Inventory Program is to determine the distribution and abundance of the important molluscan species which occur in New Jersey's estuaries. The program provides valuable information on the major shellfish species (e.g., species composition, relative abundance and size frequency distribution), water quality information (e.g., dissolved oxygen, salinity, pH and temperature) and sediment classification (e.g., grain size analysis). This baseline data is necessary for the development of various management strategies designed to preserve shellfish habitat and enhance the shellfish resource of New Jersey. All estuarine waters between Raritan Bay and Brigantine (inclusive) have been sampled since the inventory began in 1983.

Finfish and Crustaceans

Commercial fisheries landings have fluctuated over time with generally high landings in the 1970's, depressed landings throughout much of the 1980's and increasing harvest being recorded in the first half of the present decade (see **Figure 35**). Recreational harvest and participation peaked in the middle 1980's and has been relatively stable throughout the 1990's (see **Figure 36**). Landings data of this sort, along with other trend indicators described below, are key components to understanding the health of the biological community off our coast.

Figure 35

New Jersey Commercial Fishery Landings 1965 - 1995

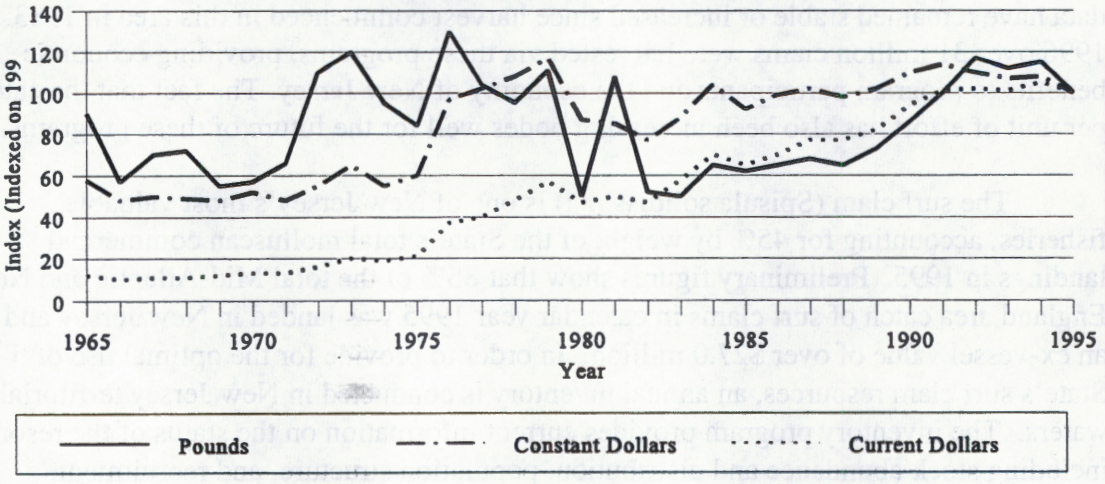
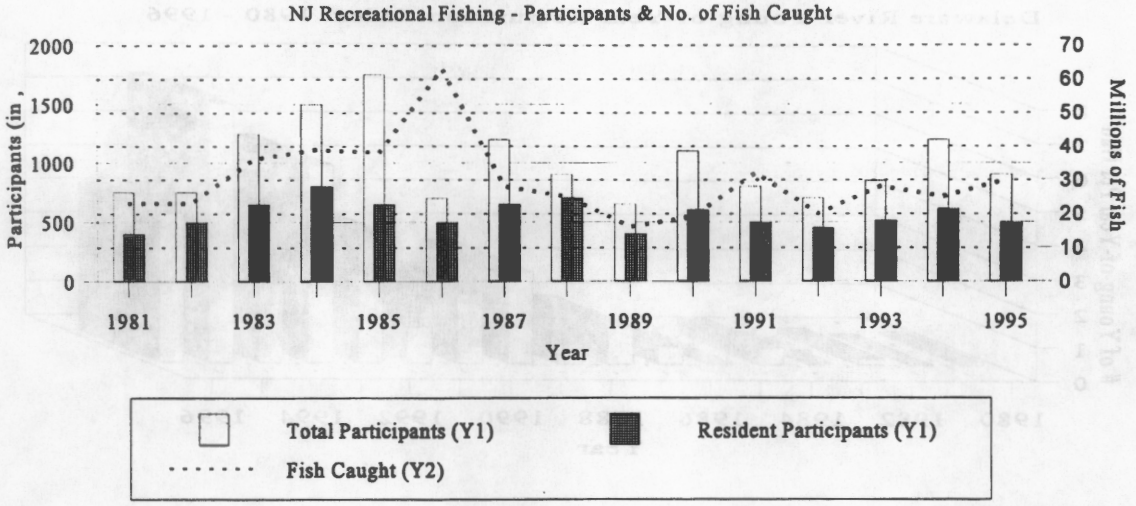


Figure 36



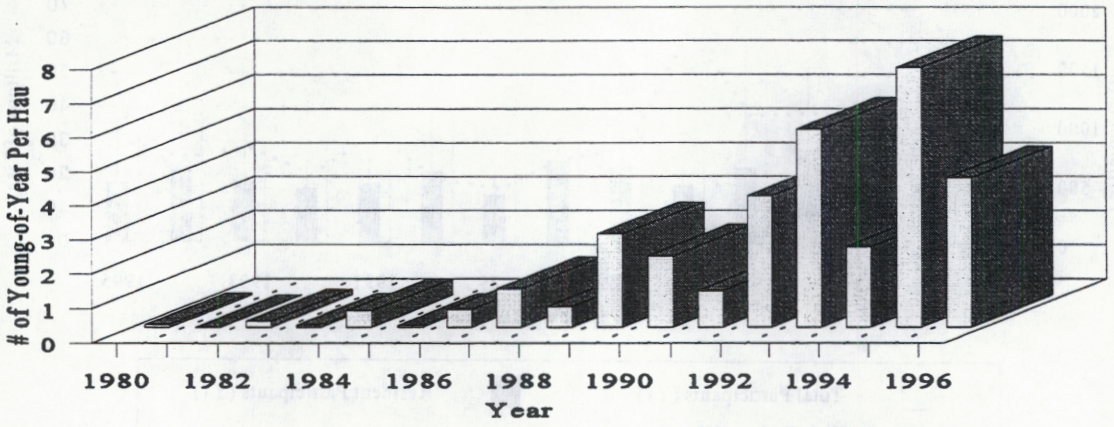
The abundance and distribution of coastal fishes are monitored with a trawl survey program now entering its ninth year of operation. The sampling area encompasses nearly 1900 square miles of the Atlantic Ocean between Sandy Hook, New Jersey and Cape Henlopen, Delaware. Sampling locations are random and range from just off the beach to the 90 foot depth zone, which in some areas is as much as 20 miles offshore. Along with providing a fairly accurate picture of the distribution and abundance of our coastal fisheries resources, the information collected by the program is also used to help manage fish stocks. Seasonal restriction, minimum sizes and catch limits often result in the effort to restore or maintain healthy, plentiful, fish stocks. The monitoring program is also used to check on the success of these efforts.

Since 1980, the New Jersey Department of Environmental Protection has conducted a striped bass young of year survey in the Delaware River (see **Figure 37**). The main objective of the survey is to provide an annual index of relative abundance for young of year striped bass in the Delaware River. The Delaware River recruitment survey has reflected the increase in the striped bass population along the East Coast. Data collected on all species during this sampling program are useful to the Delaware Estuary Program's needs.

Over the past decade, we have seen such species as striped bass, Atlantic mackerel and Atlantic herring recover from very low levels to fully restored status. Other species such as summer flounder (fluke), weakfish, king mackerel and Spanish mackerel are showing increased stock sizes. There are, of course, many other species which are still at low levels, such as cod and haddock. There are also species which have not been under management programs long enough to show signs of recovery such as tautog (blackfish) or scup.

Figure 37

Delaware River Young-of-Year Recruitment Index: 1980 - 1996



Aquaculture

As natural stocks of various species decline, industry members are looking to aquaculture as a means to continue in a given fishery. To assist in this effort to replenish stocks, New Jersey finalized an Aquaculture Development Plan in January 1995 and legislation to implement many of the plan components was introduced into the Assembly in September 1996. The goal of the plan and corresponding legislation is to stimulate private investment and expand commercial aquaculture to provide a consistent supply of quality seafood products to domestic and foreign markets. Expansion of the existing aquaculture industry is expected to create thousands of jobs and benefit the state economy.

Current aquaculture activities are supported via the leasing of bay bottom for shellfish culture. Statewide, 33,600 acres of bay bottom are currently leased by commercial shellfisherman primarily for the culture of oysters and hard clams.

Fisheries Management

Many marine fisheries migrate through and are harvested in offshore waters under federal jurisdiction and/or in the waters of two or more states. The NJDEP, in conjunction with citizen appointees, is directly involved with management of these species through representation on the following councils:

Mid-Atlantic Fisheries Management Council - This council has representation from states from New York to North Carolina and the National Marine Fisheries Service. Fisheries Management Plans have been developed and implemented for nine species for the area from 3 to 200 miles offshore. Some of these include such important species as summer founder (fluke), scup, Atlantic mackerel and surf clam.

Atlantic States Marine Fisheries Commission - The Commission is composed of all of the east coast states from Maine to Florida plus Washington, D.C. and the Potomac River Fisheries Commission. Fishery Management Plans have been developed and approved for 18 species for state territorial waters. Some of these include valuable species such as bluefish, weakfish, winter flounder and lobster.

New Jersey Marine Fisheries Council and New Jersey Shellfisheries Council - In cooperation with the Department, these councils develop management measures for New Jersey's living marine resources.

Migratory Bird & Endangered Species Habitat Protection

The Cape May peninsula is one of the most important concentration areas for migratory birds in the world. The rich blend of habitat has supported these birds as they stopover to feed and rest prior to crossing the expansive Delaware Bay. Studies have shown that the survival rate of migratory birds is directly proportional to the availability of high quality habitat.

Over the past two decades, 40% of the available migratory bird habitat has been destroyed or otherwise lost, primarily through development. Remaining critical areas are facing heavy development pressures. The end result is that there has been a steady decline in the number of birds. Statewide surveys of coastal colonial waterbirds (herons, terns and gulls that live in the marshes of the Atlantic and Delaware Bay shores) have indicated a decline in several species since 1970. Surveys have shown similar declines for beach nesting birds (piping plover, least tern, and the black skimmer), to the point where they are protected under state and federal law as endangered species.

The New Jersey coastal areas provide a major stopover for many species progressing along the flyway in their seasonal migrations, the seasonal arrival of the migratory species is intertwined not only with the environment and ecology of the area but with the overall regional economy as well. Avitourism is an important component in local economies which could be significantly damaged through this habitat loss.

There is a definite need for coordinated efforts to protect these habitat areas. Because of regulations already in place and a large amount of public open space in the region, there is a unique opportunity to vastly enhance land management practices to improve migratory bird habitat on the lower Cape May peninsula. Several projects are being pursued that would advance this goal.

The first effort is the Cape May Stopover Project. This is a cooperative venture comprised of federal, state and local government agencies and private organizations that

seeks to prevent further degradation and loss of migratory bird habitat on lower Cape May peninsula while establishing public policy guidelines for land use decisions in critical habitat areas. Overall, the Stopover Project has incorporated the biological diversity policies -- preserve contiguous open space so as to create corridors that would enhance their functional integrity for biological diversity, designate critical habitats and identify and protect the habitats of resident and migratory endangered and threatened species -- developed under the State Development and Redevelopment Plan.

The governmental partners in the venture are the US Fish and Wildlife Service, the NJDEP, the NJ Office of State Planning, the Cape May Office of Planning, the municipalities of Cape May, West Cape May, Cape May Point and Lower Township. The private organizations are The Nature Conservancy, the New Jersey Audubon Society and the Association of New Jersey Environmental Commissions.

This cooperative venture has established a set of objectives to advance the goal of this project. The first objective is to develop maps for the southern 10 kilometers of the peninsula that would delineate the areas critical to migratory birds. A key component of this mapping effort is to incorporate information regarding land use/land cover, wetlands buffers, forested areas, public lands and development into the Geographic Information System (GIS). This information would then be used as the basis for delineating Conserved Land Centers (CLC) including Higbee Beach/Pond Creek, Cape May Inlet and Shellingers Creek. The CLCs would be the hub from which to expand, as necessary, migratory bird habitat.

A second objective would be to distribute these maps to public and private land owners and managers so they can be used by local environmental commissions and planning agencies as Environmental Resource Inventories. The information will also be vital in developing guidelines for landscape and development ordinances consistent with the open space and biodiversity policies of the state plan. Ordinances can then be adopted that protect migratory bird habitat and are suitable to local conditions.

The third objective would be to develop and implement a plan to provide for long term expansion of the CLCs. Areas adjacent to the CLCs would be prioritized for appropriate action and the partners would work closely with landowners and land planning and management agencies in those areas to determine their long-term land use objectives and then to develop long-term conservation plans for the expansion of the CLCs.

A second cooperative effort is Endangered Beach Nesting Bird Management on New Jersey's Municipal Beaches program. The piping plover, least tern and black skimmer are all listed as endangered species and all have a preference for nesting on

open, sandy soil. As these species can be found nesting in New Jersey from Cape May to Sandy Hook from April through September, this naturally puts the birds in constant conflict with humans competing for the same space.

The protection of these birds has required the active participation of federal, state, municipal and private interests working together to restrict to nesting areas, patrol and monitor the beaches to check for nests, to implement measures to protect the birds from predators and to disseminate educational information to the public. A significant proportion of the state's beach nesting birds nest on municipal beaches. Consequently, actions taken by coastal municipalities to manage their beaches for recreation and storm protection have ramifications, both positive and negative, for beach nesting birds. Cooperation between wildlife managers and municipal managers is critical in this effort.

Tools for Successful Shore Protection & Management

GIS - A Powerful Tool For Coastal Communities

A vital component of any decision-making process is the ability for all interested parties to access, input, coordinate and analyze up-to-date data. This ability is absolutely vital for shore protection and management. To assist in this process, the Geographic Information System (GIS) has increasingly played a role. The NJDEP has actively made outreach efforts with counties and municipalities to link together systems and share vital data. The local governments have themselves acted to input data into the system, filling in gaps that may be present in the information base contained in GIS. Examples of the efforts made in this area include NJDEP GIS outreach arrangements with both the Ocean and Monmouth Counties library systems.

Coastal planners and municipal officials can now access and share information about New Jersey's environment through the most comprehensive natural resource information base ever compiled, the Geographic Information System (GIS). Municipalities and coastal counties can participate in the democratic process of building and analyzing this information via personal computers and available software.

GIS is a computer mapping tool that provides a visual inventory of environmental factors affecting any geographic location. Through a series of computer overlays, the GIS enables the analysis of complex environmental issues by allowing the interactions and impacts, for example, of contaminants on soil, air and water to be considered simultaneously with existing roads and infrastructure. The Department of Environmental Protection has been using GIS for several years and is continually expanding the information network through cooperative partnerships with state agencies, environmental

organizations, counties, municipalities, colleges and public libraries. All of the coastal counties are using now GIS.

GIS has provided coastal communities with the ability to be active participants in the planning and decision-making process instead of just being recipients of state information. Advancements in computer technology have made it cost-effective for local governments to maintain an independent yet completely compatible GIS. This results in a GIS solution that draws on the best of both worlds: cost-effective day-to-day independence and complete compatibility when needed.

Planners are currently using the GIS. For example, a GIS user can view a prospective new development site on a computerized map showing wetlands, known contaminated sites, flood prone areas, schools and industries. An environmental profile can be quickly and easily prepared for any geographic location. Municipal officials can compare prospective locations for development that are most suitable and have minimal environmental impact. Currently the GIS has coastal data sets which include: land use/land cover, coast and shoreline features, location of regulated facilities, sewer service areas, socio-political boundaries (e.g., municipal, county, CAFRA, Pinelands boundaries, or State Plan centers/planning areas) as well as geologic and natural features. In addition, there is a wealth of demographic data, compiled by the US Census Bureau, also available in GIS format.

Through a creative public/private partnership, the DEP provides GIS software to over 40 non-profit environmental groups which are conducting local mapping projects. DEP has also been compiling a comprehensive regulated facility file of all permits and is working to acquire accurate locations of over 100,000 facilities Statewide.

Through a foundation of quality data, partnerships and an expanding network of GIS users throughout the state, a progressive and dynamic planning process is underway. NJDEP is using GIS as a tool in developing a statewide data base that would be a prime component of an environmental master plan as well as the Department's planning strategy for the Coast. It is also a valuable tool in our vision for comprehensive watershed and airshed management.

Universities and colleges, such as Rutgers, Brookdale and Stockton, are also using GIS and have been working with the DEP to improve and expand the network of information and skilled GIS technicians. Computer training in using the GIS Arcview software is available through a partnership program with the colleges.

The Department has recently compiled the most sought-after DEP/GIS information on compact disks to make it more widely available on CD-ROM. In the near future, the GIS system will come on line through the Internet.

As the DEP moves forward with its planning strategy for the Coast, the GIS will continue to be the backbone of information management. Current data sets will be refined and updated. The user network will be expanded at every level of government and to the public through access at public libraries and the Internet. The DEP will keep pace with technology improvements and develop a new series of products for continued planning of the Coast region. Shoreline dynamics over time will facilitate erosion control of beaches and hazard mitigation strategies. The GIS will be able to survey land use patterns over time to determine effectiveness of coastal regulations, State Plan policies with respect to planning areas and centers, and the collaborative role of the Pinelands CMP in managing natural resources.

Public Education

As can be seen throughout this document, the success of many of the shore protection programs and initiatives is directly tied to the effectiveness of efforts to educate the public and/or to foster partnerships between the levels of government involved in the initiative. Public involvement and knowledge assists shore protection on several levels. First, as the public becomes more aware of the shore environment, individual behaviors will be shaped for the better. In many cases, members of the public do things without thinking of the consequences. Public education can help make people aware and perhaps alter their actions. Nonpoint source pollution is an example where the actions of an individual can make a difference, either good or bad, to the environment. Education can help to guide these actions so that they do not negatively impact the environment.

Another way in which education can assist in shore protection efforts is by enhancing public understanding of certain actions being taken by State and local government agencies. Many of the problems government agencies have in advancing environmental protection efforts rise not from the implementation of the programs themselves but from miscommunications and public misunderstandings. For example, decisions often made with regard to land use or permitting will not be universally accepted. However, up front public education will help to minimize the antagonism as people understand the rationale behind decisions. At the very least, it will reduce the time and effort that will have to be expended at a later date in correcting the misunderstanding.

The involvement of the public can also serve to extend limited governmental resources in numerous shore related areas. Volunteer efforts through the Adopt a Beach Program have proven invaluable in the collection of floatables, for example.

There have historically been a number of programs operating throughout the state and at the shore which meet the above purposes. Following is a summary that provides lists some of NJDEP's marine, coastal and watershed education and public participation efforts:

School (K -12),Youth and Community Education Initiatives Offered Statewide:

Aquatic Project WILD

- Sponsored by NJDEP Division of Fish, Game and Wildlife
- Environmental Education Curriculum Supplement for grades K-8 focusing on coastal ecology, water quality and related pollution issues.
- A number of teachers in NJ are trained to facilitate/conduct Aquatic WILD workshops in the state. Between 150-225 teachers receive Aquatic WILD training yearly. Teachers can obtain the guide (and training to use it) by attending 1-day workshops.

Project WET (Water Education for Teachers)

- Official State Sponsor: The Wetlands Institute assisted by the NJDEP Office of Environmental Planning
- The WET activity guide is for grades K-12 and focuses on water, water quality and pollution issues. This guide, along with "WOW! The Wonders of Wetlands Curriculum Supplement" and the guide, "How To Create A Water Celebration Event", a Project WET publication, are available to educators through workshops.
- The Project WET Groundwater Flow Model, available for sale through Project WET.
- 75 teachers have been trained to give Project WET workshops, and over 12 workshops have been conducted, since its arrival to New Jersey about 2 years ago.

Marine Education Resource Packet

- Sponsored by NJDEP Division of Fish, Game and Wildlife
- This packet is available to teachers and educators. It lists more than 350 educational resources related to marine, coastal and wetlands environments. Selections include curricula, seminars, events, field trips and materials.

Annual Coastal Workshop for Educators

- Sponsored by NJDEP Division of Fish, Game and Wildlife
- Content and curriculum-related topics at this annual, weekend workshop focus on barrier islands, wetlands, coastal birds, wildlife management, marine resources and coastal/NPS pollution. The emphasis is placed on

field experiences and hands-on classroom activities related to these topics, designed for youth educators of grades K -12.

Beneath the Shell .... A Teacher's Guide to Nonpoint Source Pollution

- Sponsored by NJDEP Office of Environmental Planning
- An Environmental Education Curriculum Supplement for Grades K -8
- Developed by the DEP Environmental Education Unit and currently distributed (by mail and occasional workshops) by the Office of Environmental Planning, this activity guide introduces such concepts as watersheds, the water cycle, watershed management and nonpoint source pollution.

The Adventures of Samantha Sturgeon Coloring Book

- Sponsored by NJDEP Office of Environmental Planning
- This coloring book is available to educators of young children and introduces, in an interactive way, such concepts as water quality, litter, marine habitat and marine animals, and responsible human behavior.

The New Jersey Water Photography Contest

- Sponsored by NJDEP Office of Environmental Planning
- A Statewide contest offered to students in grades 9 -12.
- In order to participate, students must take an active role in exploring their local environment and assessing the beauty and necessity of water, through photography and design. This contest is designed to raise student awareness of water flow, water quality and watersheds. Awards are presented annually as part of the NJDEP's Environmental Education Week and Earth Day activities.

Classroom Posters on Marine Fish and Marine Life

- Sponsored by NJDEP Division of Fish, Game and Wildlife
- These posters (1 set per request) are usually given to any educator who can use them in a classroom learning situation. They are New Jersey-specific and include marine fish, birds and mammals.

The Clean Water Raingers Program

- Sponsored by NJDEP Office of Environmental Planning
- This is a youth-oriented, flexible (grades K -8) group-oriented program, appropriate for scouts, church groups, science classes, environmental clubs and community groups. Any organized youth group can register to become a Clean Water Raingers group. Group activities are both freshwater and saltwater related, and include cleanups, events, water conservation, NPS

surveys and prevention, exhibits development, storm drain stenciling activities, local walks and talks, and the use of maps to determine a group's local watershed address.

The Rainstick Contest

- Sponsored by NJDEP Office of Environmental Planning
- A Statewide contest offered to students in grades 6 -8.
- This interactive, research-based contest primarily helps students to determine what a watershed is, as well as their own watershed address. In designing and making their own rainstick, they learn about water through time and place by studying culture, history and science.

The Adopt A Beach Program

- Sponsored by NJDEP Office of Enforcement Coordination
- This statewide, coastal cleanup initiative is available to individuals and groups, twice each year. People converge to a publicized or assigned public/state property to conduct a cleanup of beach litter. The department usually works in conjunction with Clean Ocean Action, who tabulates the volume and types of materials collected and adds this to a national database of marine debris and waste collected yearly at various coastal sites around the country.

The Water Watch Program

- Sponsored by NJDEP Office of Enforcement Coordination
- This is a youth-oriented, flexible (grades K -8) group-oriented program, appropriate for scouts, church groups, science classes, volunteers, environmental clubs and community groups. Any organized group can adopt a freshwater or saltwater shoreline and monitor it via visual surveys, water samples/tests, or surveys of its flora and fauna. Some materials are available to support these activities.

The Clean Streets, Clean Beaches Campaign

- Sponsored by NJDEP Division of Solid and Hazardous Waste and US EPA Region II
- The Region II office distributes campaign materials to interested educators, which includes The "Adventures of the Camouflage Kid" video, newsletter and teacher's guide. The purpose of this package is to demonstrate how street litter and chemicals can travel with stormwater and end up along waterways and the state's coastline.

The Local Coastal Grants Program

- Sponsored by NJDEP Office of Environmental Planning
- The office awarded several demonstration grants to coastal not-for-profit organizations and community organizations, a few which related to local education and outreach initiatives. Outstanding projects included eco-tours at Long Beach Island, a brochure for "smart and environmentally friendly boating tips", walkways and exhibitry. Now official, the grants program is currently soliciting for its first round of grants.

The New Jersey Coastal Heritage Trail

- Sponsored by NJDEP Division of Parks and Forestry
- This is a long-term, cooperative effort between the National Park Service and New Jersey, along with other federal, local and private entities. Its purpose is to provide for public appreciation, education, understanding, and enjoyment of nationally significant natural and cultural sites associated with the New Jersey coastal area. The trail is to be a vehicular route along existing public roads and is to link selected sites within the trail's project area through a coordinated interpretive program. It extends from the area of Perth Amboy (Middlesex County) to the southern tip of Cape May, and northwest along the Delaware Bay shoreline to Deepwater (Salem County). Its continued development includes a number of "themes" and the use of existing interpretive facilities, along with some new facilities.

Interpretive and Visitor Facilities

- Sponsored by NJDEP Division of Parks and Forestry
- Coastal/marine programming and information are made available through park staff at Island Beach State and Cape May Point State Parks.

School (K -12),Youth and Community Education Initiatives Offered on a <u>Regional</u> Basis

- Sponsored by NJDEP
- New Jersey has three National Estuary Programs including the NY-NJ Harbor Estuary/NY Bight Program (HEP), the Delaware Estuary Program (DELEP) and the Barnegat Bay Estuary Program (BBEP). These are nationally significant estuaries that are threatened by pollution, overuse and development. Confined to specific regions/counties, the programs build assorted partnerships between government and the public, in order to develop and implement management plans for the estuarine and marine waters. Both HEP and DELEP have completed their management plans and are conducting outreach programs, while BBEP is developing its plan with public input. Activities in the programs include a mini-grants program,

publications, newsletters, committee work, events, curricula, public access guides, and audiovisuals.

NJDEP's Coastal, Marine and Watershed Publication Efforts

- ***The Clean Water Book*** (NJDEP Office of Environmental Planning)
- ***The Jersey Coast***, newsletter (NJDEP Office of Environmental Planning)
- ***Watershed Focus***, newsletter (NJDEP Office of Environmental Planning)
- ***The Whippany Watershed Partnership***, newsletter (NJDEP Office of Environmental Planning)
- ***Water Resources Protection Practices*** (4 brochures) (NJDEP Office of Environmental Planning)
- ***Boat Sewage Disposal Facility Locations*** (Del. Est./NJ Coast)

Chapter 3.
Challenges for the Future

The majority of this Report describes the conditions of the coastal region and the efforts that have been implemented or are currently taking place to protect and enhance this unique area. While much useful information is contained here, there is still much to be resolved to ensure a balanced and effective program which will protect the coastal area into the next century. The logical question to be asked now is: "Where do we go from here?"

The NJDEP plans to implement a consensus building process involving the all stakeholders which will lead to a New Jersey Coastal Partnership Management Plan. The intent of this concluding section of the Report -- along with the Coastal Alliance 1997 -- is to issue a set of challenges that will create the framework for this next process to begin. These challenges are presented in both a series of recommendations and additional questions regarding key shore management and protection issues. They will become the discussion points at Coastal Alliance 1997, laying the groundwork for future efforts.

Do We Need a Coastal Advisory Organization?

Throughout this report, numerous examples have demonstrated that success is best achieved when the various stakeholders coordinate their efforts and participation in an ongoing dialogue leading to consensus and action. It is a prime objective that the dialogue not end with this report or the Coastal Alliance 1997 but continues into the future. However, no permanent mechanism or forum presently exists to foster this dialogue. For this reason, the question has arisen as to whether a formal Coastal Advisory Organization to advise the NJDEP Commissioner should be established. Such a group might be comprised of representatives of the various interest groups with a stake in continued shore protection. If created, they could meet regularly to discuss coastal issues and problems and then present the results of these discuss to the NJDEP Commissioner. Examples of members who could be represented on this organization would include the various state agencies, local and county governments, environmental organizations, builders and developers, fishing and shellfish industries, and the tourism industry. We are looking to the Coastal Alliance 1997 participants to provide guidance in answering these questions

Challenges:

- Should a formal organization be established to provide guidance on shore management and protection?
- What would be the most appropriate makeup of such a group in order for it to be an effective body?

- What should be the scope of issues to be addressed should such a group be established?

Land Use, CAFRA and the State Plan

A significant amount of space in this Report was devoted to the ongoing administration of CAFRA. It is obvious that the manner in which land is used and developed has a profound influence on the coastal environment and on the quality of life for those who live, work and recreate at the shore. The State, therefore, has a definite interest in overseeing the management of this development and this interest has been expressed in CAFRA. CAFRA implementation needs to be coordinated with the State Plan as well as with local concerns. The 1993 amendments to CAFRA have resulted in significant change in the regulation of development at the shore but a great deal remains to be accomplished through a cooperative state/local effort to make the objectives of the amendments a reality.

Challenges:

- The NJDEP needs to implement coordination of CAFRA and the State Development and Redevelopment Plan. What is the best way to pursue finalization of coastal rules/coordination with State Plan?
- What is the proper balance between local planning/economic needs and protection of the coastal natural resources? How can CAFRA best be implemented to achieve this balance?
- While not strictly within the purview of CAFRA, the issues of public access & public transportation are important components in the development of the shore. How are these issues to be best addressed?

Hazard Mitigation and Beach Replenishment

The State of New Jersey recognizes the importance of the Jersey Shore as an environmental, economic and social asset to the State and the entire region. As such, the NJDEP is committed to continuing to pursue projects that will best protect the environment, people and property in the coastal region. It is realized that the State must continue to obtain substantial financial investments at the federal, state and local levels to meet this commitment. Also, local involvement and input is recognized as a vital component as well.

Challenges:

- What are the best mechanisms to ensure that the State can appropriately meet commitments to mitigation, shore protection and beach replenishment?
- How do Blue Acres land acquisition strategies fit into this commitment?

- Sea level rise is increasingly being recognized as a component contributing to hazards at the shore. What can the State and other parties do to mitigate and reduce the factors, such as emissions to the air of greenhouse gases, that influence sea level rise?
- What are the proper mechanisms to ensure that monies are spent wisely and produce the greatest mitigation benefits for the dollar and, at the same time, provide ample opportunities for the public and the local leaders to have input into this process?

Nonpoint Source & Stormwater Pollution in Coastal Waters

Over the past 20 years, New Jersey has made significant improvements to its coastal water quality primarily through upgrading sewage treatment in coastal communities. In addition, awareness of coastal water quality has increased on the part of many municipalities. Residents of Barnegat Bay have worked together to develop a management plan for the Bay. Most coastal municipalities have worked through the Sewage Infrastructure Improvement Act (SIIA) to identify and map potential sources of water pollution. Some municipalities have adopted stormwater management ordinances. Significant efforts have been made to reduce or eliminate floatables and beach litter.

While these efforts have resulted in significant improvements, there is a recognition that much additional work is needed. As coastal municipalities become more densely populated, stormwater management and nonpoint source pollution control will become even more essential to maintaining and improving coastal water quality. The Statewide Watershed Framework and the National Estuary Programs in the NY/NJ Harbor, Barnegat Bay and Delaware Estuary are giving structure to the Department plans to control nonpoint sources of pollution and stormwater runoff in the coastal zone.

Collectively we need to continue to define the cause and effect relationship between nonpoint source/stormwater pollution and water quality impacts. In addition, we need to develop and apply appropriate and cost-effective best management practices for reducing nonpoint source pollution.

Many of the sources of nonpoint source/stormwater pollution must be addressed at the local level. To control these sources, an effective forum needs to be established to increase local participation in the development and implementation of goals and action plans. Watershed planning and National Estuary Program implementation should facilitate this dialogue. Though the Department has earmarked significant resources for the implementation of watershed management, these efforts will require the collective resources of state, regional agencies, county, and local governments, as well as private citizens in order to meet the goal of improving, protecting and maintaining coastal water quality.

Challenges:

- The NJDEP's proposed watershed management framework will enable State agencies, regional and local governments and private citizens to cooperatively design programs that will address water quality and water supply problems specific to a given watershed. What are the next steps in implementing the watershed management framework and how will it be able to handle the problems of nonpoint and stormwater pollution?
- Are there additional steps and actions that local communities can take on their own to address the problem of nonpoint source pollution? Are there models that have been successful in some communities that could be used elsewhere along the coast?
- What lessons are we learning in the estuary programs that could help in achieving the goals laid out here?
- Public education is a key component to success in meeting this challenge. Are public education efforts in the coastal area successful or is there are need to augment them?

Relationship of Tourism/Economic Development & Environmental Protection

The shore as a whole is a prime component of the economy of this State. The tourist industry alone is among the top generators of both jobs and dollars for the State. Therefore, it is important that a balanced approach be put forward that will at the same time enhance not only tourism but other coastal economic opportunities and promote protection of the environmental resources (which are, not coincidently, the reasons for much of the tourism in the first place). In addition, there are other opportunities for economic development, such as navigational dredging for example, that must be pursued but in the most environmentally sound manner possible.

Challenges:

- What and where are the prime opportunities to capitalize on the eco-tourism initiative while ensuring protection of the resource?
- What are the mechanisms that can be put to use to advance eco-tourism in the coastal region?
- Are there eco-tourism models of success on which to build?
- What are the plans to initiate and continue needed dredging of channels throughout the coastal area?

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